Advanced Qualification Question Bank

This document has been revised 2017.01.05. It includes all the questions of the latest version released by Innovation, Science and Economic Development (ISED), formerly called Industry Canada (IC), in August 12, 2016. Read on to see how the question bank has been integrated with the ***Canadian Amateur Radio Advanced Qualification Study Guide****, 1st edition and 2nd edition. Many thanks to George P. Demetre VE6JZZ, who brought order out of chaos and gave our efforts a very professional look. As you go through the question bank you will see that it is divided up into sections, 7 in total, and 50 sub-sections. Within each sub-section you will notice a lot of duplication. If you can do one question in a sub-section then you should have no problem with all the similar questions. This is particularly true in questions that involve calculations. The exam is generated by computer and it seems as if they pick one question from each sub-section for a total of 50 questions. You need to provide correct answers for 35 questions, 70%, to earn a passing grade.*

1
A-001-001-001
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What is the meaning of the term “time constant” in an RL circuit?

- The time required for the current in the circuit to build up to 36.8% of the maximum value
- The time required for the voltage in the circuit to build up to 63.2% of the maximum value
- The time required for the voltage in the circuit to build up to 36.8% of the maximum value
- The time required for the current in the circuit to build up to 63.2% of the maximum value

< The time required for the current in the circuit to build up to 63.2% of the maximum value >
1.11

- Just above the question number you will find the chapter of the study guide where you will find the information necessary to provide you with the correct answer. If it is a new question this is indicated.
- For convenience, the answers were numbered, but ISED has changed the order of the answers from revision to revision. The correct answer for a question is indicated by enclosing it inside < >. After the last possible answer you will find the correct answer for the question. This approach allows for a quicker update of this document when ISED updates the Question Bank.
- Below the answer you will find the section of the chapter in the study guide where you will find the answer. In some instances, you may find the answer in more than one section. For some of the questions, we have provided explanations on how the answer was arrived at. If the material is not in the 1st Edition but has been added to the 2nd Edition the section location will look like this:

  1st Ed. – see below; 2nd Ed. – 11.15

Now on to the questions! There are 549 questions. The actual questions commence on Page 12.

Advanced Qualification Examination

Information from the Amateur Radio Service RIC- 3, Issue 4, December 2016

An examination of 50 questions is prepared by drawing one question from a series of questions applicable to the following 50 topic areas. The pass mark is 70%.

Advanced Theory - 001

- 1-1 Time constant - capacitive and inductive
- 1-2 Electrostatic and electromagnetic fields, skin effect
- 1-3 Series-resonance
- 1-4 Parallel resonance
- 1-5 Quality factor (Q)

Advanced Components and Circuits - 002

- 2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type
- 2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.
- 2-3 Transistors - NPN/PNP
- 2-4 Field effect transistor (FET), JFET, MOSFET
- 2-5 Silicon controlled rectifier (SCR)
- 2-6 Amplifiers - classes A, AB, B and C
- 2-7 Amplifier circuits - discrete and IC
- 2-8 Operational amplifiers, properties and applications
- 2-9 Mixers, frequency multipliers
- 2-10 Digital logic elements
- 2-11 Quartz crystal - properties and applications
- 2-12 Advanced filter circuits - AF, RF

Measurements - 003

- 3-1 AC - peak, peak-to-peak, average, root mean square (RMS)
- 3-2 PEP, PEP relative to average power, PEP relative to voltage across load
- 3-3 Dip meter, signal generator
- 3-4 Crystal calibrator, marking generator, frequency counter
- 3-5 Oscilloscope
- 3-6 Meters, multimeter, power meter

Power Supplies - 004

- 4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP
- 4-2 Filter circuits, bleeder resistor function
- 4-3 Linear and switching voltage regulator circuits
- 4-4 Regulated power supplies

Transmitters, Modulation and Processing - 005

- 5-1 Oscillator circuits, phase locked loop (PLL)
- 5-2 RF power amplifiers
- 5-3 Transmitters, neutralisation
- 5-4 AM, single sideband, linearity, two-tone test
- 5-5 FM deviation, modulation index, deviation ratio, deviation meter
- 5-6 FM transmitter, repeater circuits
- 5-7 Signal processing - AF, IF, and RF
- 5-8 Codes and protocols, Baudot, ASCII, parity, CRC, X.25, ISO layers
- 5-9 Spread spectrum - frequency hopping, direct sequence

Receivers - 006

- 6-1 Single, double conversion superheterodyne architecture
- 6-2 Oscillators, mixers, tuning
- 6-3 RF, IF amplifiers, selectivity
- 6-4 Detection, audio, automatic gain control
- 6-5 Performance limitations - instability, image, spurious, etc.

Feedlines - Matching and Antenna Systems - 007

- 7-1 Antenna tuner/transmatch, impedance matching circuits
- 7-2 Velocity factor, effect of line terminated in non-characteristic impedance
- 7-3 Antenna feed arrangements - tee, gamma, stub
- 7-4 Current and voltage distribution on antenna
- 7-5 Polarization, helical beam, parabolic antennas
- 7-6 Losses in real antenna systems, effective radiated power
- 7-7 Ground and elevation effects, vertical radiation (take off) angle
- 7-8 Radiation resistance, antenna efficiency, beamwidth
- 7-9 Waveguide, microstripline

Advanced Qualification Examination

Question Bank Cross Reference

Following is a list of the questions organized by chapter from the Advanced Study Guide. In this manner, once a chapter is studied, the questions on that chapter may be found easily.

Question	Subject	Chapter	Section	Section	Section
A-001-001-001	1-1 Time constant - capacitive and inductive	1	1.11		
A-001-001-002	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-001-003	1-1 Time constant - capacitive and inductive	1	1.11		
A-001-001-004	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-001-005	1-1 Time constant - capacitive and inductive	1	1.1	1.11	
A-001-001-006	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-001-007	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-001-008	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-001-009	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-001-010	1-1 Time constant - capacitive and inductive	1	1.9		
A-001-002-006	1-2 Electrostatic and electromagnetic fields, skin effect	1	1.8		
A-001-002-007	1-2 Electrostatic and electromagnetic fields, skin effect	1	1.3		
A-001-002-008	1-2 Electrostatic and electromagnetic fields, skin effect	1	1.3		
A-001-002-009	1-2 Electrostatic and electromagnetic fields, skin effect	1	1.8		
A-001-002-010	1-2 Electrostatic and electromagnetic fields, skin effect	1	1.8		
A-001-002-011	1-2 Electrostatic and electromagnetic fields, skin effect	1	1.1		
A-001-003-001	1-3 Series-resonance	1	1.14		
A-001-003-002	1-3 Series-resonance	1	1.14		
A-001-003-003	1-3 Series-resonance	1	1.14		
A-001-003-004	1-3 Series-resonance	1	1.14		
A-001-003-005	1-3 Series-resonance	1	1.14		
A-001-003-006	1-3 Series-resonance	1	1.14		
A-001-003-007	1-3 Series-resonance	1	1.14		
A-001-003-008	1-3 Series-resonance	1	1.14		
A-001-003-009	1-3 Series-resonance	1	1.14		
A-001-003-010	1-3 Series-resonance	1	1.14		
A-001-003-011	1-3 Series-resonance	1	1.14		
A-001-004-001	1-4 Parallel resonance	1	1.14		
A-001-004-002	1-4 Parallel resonance	1	1.14		
A-001-004-003	1-4 Parallel resonance	1	1.14		
A-001-004-004	1-4 Parallel resonance	1	1.14		
A-001-004-005	1-4 Parallel resonance	1	1.14		
A-001-004-006	1-4 Parallel resonance	1	1.14		
A-001-004-007	1-4 Parallel resonance	1	1.14		
A-001-004-008	1-4 Parallel resonance	1	1.14		
A-001-004-009	1-4 Parallel resonance	1	1.14		
A-001-004-010	1-4 Parallel resonance	1	1.14		
A-001-004-011	1-4 Parallel resonance	1	1.14		
A-001-005-001	1-5 Quality factor (Q)	1	1.15		
A-001-005-002	1-5 Quality factor (Q)	1	1.15		
A-001-005-003	1-5 Quality factor (Q)	1	1.15		
A-001-005-004	1-5 Quality factor (Q)	1	1.15		
A-001-005-005	1-5 Quality factor (Q)	1	1.15		
A-001-005-006	1-5 Quality factor (Q)	1	1.15		
A-001-005-007	1-5 Quality factor (Q)	1	1.15		
A-001-005-008	1-5 Quality factor (Q)	1	1.15		
A-001-005-009	1-5 Quality factor (Q)	1	1.15		
A-001-005-010	1-5 Quality factor (Q)	1	1.15		
A-001-005-011	1-5 Quality factor (Q)	1	1.15		
A-002-011-001	2-11 Quartz crystal - properties and applications	1	1.17		
A-002-011-002	2-11 Quartz crystal - properties and applications	1	1.17		
A-002-011-003	2-11 Quartz crystal - properties and applications	1	1.17		
A-002-011-005	2-11 Quartz crystal - properties and applications	1	1.17		
A-002-012-001	2-12 Advanced filter circuits - AF, RF	1	1.17		
A-002-012-002	2-12 Advanced filter circuits - AF, RF	1	1.17		
A-002-012-003	2-12 Advanced filter circuits - AF, RF	1	1.17		
A-002-012-004	2-12 Advanced filter circuits - AF, RF	1	1.17		
A-002-012-005	2-12 Advanced filter circuits - AF, RF	1	1.16		
A-002-012-006	2-12 Advanced filter circuits - AF, RF	1	1.16		

A-002-012-007	2-12 Advanced filter circuits - AF, RF	1	1.16	
A-002-012-008	2-12 Advanced filter circuits - AF, RF	1	1.17	
A-002-012-009	2-12 Advanced filter circuits - AF, RF	1	1.17	
A-002-012-010	2-12 Advanced filter circuits - AF, RF	1	1.17	
A-002-012-011	2-12 Advanced filter circuits - AF, RF	1	1.16	
A-003-001-002	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	11.4.2
A-003-001-003	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	11.4.2
A-003-001-004	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	11.4.2
A-003-001-005	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	11.4.2
A-003-001-006	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	11.4.2
A-003-001-009	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	
A-003-001-010	3-1 AC - peak, peak-to-peak, average, root mean square (RMS)	1	1.4	11.4.2
A-004-002-007	4-2 Filter circuits, bleeder resistor function	1	1.1	

A-002-001-001	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-002	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-003	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-004	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-005	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-006	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-007	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-008	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-009	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-010	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-001-011	2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type	2	2.1	
A-002-002-001	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.5	
A-002-002-002	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.6	
A-002-002-003	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.7	
A-002-002-004	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.15	
A-002-002-005	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.2	
A-002-002-006	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.2	2.4
A-002-002-007	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.4	
A-002-002-008	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.4	
A-002-002-009	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.5	
A-002-002-010	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.5	
A-002-002-011	2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.	2	2.5	
A-002-003-001	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-002	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-003	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-004	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-005	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-006	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-007	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-008	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-009	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-010	2-3 Transistors - NPN/PNP	2	2.1	
A-002-003-011	2-3 Transistors - NPN/PNP	2	2.1	
A-002-004-001	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-002	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-003	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-004	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-005	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-006	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-007	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-008	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-009	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-010	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-004-011	2-4 Field effect transistor (FET), JFET, MOSFET	2	2.13	
A-002-005-001	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-002	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-003	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-004	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-005	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-006	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-007	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-008	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-009	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-010	2-5 Silicon controlled rectifier (SCR)	2	2.14	
A-002-005-011	2-5 Silicon controlled rectifier (SCR)	2	2.14	

A-004-001-001	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.7
A-004-001-002	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.5
A-004-001-003	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.5

A-004-001-004	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.7	
A-004-001-005	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.7	
A-004-001-006	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.7	
A-004-001-007	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.5	
A-004-001-008	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.9	
A-004-001-009	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.5	
A-004-001-010	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.7	
A-004-001-011	4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP	3	3.6	
A-004-002-001	4-2 Filter circuits, bleeder resistor function	3	3.8.2	
A-004-002-002	4-2 Filter circuits, bleeder resistor function	3	3.8.2	3.8.3
A-004-002-003	4-2 Filter circuits, bleeder resistor function	3	3.8.3	
A-004-002-004	4-2 Filter circuits, bleeder resistor function	3	3.8.2	
A-004-002-005	4-2 Filter circuits, bleeder resistor function	3	3.8.2	3.8.3
A-004-002-006	4-2 Filter circuits, bleeder resistor function	3	3.1	
A-004-002-008	4-2 Filter circuits, bleeder resistor function	3	3.1	
A-004-002-009	4-2 Filter circuits, bleeder resistor function	3	3.8.2	
A-004-002-010	4-2 Filter circuits, bleeder resistor function	3	3.8.2	
A-004-002-011	4-2 Filter circuits, bleeder resistor function	3	3.8.3	
A-004-003-001	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-003-002	4-3 Linear and switching voltage regulator circuits	3	3.14	
A-004-003-003	4-3 Linear and switching voltage regulator circuits	3	2.5	3.11.1
A-004-003-004	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-003-005	4-3 Linear and switching voltage regulator circuits	3	3.11.1	
A-004-003-006	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-003-007	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-003-008	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-003-009	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-003-010	4-3 Linear and switching voltage regulator circuits	3	3.2	
A-004-003-011	4-3 Linear and switching voltage regulator circuits	3	3.11.3	
A-004-004-001	4-4 Regulated power supplies	3	3.11.2	
A-004-004-002	4-4 Regulated power supplies	3	3.11.3	
A-004-004-003	4-4 Regulated power supplies	3	3.3	
A-004-004-004	4-4 Regulated power supplies	3	3.11	
A-004-004-005	4-4 Regulated power supplies	3	3.11	
A-004-004-006	4-4 Regulated power supplies	3	3.11	
A-004-004-007	4-4 Regulated power supplies	3	3.11	
A-004-004-008	4-4 Regulated power supplies	3	3.7	
A-004-004-009	4-4 Regulated power supplies	3	3.15	
A-004-004-010	4-4 Regulated power supplies	3	3.11.3	
A-004-004-011	4-4 Regulated power supplies	3	3.11.3	

A-002-006-001	2-6 Amplifiers - classes A, AB, B and C	4	4.3.1
A-002-006-002	2-6 Amplifiers - classes A, AB, B and C	4	4.3.1
A-002-006-003	2-6 Amplifiers - classes A, AB, B and C	4	4.3.3
A-002-006-004	2-6 Amplifiers - classes A, AB, B and C	4	4.3.2
A-002-006-005	2-6 Amplifiers - classes A, AB, B and C	4	4.3.4
A-002-006-006	2-6 Amplifiers - classes A, AB, B and C	4	4.3.4
A-002-006-007	2-6 Amplifiers - classes A, AB, B and C	4	4.3.4
A-002-006-008	2-6 Amplifiers - classes A, AB, B and C	4	4.3.1
A-002-006-009	2-6 Amplifiers - classes A, AB, B and C	4	4.3.4
A-002-006-010	2-6 Amplifiers - classes A, AB, B and C	4	4.3.1
A-002-006-011	2-6 Amplifiers - classes A, AB, B and C	4	4.3.4
A-002-007-001	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-002	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-003	2-7 Amplifier circuits - discrete and IC	4	4.4
A-002-007-004	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-005	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-006	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-007	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-008	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-009	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-010	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-007-011	2-7 Amplifier circuits - discrete and IC	4	4.3
A-002-008-001	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-002	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-003	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-004	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-005	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-006	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-007	2-8 Operational amplifiers, properties and applications	4	4.11
A-002-008-008	2-8 Operational amplifiers, properties and applications	4	4.11
A-002-008-009	2-8 Operational amplifiers, properties and applications	4	4.1
A-002-008-010	2-8 Operational amplifiers, properties and applications	4	4.1

A-002-008-011	2-8 Operational amplifiers, properties and applications	4	4.1	
A-002-009-004	2-9 Mixers, frequency multipliers	4	4.7	
A-002-009-005	2-9 Mixers, frequency multipliers	4	4.7	
A-002-009-006	2-9 Mixers, frequency multipliers	4	4.7	
A-002-009-007	2-9 Mixers, frequency multipliers	4	4.7	
A-002-009-008	2-9 Mixers, frequency multipliers	4	4.7	
A-002-009-009	2-9 Mixers, frequency multipliers	4	4.7	
A-002-009-010	2-9 Mixers, frequency multipliers	4	4.7	
A-005-002-002	5-2 RF power amplifiers	4	4.16	
A-005-002-003	5-2 RF power amplifiers	4	4.16	
A-005-002-004	5-2 RF power amplifiers	4	4.16	
A-005-002-005	5-2 RF power amplifiers	4	4.16	
A-005-002-006	5-2 RF power amplifiers	4	4.16	
A-005-002-007	5-2 RF power amplifiers	4	4.16	
A-005-002-008	5-2 RF power amplifiers	4	4.16	1.2
A-005-002-009	5-2 RF power amplifiers	4	4.16	
A-005-002-010	5-2 RF power amplifiers	4	4.16	

A-002-010-001	2-10 Digital logic elements	5	5.5	
A-002-010-002	2-10 Digital logic elements	5	5.5	
A-002-010-003	2-10 Digital logic elements	5	5.5	
A-002-010-004	2-10 Digital logic elements	5	5.5	
A-002-010-005	2-10 Digital logic elements	5	5.6	
A-002-010-006	2-10 Digital logic elements	5	5.6	
A-002-010-007	2-10 Digital logic elements	5	5.5	
A-002-010-008	2-10 Digital logic elements	5	5.1	
A-002-010-009	2-10 Digital logic elements	5	5.1	
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Advanced Theory - 001

1-1 Time constant - capacitive and inductive

1
A-001-001-001
****
What is the meaning of the term “time constant” in an RL circuit?

- The time required for the current in the circuit to build up to 36.8% of the maximum value
- The time required for the voltage in the circuit to build up to 63.2% of the maximum value
- The time required for the voltage in the circuit to build up to 36.8% of the maximum value
- The time required for the current in the circuit to build up to 63.2% of the maximum value

< The time required for the current in the circuit to build up to 63.2% of the maximum value >
1.11

1
A-001-001-002
****
What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the supply voltage?

- An exponential rate of one
- One time constant
- A time factor of one
- One exponential period

< One time constant >
1.9

1
A-001-001-003
****
What is the term for the time required for the current in an RL circuit to build up to 63.2% of the maximum value?

- One time constant
- An exponential period of one
- A time factor of one
- One exponential rate

< One time constant >
1.11

1
A-001-001-004
****
What is the term for the time it takes for a charged capacitor in an RC circuit to discharge to 36.8% of its initial value of stored charge?

- A discharge factor of one
- An exponential discharge of one
- One time constant
- One discharge period

< One time constant >
1.9

1
A-001-001-005
****
What is meant by "back EMF"?

- A current that opposes the applied EMF
- A voltage that opposes the applied EMF
- An opposing EMF equal to R times C percent of the applied EMF
- A current equal to the applied EMF

< A voltage that opposes the applied EMF >
1.10, 1.11

1
A-001-001-006
****
After two time constants, the capacitor in an RC circuit is charged to what percentage of the supply voltage?

- 63.2%
- 86.5%
- 95%
- 36.8%

< 86.5% >
1.9

1
A-001-001-007
****

After two time constants, the capacitor in an RC circuit is discharged to what percentage of the starting voltage?

- 13.5%
- 36.8%
- 86.5%
- 63.2%

< 13.5% >
1.9

1
A-001-001-008
****

What is the time constant of a circuit having a 100 microfarad capacitor in series with a 470 kilohm resistor?

- 4700 seconds
- 470 seconds
- 0.47 seconds
- 47 seconds

< 47 seconds >
1.9

Voltage in a resistance-capacitance (RC) or resistance-inductance (RL) circuit cannot reach the applied voltage instantaneously because the resistance limits the rate of charge. Time constant is a way of measuring the charge that has built up over a period of time. One time constant is the time for the voltage to reach 63.2% of the applied voltage, or for the charge of the capacitor or inductor to decay by 63.2%. In subsequent periods of one time constant, the charge will increase or decrease by additional units of 63.2%. The voltage across the inductor or capacitor will never reach 100% of the applied voltage but one reaches a point of diminishing returns after 5 time constants when the charge is 99.3% of the applied voltage or the charge has decayed to 0.7% of the original charge.

The formula for the time constant for a capacitor in series with a resistor is:

$$T = RC$$

where T is time in seconds, R is resistance in ohms, and C is capacitance in farads.

Since our resistance and capacitance are given in non-standard units we have to do some unit conversions. As usual, start by converting all given values to base units.

470 kilohms = $4.7 \times 10^{+5}$ *ohms and 100 μf =* 1.00×10^{-4} *farads*

Now substitute these values in the formula:

$T = (4.7 \times 10^{+5})\ (1.00 \times 10^{-4}) = 47$ *seconds*

1
A-001-001-009
****
What is the time constant of a circuit having a 470 microfarad capacitor in series with a 470 kilohm resistor?

- 221 000 seconds
- 47 000 seconds
- 221 seconds
- 470 seconds

< 221 seconds >
1.9

As in A-001-001-008

1
A-001-001-010
****
What is the time constant of a circuit having a 220 microfarad capacitor in series with a 470 kilohm resistor?

- 470 000 seconds
- 470 seconds
- 103 seconds
- 220 seconds

< 103 seconds >
1.9

As in A-001-001-008

1-2 Electrostatic and electromagnetic fields, skin effect

14
A-001-002-001
****
What is the result of skin effect?

- As frequency increases, RF current flows in a thinner layer of the conductor, closer to the surface
- As frequency decreases, RF current flows in a thinner layer of the conductor, closer to the surface
- Thermal effects on the surface of the conductor increase impedance
- Thermal effects on the surface of the conductor decrease impedance

< As frequency increases, RF current flows in a thinner layer of the conductor, closer to the surface >
14.4.2

14
A-001-002-002
****
What effect causes most of an RF current to flow along the surface of a conductor?

- Piezoelectric effect
- Resonance effect
- Skin effect
- Layer effect

< Skin effect >
14.4.2

14
A-001-002-003
****
Where does almost all RF current flow in a conductor?

- In a magnetic field in the centre of the conductor
- In a magnetic field around the conductor
- Along the surface of the conductor
- In the centre of the conductor

< Along the surface of the conductor >
14.4.2

14
A-001-002-004
****
Why does most of an RF current flow within a very thin layer under the conductor’s surface?

- Because the RF resistance of a conductor is much less than the DC resistance
- Because of skin effect
- Because a conductor has AC resistance due to self-inductance
- Because of heating of the conductor’s interior

< Because of skin effect >
14.4.2

14
A-001-002-005
****
Why is the resistance of a conductor different for RF currents than for direct currents?

- Because of skin effect
- Because of the Hertzberg effect
- Because conductors are non-linear devices
- Because the insulation conducts current at high frequencies

< Because of skin effect >
14.4.2

1
A-001-002-006
****
What unit measures the capacity to store electrical energy in an electrostatic field?

- Coulomb
- Watt
- Volt
- Farad

< Farad >
1.8

1
A-001-002-007
****
A wire has a current passing through it. Surrounding the wire there is:

- an electromagnetic field
- an electrostatic field
- a cloud of electrons
- a skin effect that diminishes with distance

< an electromagnetic field >
1.3

1
A-001-002-008
****
In what direction is the magnetic field oriented about a conductor in relation to the direction of electron flow?

- In the direction determined by the left-hand rule
- In all directions
- In the same direction as the current
- In the direct opposite to the current

< In the direction determined by the left-hand rule >
1.3

1
A-001-002-009
****
What is the term for energy that is stored in an electromagnetic or electrostatic field?

- Potential energy
- Kinetic energy
- Ampere-joules
- Joule-coulombs

< Potential energy >
1.8

1
A-001-002-010
Between the charged plates of a capacitor there is:

- an electrostatic field
- a magnetic field
- a cloud of electrons
- an electric current

< an electrostatic field >
1.8

1
A-001-002-011
Energy is stored within an inductor that is carrying a current. The amount of energy depends on this current but it also depends on a property of the inductor. This property has the following unit:

- watt
- henry
- coulomb
- farad

< henry >
1.10

1-3 Series-resonance

Questions A-001-003-001 through A-001-003-010 all use the same approach; only the values change. A detailed solution of A-001-003-006 has been provided to show you how to proceed.

1
A-001-003-001
****
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 50 microhenrys and C is 40 picofarads?

- 1.78 MHz
- 3.56 MHz
- 7.96 MHz
- 79.6 MHz

< 3.56 MHz >
1.14

As for A-001-003-006

1
A-001-003-002
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 40 microhenrys and C is 200 picofarads?

- 1.99 kHz
- 1.99 MHz
- 1.78 kHz
- 1.78 MHz

< 1.78 MHz >
1.14

As for A-001-003-006

1
A-001-003-003
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 50 microhenrys and C is 10 picofarads?

- 7.12 kHz
- 3.18 MHz
- 3.18 kHz
- 7.12 MHz

< 7.12 MHz >
1.14

As for A-001-003-006

1
A-001-003-004
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 25 microhenrys and C is 10 picofarads?

- 63.7 MHz
- 10.1 kHz
- 63.7 kHz
- 10.1 MHz

< 10.1 MHz >
1.14

As for A-001-003-006

1
A-001-003-005
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 3 microhenrys and C is 40 picofarads?

- 13.1 MHz
- 14.5 MHz
- 13.1 kHz
- 14.5 kHz

< 14.5 MHz >
1.14

As for A-001-003-006

1
A-001-003-006
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 4 microhenrys and C is 20 picofarads?

- 19.9 MHz
- 17.8 MHz
- 19.9 kHz
- 17.8 kHz

< 17.8 MHz >
1.14

This problem involves using the formula that you will find in Section 1.14 of the Advanced Study Guide for calculating the resonant frequency of a series RLC circuit. The factors in the formula are: f_R = resonant frequency in Hz, pi = 3.14, L = inductance in henrys and C = capacitance in farads. You also have to be comfortable with changing units as you will see as we show you how to answer the question.

Since L is in microhenrys, we have to convert it to henrys. 4 microhenrys = 0.000 004 henrys or 4.0×10^{-6} if we use scientific notation. A similar calculation has to be done to change picofarads to farads. 20 picofarads = 0.000 000 000 020 farads or 20×10^{-12} farads if we use scientific notation.

This problem is best solved in steps unless you are really comfortable with your calculator. We are assuming that you have a scientific calculator.

Multiply 0.000 004 by 0.000 000 000 020 and then hit the SQRT (square root) key. Your calculator may show the symbol √ for "square root" – this symbol is used in the formula. Given that your calculator may not handle this you might be better off to use the scientific notation function of your calculator to do this calculation. For this question L = 4.0×10^{-06} so you would key in 4.0 first. Then tap the EXP key and enter -6. Some calculators may automatically enter a 0 in front so your display may appear as -06. Now tap the multiply key and enter the value for C, 20×10^{-12}, in a similar fashion. Now tap the SQRT key. Regardless of which method you employed DO NOT clear your calculator. This value will be 8.994×10^{-9} to three decimal places. Don't worry about the numbers beyond three decimal places; we will leave them in and deal with them later.

Multiply the value the value above by 2 and then by pi, 3.14, and tap the = key. This will yield a value of 5.617×10^{-8} to three decimal places. Again, don't worry about the numbers beyond three decimal places; we will leave them in and deal with them later.

Now comes the easy part. Look for the reciprocal key on your calculator; it is usually labeled 1/x. Tap this key and up pops 17 803 088. DO NOT clear your calculator.

Our calculated value is in Hz and our answers are given in MHz and kHz. We convert Hz to MHz by dividing 17 803 088 by 1 000 000, yielding 17.803088 MHz. Converting to kHz we get 17 803.088 kHz. The correct answer is shown to two decimal places so our calculated value looks a lot like the answer when we round off 17.803088 MHz to 17.8 MHz.

1
A-001-003-007
****

What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 8 microhenrys and C is 7 picofarads?

- 28.4 MHz
- 21.3 MHz
- 2.84 MHz
- 2.13 MHz

< 21.3 MHz >
1.14

As for A-001-003-006

1
A-001-003-008
****

What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 3 microhenrys and C is 15 picofarads?

- 35.4 MHz
- 23.7 MHz
- 35.4 kHz
- 23.7 kHz

< 23.7 MHz >
1.14

As for A-001-003-006

1
A-001-003-009
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 4 microhenrys and C is 8 picofarads?

- 49.7 MHz
- 28.1 MHz
- 49.7 kHz
- 28.1 kHz

< 28.1 MHz >
1.14

As for A-001-003-006

1
A-001-003-010
****
What is the resonant frequency of a series RLC circuit, if R is 47 ohms, L is 1 microhenry and C is 9 picofarads?

- 53.1 MHz
- 5.31 MHz
- 17.7 MHz
- 1.77 MHz

< 53.1 MHz >
1.14

As for A-001-003-006

1
A-001-003-011
****
What is the value of capacitance (C) in a series RLC circuit, if the circuit resonant frequency is 14.25 MHz and L is 2.84 microhenrys?

- 2.2 microfarads
- 44 microfarads
- 44 picofarads
- 2.2 picofarads

< 44 picofarads >
1.14

This is a very practical problem. Imagine that you are trying to construct an RLC circuit resonant at a specific frequency. Your junk box yields a capacitor or inductor with a fixed value. What is the value of the other component you will have to procure?

This problem involves using the formula you will find in Section 1.14 in the Advanced Study Guide for

calculating the resonant frequency of a parallel RLC circuit. The factors in the formula are: f_R *= resonant frequency in Hz, pi = 3.14, L = inductance in henrys and C = capacitance in farads. You also have to be comfortable with changing units as you will see as we show you how to answer the question.*

However, this problem has "thrown you a curve". Unlike the other resonance calculation questions this one gives you the resonant frequency and the value of the inductance. You have to find the capacitance. We will have to re-write the equation as follows:

$$\frac{1}{f_R 2\pi} = \sqrt{LC}$$

On the left all our values are "knowns". We can use these to find the value of SQRT LC. Once we know this we can use it and the value of L to find the value of C. Don't despair – all will be revealed.

Before we start crunching numbers we need to do some unit conversions. f_R *= 14.25 MHz = 14 250 000 Hz =* 14.25×10^6 *Hz. C = 44 picofarads = 0.000 000 000 044 farads =* 44×10^{-12} *farads.*

We want to find the value of $\frac{1}{f_R 2\pi}$*. The simplest route is to use scientific notation.*

$1/((14.25 \times 10^6)(2)(3.14)) = 11.17 \times 10^{-9}$

We have just calculated the value of SQRT (LC). We now want to find the value of LC. To do this we have to square 11.17×10^{-9} *(multiply it by itself). You can enter the value into your calculator and look for the key that squares any value or you can simply enter it again and tap the MULTIPLY key. Regardless of the method you employ the result will be* 1.248×10^{-16} *to three decimal places.*

We now know that LC = 1.248×10^{-16} *and we know the value of L. So the task is to find the value of C, which will be* 1.248×10^{-16} */ L. Plugging in all the numbers we find* $1.248 \times 10^{-16} / 28.4 \times 10^{-6} = 43.94 \times 10^{-12}$ *farads.*

The size of the exponent suggests that our answer will be in picofarads, so we convert farads to picofarads. If we round this off to 44 picofarads we find we have the value needed.

1-4 Parallel resonance

Questions A-001-004-001 through A-001-004-010 all use the same approach; only the values change. A detailed solution of A-001-004-001 is provided as an example of how to proceed.

1
A-001-004-001
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 1 microhenry and C is 10 picofarads?

- 15.9 kHz
- 50.3 MHz
- 50.3 kHz
- 15.9 MHz

< 50.3 MHz >
1.14

This problem involves using the formula you will find in Section 1.14 in the Advanced Study Guide for

calculating the resonant frequency of a parallel RLC circuit. The factors in the formula are: f_R = resonant frequency in Hz, pi = 3.14, L = inductance in henrys and C = capacitance in farads. You also have to be comfortable with changing units as you will see as we show you how to solve the question.

Since L is in microhenrys, we have to convert it to henrys. 1 microhenry = 0.000 001 henrys or 1.0 x 10^{-6} if we use scientific notation. A similar calculation has to be done to change picofarads to farads. 10 picofarads = 0.000 000 000 010 farads or 10 x 10^{-12}.

This problem is best solved in steps unless you are really comfortable with your calculator. We are assuming that you have a scientific calculator.

Multiply 0.000 001 by 0.000 000 000 010 and then hit the SQRT (square root) key. Your calculator may show the symbol for "square root" – this symbol is used in the formula. Given that your calculator may not handle this you might be better off to use the scientific notation function of your calculator to do this calculation. For this question L = 1.0 x 10^{-06}. For L you would key in 1.0 first. Then tap the EXP key and enter -6. Some calculators may automatically enter a 0 in front so your display may appear as -06. Now tap the multiply key and enter the value for C, 10 x 10^{-12}. Now tap the SQRT key. Regardless of which method you employed DO NOT clear your calculator. This value will be 3.163 x 10^{-9} to three decimal places. Don't worry about the numbers beyond three decimal places; we will leave them in and deal with them later.

Multiply the value the value above by 2 and then by pi, 3.14, and tap the = key. This will yield a value of 19.85 x 10^{-9} to three decimal places. Again, don't worry about the numbers beyond three decimal places; we will leave them in and deal with them later.

Now comes the easy part. Look for the reciprocal key on your calculator; it is usually labelled 1/x. Tap this key and up pops 50 354 739. DO NOT clear your calculator.

Our calculated value is in Hz and our answers are given in MHz and kHz. We convert Hz to MHz by dividing by 1 000 000, yielding 50.354739 MHz. Converting to kHz we get 50354.739 kHz. The correct answer is shown to one decimal place so our calculated value looks a lot like the answer in MHz when we round off 50.354939 MHz to 50.4 MHz.

1
A-001-004-002
****

What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 2 microhenrys and C is 15 picofarads?

- 29.1 MHz
- 29.1 kHz
- 5.31 MHz
- 5.31 kHz

< 29.1 MHz >
1.14

As for A-001-004-001

1
A-001-004-003
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 5 microhenrys and C is 9 picofarads?

- 23.7 kHz
- 3.54 MHz
- 3.54 kHz
- 23.7 MHz

< 23.7 MHz >
1.14

As for A-001-004-001

1
A-001-004-004
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 2 microhenrys and C is 30 picofarads?

- 2.65 MHz
- 20.5 MHz
- 2.65 kHz
- 20.5 kHz

< 20.5 MHz >
1.14

As for A-001-004-001

1
A-001-004-005
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 15 microhenrys and C is 5 picofarads?

- 2.12 kHz
- 2.12 MHz
- 18.4 MHz
- 18.4 kHz

< 18.4 MHz >
1.14

As for A-001-004-001

1
A-001-004-006
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 3 microhenrys and C is 40 picofarads?

- 1.33 kHz
- 1.33 MHz
- 14.5 MHz
- 14.5 kHz

< 14.5 MHz >
1.14

As for A-001-004-001

1
A-001-004-007
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 40 microhenrys and C is 6 picofarads?

- 6.63 MHz
- 10.3 MHz
- 6.63 kHz
- 10.3 kHz

< 10.3 MHz >
1.14

As for A-001-004-001

1
A-001-004-008
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 10 microhenrys and C is 50 picofarads?

- 7.12 MHz
- 7.12 kHz
- 3.18 MHz
- 3.18 kHz

< 7.12 MHz >
1.14

As for A-001-004-001

1
A-001-004-009
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 200 microhenrys and C is 10 picofarads?

- 3.56 kHz
- 7.96 MHz
- 7.96 kHz
- 3.56 MHz

< 3.56 MHz >
1.14

As for A-001-004-001

1
A-001-004-010
****
What is the resonant frequency of a parallel RLC circuit if R is 4.7 kilohms, L is 90 microhenrys and C is 100 picofarads?

- 1.77 kHz
- 1.77 MHz
- 1.68 MHz
- 1.68 kHz

< 1.68 MHz >
1.14

As for A-001-004-001

1
A-001-004-011
****
What is the value of inductance (L) in a parallel RLC circuit, if the resonant frequency is 14.25 MHz and C is 44 picofarads?

- 253.8 millihenrys
- 3.9 millihenrys
- 0.353 microhenry
- 2.8 microhenrys

< 2.8 microhenrys >
1.14

This is a very practical problem. Imagine that you are trying to construct an RLC circuit resonant at a specific frequency. Your junk box yields a capacitor or inductor with a fixed value. What is the value of the other component you will have to procure?

This problem involves using the formula you will find in Section 1.14 in the Advanced Study Guide for

calculating the resonant frequency of a parallel RLC circuit. The factors in the formula are: f_R = resonant frequency in Hz, pi = 3.14, L = inductance in henrys and C = capacitance in farads. You also have to be comfortable with changing units as you will see as we show you how to answer the question.

However, this problem has "thrown you a curve". Unlike the other resonance calculation questions this one gives you the resonant frequency and the value of the capacitance. You have to find the inductance. We will have to re-write the equation as follows:

$$\frac{1}{f_R 2\pi} = \sqrt{LC}$$

On the left all our values are "knowns". We can use these to find the value of SQRT LC. Once we know this we can use it and the value of C to find the value of L. Don't despair – all will be revealed.

Before we start crunching numbers we need to do some unit conversions. f_R = 14.25 MHz = 14 250 000 Hz = 14.25 x 10^6 Hz. C = 44 picofarads = 0.000 000 000 044 farads = 44 x 10^{-12} farads .

We want to find the value of $\frac{1}{f_R 2\pi}$. The simplest route is to use scientific notation.

1/((14.25 x 10^6)(2)(3.14)) = 11.17 x 10^{-9}

We have just calculated the value of SQRT (LC). We now want to find the value of LC. To do this we have to square 11.17 x 10^{-9} (multiply it by itself). You can enter the value into your calculator and look for the key that squares any value or you can simply enter it again and tap the MULTIPLY key. Regardless of the method you employ the result will be 1.248 x 10^{-16} to three decimal places.

We now know that LC = 1.248 x 10^{-16} and we know the value of C. So the task is to find the value of L, which will be will be 1.248 x 10^{-16} /C. Plugging in all the numbers we find 1.248 x 10^{-16} / 44 x 10^{-12} = 2.836 x 10^{-6} henrys.

The size of exponent, 10^{-6}, suggests that our final answer should be expressed in microhenrys so we convert 2.836 x 10^{-6} henrys to microhenrys by multiplying by 1 000 000, 1 x 10^{-6}. This gives us a value of 2.836. To one place of decimals this rounds down to 2.8 microhenrys, the same.

1-5 Quality factor (Q)

1
A-001-005-001
****

What is the Q of a **parallel** RLC circuit, if it is resonant at 14.128 MHz, L is 2.7 microhenrys and R is 18 kilohms?

- 7.51
- 0.013
- 71.5
- 75.1

< 75.1 >
1.15

*Since it is a **parallel circuit** use the following formula: Q = R/2πfL. Ensure that **kilohms** are converted to **ohms**, **f** is converted from **MHz** to **Hz**, and **microhenries** are converted to **henrys**.*

1
A-001-005-002
****
What is the Q of a parallel RLC circuit, if it is resonant at 14.128 MHz, L is 4.7 microhenrys and R is 18 kilohms?

- 13.3
- 43.1
- 0.023
- 4.31

< 43.1 >
1.15

See A-001-005-001 above.

1
A-001-005-003
****
What is the Q of a parallel RLC circuit, if it is resonant at 4.468 MHz, L is 47 microhenrys and R is 180 ohms?

- 0.136
- 7.35
- 0.00735
- 13.3

< 0.136 >
1.15

See A-001-005-001 above.

1
A-001-005-004
****
What is the Q of a parallel RLC circuit, if it is resonant at 14.225 MHz, L is 3.5 microhenrys and R is 10 kilohms?

- 7.35
- 31.9
- 0.0319
- 71.5

< 31.9 >
1.15

See A-001-005-001 above.

1
A-001-005-005
****
What is the Q of a parallel RLC circuit, if it is resonant at 7.125 MHz, L is 8.2 microhenrys and R is 1 kilohm?

- 2.73
- 36.8
- 0.368
- 0.273

< 2.73 >
1.15

See A-001-005-001 above.

1
A-001-005-006
****
What is the Q of a parallel RLC circuit, if it is resonant at 7.125 MHz, L is 10.1 microhenrys and R is 100 ohms?

- 22.1
- 0.00452
- 0.221
- 4.52

< 0.221 >
1.15

See A-001-005-001 above.

1
A-001-005-007
****
What is the Q of a parallel RLC circuit, if it is resonant at 7.125 MHz, L is 12.6 microhenrys and R is 22 kilohms?

- 39
- 22.1
- 0.0256
- 25.6

< 39 >
1.15

See A-001-005-001 above.

1
A-001-005-008
****
What is the Q of a parallel RLC circuit, if it is resonant at 3.625 MHz, L is 3 microhenrys and R is 2.2 kilohms?

- 25.6
- 31.1
- 32.2
- 0.031

< 32.2 >
1.15

See A-001-005-001 above.

1
A-001-005-009
****
What is the Q of a parallel RLC circuit, if it is resonant at 3.625 MHz, L is 42 microhenrys and R is 220 ohms?

- 2.3
- 4.35
- 0.23
- 0.00435

< 0.23 >
1.15

See A-001-005-001 above.

1
A-001-005-010
****
What is the Q of a parallel RLC circuit, if it is resonant at 3.625 MHz, L is 43 microhenrys and R is 1.8 kilohms?

- 0.543
- 54.3
- 23
- 1.84

< 1.84 >
1.15

See A-001-005-001 above.

1
A-001-005-011
****
Why is a resistor often included in a parallel resonant circuit?

- To increase the Q and decrease the skin effect
- To decrease the Q and increase the resonant frequency
- To increase the Q and decrease bandwidth
- To decrease the Q and increase the bandwidth

< To decrease the Q and increase the bandwidth >
1.15

In a resonant circuit, electrical energy is continually passed back and forth between the inductor and the capacitor. The rate at which this energy can be passed between the two components, based on the requirement to create and destroy the inductor's magnetic field and to charge and discharge the capacitor though the impedance of the inductor, determines the resonant frequency.

In a perfect circuit no energy would be lost, the electrical energy would be passed between the two components forever, and the range of frequencies passed would be a single frequency.

Reality intrudes primarily in the resistance of the wire in the inductor and losses in the capacitor's dielectric, both of which cause electrical energy to be dissipated as heat. The effect of this is to widen the band of frequencies that will be passed. The ratio of the centre frequency of the resonant circuit to the band width is the `Quality Factor`*, or* `Q`*. Physically, the Q of a parallel resonant circuit is the ratio of reactance to resistance,* $Q = R/X$*. Decreasing the value of R lowers the Q, increasing the bandwidth.*

Resonant circuits are used to select frequencies or bands of frequencies from a spectrum. Depending on the characteristics of the signal being processed, the width of the band of frequencies we require varies. To adjust this bandwidth we provide additional loss to the resonant circuit, reducing its Q. Recall that in a resistive circuit, adding additional resistance in parallel reduces the total resistance of the circuit.

In a parallel resonant circuit this additional loss is provided by a resistor in parallel with the inductor and capacitor. Thus the answer <To decrease the Q and increase the bandwidth> is correct.

Advanced Components and Circuits - 002

2-1 Germanium, silicon, gallium arsenide, doping, P-type, N-type

2
A-002-001-001
****
What two elements widely used in semiconductor devices exhibit both metallic and non-metallic characteristics?

- Galena and germanium
- Silicon and germanium
- Galena and bismuth
- Silicon and gold

< Silicon and germanium >
2.1

2
A-002-001-002
****
In what application is gallium-arsenide used as a semiconductor material in preference to germanium or silicon?

- In high-power circuits
- At microwave frequencies
- At very low frequencies
- In bipolar transistors

< At microwave frequencies >
2.1

2
A-002-001-003
****
What type of semiconductor material contains fewer free electrons than pure germanium or silicon crystals?

- P-type
- N-type
- Bipolar type
- Superconductor type

< P-type >
2.1

2
A-002-001-004
****
What type of semiconductor material contains more free electrons than pure germanium or silicon crystals?

- N-type
- P-type
- Bipolar
- Superconductor

< N-type >
2.1

2
A-002-001-005
****
What are the majority charge carriers in P-type semiconductor material?

- Free electrons
- Free protons
- Holes
- Free neutrons

< Holes >
2.1

2
A-002-001-006
****
What are the majority charge carriers in N-type semiconductor material?

- Holes
- Free protons
- Free neutrons
- Free electrons

< Free electrons >
2.1

2
A-002-001-007
****
Silicon, in its pure form, is:

- a superconductor
- an insulator
- a semiconductor
- a conductor

< an insulator >
2.1

2
A-002-001-008
****
An element which is sometimes an insulator and sometimes a conductor is called a:

- intrinsic conductor
- N-type conductor
- P-type conductor
- semiconductor

< semiconductor >
2.1

2
A-002-001-009
****
Which of the following materials is used to make a semiconductor?

- Tantalum
- Copper
- Silicon
- Sulphur

< Silicon >
2.1

2
A-002-001-010
****
Substances such as silicon in a pure state are usually good:

- conductors
- tuned circuits
- inductors
- insulators

< insulators >
2.1

2
A-002-001-011
****
A semiconductor is said to be doped when it has added to it small quantities of:

- protons
- ions
- electrons
- impurities

< impurities >
2.1

2-2 Diodes - point-contact, junction, hot-carrier, Zener, etc.

2
A-002-002-001
****
What is the principal characteristic of a Zener diode?

- A constant current under conditions of varying voltage
- A negative resistance region
- An internal capacitance that varies with the applied voltage
- A constant voltage under conditions of varying current

< A constant voltage under conditions of varying current >
2.5

2
A-002-002-002
****
What type of semiconductor diode varies its internal capacitance as the voltage applied to its terminals varies?

- Varactor
- Zener
- Silicon-controlled rectifier
- Hot-carrier (Schottky)

< Varactor >
2.6

2
A-002-002-003
****
What is a common use for the hot-carrier (Schottky) diode?

- As VHF and UHF mixers and detectors
- As balanced mixers in FM generation
- As a variable capacitance in an automatic frequency control (AFC) circuit
- As a constant voltage reference in a power supply

< As VHF and UHF mixers and detectors >
2.7

The hot carrier diode is the modern replacement for the older point-contact diode. They are very small signal rectifiers; in fact, small cousins of the Schottky barrier rectifier. Hot carrier diodes feature very low internal noise up into the microwave range. They also have a good ratio of forward current to leakage (reverse) at a low PIV rating. These diodes have closely matched characteristics within each series and high conversion efficiency in mixer and detector circuits. This makes them very useful and efficient for mixers and detectors in the VHF range and above.

2
A-002-002-004
****
What limits the maximum forward current in a junction diode?

- Forward voltage
- Junction temperature
- Back EMF
- Peak inverse voltage

< Junction temperature >
2.15

2
A-002-002-005
****
What are the major ratings for junction diodes?

- Maximum reverse current and capacitance
- Maximum forward current and capacitance
- Maximum forward current and peak inverse voltage (PIV)
- Maximum reverse current and peak inverse voltage (PIV)

< Maximum forward current and peak inverse voltage (PIV) >
2.2

2
A-002-002-006
****
Structurally, what are the two main categories of semiconductor diodes?

- Vacuum and point contact
- Electrolytic and point contact
- Junction and point contact
- Electrolytic and junction

< Junction and point contact >
2.2, 2.4

2
A-002-002-007
****
What is a common use for point contact diodes?

- As a constant current source
- As a constant voltage source
- As an RF detector
- As a high voltage rectifier

< As an RF detector >
2.4

2
A-002-002-008
****
What is one common use for PIN diodes?

- As a constant current source
- As an RF switch
- As a high voltage rectifier
- As a constant voltage source

< As an RF switch >
2.4

2
A-002-002-009
****
A Zener diode is a device used to:

- regulate voltage
- dissipate voltage
- decrease current
- increase current

< regulate voltage >
2.5

2
A-002-002-010
****
If a Zener diode rated at 10 V and 50 watts were operated at maximum dissipation rating, it would conduct ____________ amperes:

- 50
- 0.05
- 5
- 0.5

< 5 >
2.5

At first glance, this question appears to be a simple Ohm's Law calculation. What makes it interesting is that the active device is a Zener diode. Zener diodes have a more or less constant voltage across them during large excursions in the current. For this reason, Zener diodes are rated by the power that they can safely dissipate without being damaged by heat or drifting outside their voltage tolerance limits.

The Ohm's Law formula for Power is: $P = EI$

In this case, we know that no matter what value I takes, the voltage across the Zener diode will be 10 V. Thus we can apply the power formula directly.

$P = 10 \times I$ *so* $I = P/10 = 50/10 = 5$ *A.*

2
A-002-002-011
****
The power-handling capability of most Zener diodes is rated at 25 degrees C or approximately room temperature. If the temperature is increased, the power handling capability is:

- the same
- less
- much greater
- slightly greater

< less >
2.5

2-3 Transistors - NPN/PNP

2
A-002-003-001
****
What is the alpha of a bipolar transistor?

- The change of collector current with respect to base current
- The change of collector current with respect to emitter current
- The change of base current with respect to collector current
- The change of collector current with respect to gate current

< The change of collector current with respect to emitter current >
2.10

2
A-002-003-002
****
What is the beta of a bipolar transistor?

- The change of base current with respect to emitter current
- The change of collector current with respect to emitter current
- The change of base current with respect to gate current
- The change of collector current with respect to base current

< The change of collector current with respect to base current >
2.10

2
A-002-003-003
****
Which component conducts electricity from a negative emitter to a positive collector when its base voltage is made positive?

- A varactor
- A triode vacuum tube
- An NPN transistor
- A PNP transistor

< An NPN transistor >
2.10

2
A-002-003-004
****
What is the alpha of a bipolar transistor in common base configuration?

- Forward voltage gain
- Reverse current gain
- Reverse voltage gain
- Forward current gain

< Forward current gain >
2.10

2
A-002-003-005
****
In a bipolar transistor, the change of collector current with respect to base current is called:

- gamma
- beta
- delta
- alpha

< beta >
2.10

A-002-003-006
****
The alpha of a bipolar transistor is specified for what configuration?

- Common collector
- Common base
- Common gate
- Common emitter

< Common base >
2.10

This is an interesting question because we aren't at all sure that it is true! Some research didn't turn up an answer but it did turn up a note in the 1962 GE transistor manual regarding measurement of alpha that might be relevant: "alpha in most configurations is not available at the external terminals of the transistor".

We agree that the only configuration where alpha can be measured directly is the common base configuration. Also, there is little or no use made of alpha in other configurations such as common emitter so far as we are aware, although you should not put too much trust in things we may never have encountered!

On the other hand, alpha can be calculated for at least the common emitter configuration by:

alpha = beta/(1 + beta)

This is ISED question A-002-003-009.

2
A-002-003-007
****

The beta of a bipolar transistor is specified for what configurations?

- Common emitter or common gate
- Common base or common collector
- Common emitter or common collector
- Common base or common emitter

< Common emitter or common collector >
2.10

Technically, this is a definition question; but when reviewing the ISED question bank we concluded that we didn't do a very good job of explaining it in section 2.10. To start at the beginning, we refer you to the following paragraph:

"A more meaningful parameter is related to the control the base has over the collector current, the ratio of base current to collector current. This parameter is called beta. Beta is more commonly written as h_{fe}*, where h stands for hybrid parameters. The letter h has a capital subscript if the parameter refers to the static DC forward current gain,* h_{FE}*, and a lower case subscript* h_{fe} *if the gain refers to AC parameters."*

What we didn't do was explain hybrid parameters. Specifically, h stands for `hybrid` *and the subscript defines which hybrid parameter we have in mind. The first letter of the subscript is the relationship, f is* `forward current gain`*, and the second letter is the configuration to which the parameter applies, in this case* `i` *is common emitter. The other choices are* `b` *is common base and* `c` *is common collector.*

Our suggestion, remember that beta/h_{fe} *applies to the common emitter configuration and don't worry about the rest which are rarely required in most designs. For the common emitter configuration the following hybrid parameters exist:*

- h_{ie} *common emitter input impedance*
- h_{fe} *common emitter forward current transfer ratio*
- h_{re} *common emitter reverse voltage transfer ratio*
- h_{oe} *common emitter output impedance*

2
A-002-003-008
****

Which component conducts electricity from a positive emitter to a negative collector when its base is made negative?

- A triode vacuum tube
- A PNP transistor
- A varactor
- An NPN transistor

< A PNP transistor >
2.10

2
A-002-003-009
****
Alpha of a bipolar transistor is equal to:

- beta x (1 + beta)
- beta / (1 + beta)
- beta x (1 - beta)
- beta / (1 - beta)

< beta / (1 + beta) >
2.10

2
A-002-003-010
****
The current gain of a bipolar transistor in common emitter or common collector compared to common base configuration is:

- high to very high
- very low
- usually about double
- usually about half

< high to very high >
2.10

2
A-002-003-011
****
Beta of a bipolar transistor is equal to:

- alpha / (1 - alpha)
- alpha / (1 + alpha)
- alpha x (1 - alpha)
- alpha x (1 + alpha)

< alpha / (1 - alpha) >
2.10

2-4 Field effect transistor (FET), JFET, MOSFET

2
A-002-004-001
****
What is an enhancement-mode FET?

- An FET without a channel; no current occurs with zero gate voltage
- An FET with a channel that blocks voltage through the gate
- An FET with a channel that allows current when the gate voltage is zero
- An FET without a channel to hinder current through the gate

< An FET without a channel; no current occurs with zero gate voltage >
2.13

2
A-002-004-002
****
What is a depletion-mode FET?

- An FET without a channel; no current flows with zero gate voltage
- An FET that has a channel with no gate voltage applied; a current flows with zero gate voltage
- An FET without a channel to hinder current through the gate
- An FET that has a channel that blocks current when the gate voltage is zero

< An FET that has a channel with no gate voltage applied; a current flows with zero gate voltage >
2.13

2
A-002-004-003
****
Why do many MOSFET devices have built-in gate protective Zener diodes?

- The gate-protective Zener diode keeps the gate voltage within specifications to prevent the device from overheating
- The gate-protective Zener diode protects the substrate from excessive voltages
- The gate-protective Zener diode prevents the gate insulation from being punctured by small static charges or excessive voltages
- The gate-protective Zener diode provides a voltage reference to provide the correct amount of reverse-bias gate voltage

< The gate-protective Zener diode prevents the gate insulation from being punctured by small static charges or excessive voltages >
2.13

2
A-002-004-004
****
Why are special precautions necessary in handling FET and CMOS devices?

- They are light-sensitive
- They are susceptible to damage from static charges
- They have micro-welded semiconductor junctions that are susceptible to breakage
- They have fragile leads that may break off

< They are susceptible to damage from static charges >
2.13

2
A-002-004-005
****
How does the input impedance of a field-effect transistor (FET) compare with that of a bipolar transistor?

- One cannot compare input impedance without knowing supply voltage
- An FET has low input impedance; a bipolar transistor has high input impedance
- The input impedance of FETs and bipolar transistors is the same
- An FET has high input impedance; a bipolar transistor has low input impedance

< An FET has high input impedance; a bipolar transistor has low input impedance >
2.13

2
A-002-004-006
****
What are the three terminals of a junction field-effect transistor (JFET)?

- Emitter, base 1, base 2
- Emitter, base, collector
- Gate, drain, source
- Gate 1, gate 2, drain

< Gate, drain, source >
2.13

2
A-002-004-007
****
What are the two basic types of junction field-effect transistors (JFET)?

- N-channel and P-channel
- High power and low power
- MOSFET and GaAsFET
- Silicon and germanium

< N-channel and P-channel >
2.13

2
A-002-004-008
****
Electron conduction in an n-channel depletion type MOSFET is associated with:

- n-channel depletion
- p-channel depletion
- p-channel enhancement
- q-channel enhancement

< n-channel depletion >
2.13

2
A-002-004-009
****
Electron conduction in an n-channel enhancement MOSFET is associated with:

- q-channel depletion
- p-channel enhancement
- n-channel enhancement
- p-channel depletion

< n-channel enhancement >
2.13

2
A-002-004-010
****
Hole conduction in a p-channel depletion type MOSFET is associated with:

- n-channel enhancement
- p-channel depletion
- q-channel depletion
- n-channel depletion

< p-channel depletion >
2.13

2
A-002-004-011
****
Hole conduction in a p-channel enhancement type MOSFET is associated with:

- n-channel depletion
- n-channel enhancement
- q-channel depletion
- p-channel enhancement

< p-channel enhancement >
2.13

2-5 Silicon controlled rectifier (SCR)

2
A-002-005-001
****
What are the three terminals of a silicon controlled rectifier (SCR)?

- Gate, base 1 and base 2
- Base, collector and emitter
- Anode, cathode and gate
- Gate, source and sink

< Anode, cathode and gate >
2.14

2
A-002-005-002
****
What are the two stable operating conditions of a silicon controlled rectifier (SCR)?

- Forward conducting and reverse conducting
- Conducting and non-conducting
- NPN conduction and PNP conduction
- Oscillating and quiescent

< Conducting and non-conducting >
2.14

2
A-002-005-003
****
When a silicon controlled rectifier (SCR) is triggered, to what other semiconductor diode are its electrical characteristics similar (as measured between its cathode and anode)?

- The junction diode
- The PIN diode
- The hot-carrier (Schottky) diode
- The varactor diode

< The junction diode >
2.14

2
A-002-005-004
****
Under what operating condition does a silicon controlled rectifier (SCR) exhibit electrical characteristics similar to a forward-biased silicon rectifier?

- When it is gated “off”
- When it is used as a detector
- During a switching transition
- When it is gated “on”

< When it is gated “on” >
2.14

2
A-002-005-005
****
The silicon controlled rectifier (SCR) is what type of device?

- PNPN
- NPPN
- PNNP
- PPNN

< PNPN >
2.14

2
A-002-005-006
****
The control element in the silicon controlled rectifier (SCR) is called the:

- anode
- cathode
- emitter
- gate

< gate >
2.14

2
A-002-005-007
****
The silicon controlled rectifier (SCR) is a member of which family?

- Phase locked loops
- Varactors
- Thyristors
- Varistors

< Thyristors >
2.14

2
A-002-005-008
****
In amateur radio equipment, which is the major application for the silicon controlled rectifier (SCR)?

- Power supply overvoltage “crowbar” circuit
- Class C amplifier circuit
- Microphone preamplifier circuit
- SWR detector circuit

< Power supply overvoltage “crowbar” circuit >
2.14

2
A-002-005-009
****
Which of the following devices has anode, cathode, and gate?

- The bipolar transistor
- The silicon controlled rectifier (SCR)
- The field effect transistor
- The triode vacuum tube

< The silicon controlled rectifier (SCR) >
2.14

2
A-002-005-010
****
When it is gated “on”, the silicon controlled rectifier (SCR) exhibits electrical characteristics similar to a:

- reverse-biased silicon rectifier
- forward-biased PIN diode
- reverse-biased hot-carrier (Schottky) diode
- forward-biased silicon rectifier

< forward-biased silicon rectifier >
2.14

2
A-002-005-011
****
Which of the following is a PNPN device?

- PIN diode
- Hot carrier (Schottky) diode
- Zener diode
- Silicon controlled rectifier (SCR)

< Silicon controlled rectifier (SCR) >
2.14

2-6 Amplifiers - classes A, AB, B and C

4
A-002-006-001
****
For what portion of a signal cycle does a Class A amplifier operate?

- Exactly 180 degrees
- More than 180 degrees but less than 360 degrees
- The entire cycle
- Less than 180 degrees

< The entire cycle >
4.3.1

4
A-002-006-002
****
Which class of amplifier has the highest linearity and least distortion?

- Class A
- Class AB
- Class B
- Class C

< Class A >
4.3.1

4
A-002-006-003
****
For what portion of a cycle does a Class AB amplifier operate?

- Exactly 180 degrees
- The entire cycle
- Less than 180 degrees
- More than 180 degrees but less than 360 degrees

< More than 180 degrees but less than 360 degrees >
4.3.3

4
A-002-006-004
****
For what portion of a cycle does a Class B amplifier operate?

- Less than 180 degrees
- More than 180 degrees but less than 360 degrees
- 180 degrees
- The entire cycle

< 180 degrees >
4.3.2

4
A-002-006-005
****
For what portion of a signal cycle does a Class C amplifier operate?

- More than 180 degrees but less than 360 degrees
- Less than 180 degrees
- The entire cycle
- 180 degrees

< Less than 180 degrees >
4.3.4

4
A-002-006-006
****
Which of the following classes of amplifier provides the highest efficiency?

- Class C
- Class A
- Class AB
- Class B

< Class C >
4.3.4

4
A-002-006-007
****
Which of the following classes of amplifier would provide the highest efficiency in the output stage of a CW, RTTY or FM transmitter?

- Class C
- Class AB
- Class B
- Class A

< Class C >
4.3.4

4
A-002-006-008
****
Which class of amplifier provides the least efficiency?

- Class C
- Class B
- Class A
- Class AB

< Class A >
4.3.1

4
A-002-006-009
****
Which class of amplifier has the poorest linearity and the most distortion?

- Class AB
- Class C
- Class A
- Class B

< Class C >
4.3.4

4
A-002-006-010
****
Which class of amplifier operates over the full cycle?

- Class A
- Class AB
- Class B
- Class C

< Class A >
4.3.1

4
A-002-006-011
****
Which class of amplifier operates over less than 180 degrees of the cycle?

- Class AB
- Class C
- Class A
- Class B

< Class C >
4.3.4

2-7 Amplifier circuits - discrete and IC

4
A-002-007-001
****
What determines the input impedance of a FET common-source amplifier?

- The input impedance is essentially determined by the resistance between the source and substrate
- The input impedance is essentially determined by the resistance between the source and the drain
- The input impedance is essentially determined by the gate biasing network
- The input impedance is essentially determined by the resistance between the drain and substrate

< The input impedance is essentially determined by the gate biasing network >
4.3

4
A-002-007-002
****
What determines the output impedance of a FET common-source amplifier?

- The output impedance is essentially determined by the drain supply voltage
- The output impedance is essentially determined by the drain resistor
- The output impedance is essentially determined by the gate supply voltage
- The output impedance is essentially determined by the input impedance of the FET

< The output impedance is essentially determined by the drain resistor >
4.3

4
A-002-007-003
****
What are the advantages of a Darlington pair audio amplifier?

- High gain, high input impedance and low output impedance
- Mutual gain, high stability and low mutual inductance
- Mutual gain, low input impedance and low output impedance
- Low output impedance, high mutual impedance and low output current

< High gain, high input impedance and low output impedance >
4.4

4
A-002-007-004
****
In the common base amplifier, when the input and output signals are compared:

- the output signal lags the input signal by 90 degrees
- the signals are in phase
- the output signals leads the input signal by 90 degrees
- the signals are 180 degrees out of phase

< the signals are in phase >
4.3

4
A-002-007-005
****
In the common base amplifier, the input impedance, when compared to the output impedance is:

- only slightly higher
- only slightly lower
- very low
- very high

< very low >
4.3

We are of the opinion that the question is badly written and one can play with the ratio of input/output resistance by playing with the external components.

Here's our rationale for the statement above:

(1) the input resistance is (r sub b + r sub e)/ beta. [internal base resistance + internal emitter resistance divided by beta. This will generally be quite low (around 50 ohms) PROVIDED the ratio r sub L / R sub c is low (less than 1/10, which is usually the case. (that is the load resistance is not a lot bigger than the collector internal resistance). This corresponds to a load resistance of about 10K or less in the real world.

(2) the output resistance is fairly stable at about 100K with a sudden jump to over a megohm when some internal values are changed We suppose that you could make a case for answer 3, the ISED "correct answer" based on the ratio 50:1,000,000 but as we have said all along, there are a lot of factors involved, including the external components which can really change these "intrinsic" parameters.

The real issue is that the current gain of the circuit is about 1 so the input and output CURRENTS will be similar. The power gain can be large because you can run up the collector voltage but that has feedback effects on the collector current, and by inference on the r sub c value. Common base shows a huge increase in power gain at a load resistance of about 100k. This would be the point where the external resistance matches the internal resistance which is consistent with the argument above.

4
A-002-007-006
****
In the common emitter amplifier, when the input and output signals are compared:

- the output signal leads the input signal by 90 degrees
- the output signal lags the input signal by 90 degrees
- the signals are 180 degrees out of phase
- the signals are in phase

< the signals are 180 degrees out of phase >
4.3

4
A-002-007-007
****
In the common collector amplifier, when the input and output signals are compared:

- the output signal leads the input signal by 90 degrees
- the output signal lags the input signal by 90 degrees
- the signals are in phase
- the signals are 180 degrees out of phase

< the signals are in phase >
4.3

4
A-002-007-008
****
The FET amplifier source follower circuit is another name for:

- common source circuit
- common drain circuit
- common mode circuit
- common gate circuit

< common drain circuit >
4.3

4
A-002-007-009
****
The FET amplifier common source circuit is similar to which of the following bipolar transistor amplifier circuits?

- Common collector
- Common base
- Common mode
- Common emitter

< Common emitter >
4.3

4
A-002-007-010
****
The FET amplifier common drain circuit is similar to which of the following bipolar transistor amplifier circuits?

- Common collector
- Common emitter
- Common base
- Common mode

< Common collector >
4.3

4
A-002-007-011
****
The FET amplifier common gate circuit is similar to which of the following bipolar transistor amplifier circuits?

- Common mode
- Common collector
- Common base
- Common emitter

< Common base >
4.3

2-8 Operational amplifiers, properties and applications

4
A-002-008-001
****
What is an operational amplifier (op-amp)?

- A high-gain, direct-coupled audio amplifier whose characteristics are determined by internal components of the device
- An amplifier used to increase the average output of frequency modulated amateur signals to the legal limit
- A program subroutine that calculates the gain of an RF amplifier
- A high-gain, direct-coupled differential amplifier whose characteristics are determined by components mounted externally

< A high-gain, direct-coupled differential amplifier whose characteristics are determined by components mounted externally >
4.10

4
A-002-008-002
****
What would be the characteristics of the ideal op-amp?

- Zero input impedance, zero output impedance, infinite gain, and flat frequency response
- Infinite input impedance, zero output impedance, infinite gain, and flat frequency response
- Infinite input impedance, infinite output impedance, infinite gain and flat frequency response
- Zero input impedance, infinite output impedance, infinite gain, and flat frequency response

< Infinite input impedance, zero output impedance, infinite gain, and flat frequency response >
4.10

4
A-002-008-003
****
What determines the gain of a closed-loop op-amp circuit?

- The PNP collector load
- The voltage applied to the circuit
- The external feedback network
- The collector-to-base capacitance of the PNP stage

< The external feedback network >
4.10

4
A-002-008-004
****
What is meant by the term op-amp offset voltage?

- The difference between the output voltage of the op-amp and the input voltage required for the next stage
- The potential between the amplifier input terminals of the op-amp in a closed-loop condition
- The potential between the amplifier input terminals of the op-amp in an open-loop condition
- The output voltage of the op-amp minus its input voltage

< The potential between the amplifier input terminals of the op-amp in a closed-loop condition >
4.10

4
A-002-008-005
****
What is the input impedance of a theoretically ideal op-amp?

- Very low
- Exactly 100 ohms
- Exactly 1000 ohms
- Very high

< Very high >
4.10

4
A-002-008-006
****
What is the output impedance of a theoretically ideal op-amp?

- Very high
- Exactly 100 ohms
- Exactly 1000 ohms
- Very low

< Very low >
4.10

4
A-002-008-007
****
What are the advantages of using an op-amp instead of LC elements in an audio filter?

- Op-amps are more rugged and can withstand more abuse than can LC elements
- Op-amps are available in more styles and types than are LC elements
- Op-amps are fixed at one frequency
- Op-amps exhibit gain rather than insertion loss

< Op-amps exhibit gain rather than insertion loss >
4.11

4
A-002-008-008
****
What are the principal uses of an op-amp RC active filter in amateur circuitry?

- Op-amp circuits are used as low-pass filters at the output of transmitters
- Op-amp circuits are used as audio filters for receivers
- Op-amp circuits are used as filters for smoothing power supply output
- Op-amp circuits are used as high-pass filters to block RFI at the input of receivers

< Op-amp circuits are used as audio filters for receivers >
4.11

4
A-002-008-009
****
What is an inverting op-amp circuit?

- An operational amplifier circuit connected such that the input and output signals are 180 degrees out of phase
- An operational amplifier circuit connected such that the input and output signals are in phase
- An operational amplifier circuit connected such that the input and output signals are 90 degrees out of phase
- An operational amplifier circuit connected such that the input impedance is held to zero, while the output impedance is high

< An operational amplifier circuit connected such that the input and output signals are 180 degrees out of phase >
4.10

4
A-002-008-010
****
What is a non-inverting op-amp circuit?

- An operational amplifier circuit connected such that the input and output signals are 90 degrees out of phase
- An operational amplifier circuit connected such that the input and output signals are in phase
- An operational amplifier circuit connected such that the input impedance is held low, and the output impedance is high
- An operational amplifier circuit connected such that the input and output signals are 180 degrees out of phase

< An operational amplifier circuit connected such that the input and output signals are in phase >
4.10

4
A-002-008-011
****
What term is most appropriate for a high gain, direct-coupled differential amplifier whose characteristics are determined by components mounted externally?

- Difference amplifier
- Operational amplifier
- High gain audio amplifier
- Summing amplifier

< Operational amplifier >
4.10

2-9 Mixers, frequency multipliers

8
A-002-009-001
****
What is the mixing process?

- The elimination of noise in a wideband receiver by phase differentiation
- The recovery of intelligence from a modulated signal
- The combination of two signals to produce sum and difference frequencies
- The elimination of noise in a wideband receiver by phase comparison

< The combination of two signals to produce sum and difference frequencies >
8.5.1

8
A-002-009-002
****
What are the principal frequencies that appear at the output of a mixer circuit?

- The original frequencies and the sum and difference frequencies
- 1.414 and 0.707 times the input frequencies
- The sum, difference and square root of the input frequencies
- Two and four times the original frequency

< The original frequencies and the sum and difference frequencies >
8.5.2

8
A-002-009-003
****
What occurs when an excessive amount of signal energy reaches the mixer circuit?

- Automatic limiting occurs
- Spurious signals are generated
- A beat frequency is generated
- Mixer blanking occurs

< Spurious signals are generated >
8.5.1

4
A-002-009-004
****
In a frequency multiplier circuit, the input signal is coupled to the base of a transistor through a capacitor. A radio frequency choke is connected between the base of the transistor and ground. The capacitor is:

- a DC blocking capacitor
- part of the input tuned circuit
- a by-pass for the circuit
- part of the output tank circuit

< a DC blocking capacitor >
4.7

See Figure 4-16.

4
A-002-009-005
****
A frequency multiplier circuit must be operated in:

- class AB
- class B
- class A
- class C

< class C >
4.7

4
A-002-009-006
****
In a frequency multiplier circuit, an inductance (L1) and a variable capacitor (C2) are connected in series between VCC+ and ground. The collector of a transistor is connected to a tap on L1. The purpose of the variable capacitor is to:

- tune L1 to the desired harmonic
- by-pass RF
- tune L1 to the frequency applied to the base
- provide positive feedback

< tune L1 to the desired harmonic >
4.7

See Figure 4-16.

4
A-002-009-007
****
In a frequency multiplier circuit, an inductance (L1) and a variable capacitor (C2) are connected in series between VCC+ and ground. The collector of a transistor is connected to a tap on L1. A fixed capacitor (C3) is connected between the VCC+ side of L1 and ground. The purpose of C3 is to:

- form a pi filter with L1 and C2
- resonate with L1
- provide an RF ground at the VCC connection point of L1
- by-pass any audio components

< provide an RF ground at the VCC connection point of L1 >
4.7

See Figure 4-16.

4
A-002-009-008
****
In a frequency multiplier circuit, an inductance (L1) and a variable capacitor (C2) are connected in series between VCC+ and ground. The collector of a transistor is connected to a tap on L1. C2 in conjunction with L1 operate as a:

- frequency divider
- frequency multiplier
- voltage divider
- voltage doubler

< frequency multiplier >
4.7

See Figure 4-16.

4
A-002-009-009
****
In a circuit where the components are tuned to resonate at a higher frequency than applied, the circuit is most likely:

- a frequency multiplier
- a VHF/UHF amplifier
- a linear amplifier
- a frequency divider

< a frequency multiplier >
4.7

4
A-002-009-010
****
In a frequency multiplier circuit, an inductance (L1) and a variable capacitor (C2) are connected in series between VCC+ and ground. The collector of a transistor is connected to a tap on L1. A fixed capacitor (C3) is connected between the VCC+ side of L1 and ground. C3 is a:

- DC blocking capacitor
- tuning capacitor
- RF by-pass capacitor
- coupling capacitor

< RF by-pass capacitor >
4.7

See Figure 4-16.

9
A-002-009-011
****
What stage in a transmitter would change a 5.3-MHz input signal to 14.3 MHz?

- A linear translator
- A frequency multiplier
- A mixer
- A beat frequency oscillator

< A mixer >
9.6

2-10 Digital logic elements

5
A-002-010-001
****
What is a NAND gate?

- A circuit that produces a logic “1” at its output only when all inputs are logic “1”
- A circuit that produces a logic “0” at its output only when all inputs are logic “1”
- A circuit that produces a logic “0” at its output if some but not all of its inputs are logic “1”
- A circuit that produces a logic “0” at its output only when all inputs are logic “0”

< A circuit that produces a logic “0” at its output only when all inputs are logic “1” >
5.5

5
A-002-010-002
****
What is an OR gate?

- A circuit that produces a logic “0” at its output if all inputs are logic “1”
- A circuit that produces a logic “1” at its output if any input is logic “1”
- A circuit that produces logic “1” at its output if all inputs are logic “0”
- A circuit that produces a logic “0” at its output if any input is logic “1”

< A circuit that produces a logic “1” at its output if any input is logic “1” >
5.5

5
A-002-010-003
****
What is a NOR gate?

- A circuit that produces a logic “0” at its output only if all inputs are logic “0”
- A circuit that produces a logic “1” at its output only if all inputs are logic “1”
- A circuit that produces a logic “1” at its output if some but not all of its inputs are logic “1”
- A circuit that produces a logic “0” at its output if any or all inputs are logic “1”

< A circuit that produces a logic “0” at its output if any or all inputs are logic “1” >
5.5

5
A-002-010-004
****
What is a NOT gate (also known as an INVERTER)?

- A circuit that does not allow data transmission when its input is high
- A circuit that allows data transmission only when its input is high
- A circuit that produces a logic “1” at its output when the input is logic “1”
- A circuit that produces a logic “0” at its output when the input is logic “1”

< A circuit that produces a logic “0” at its output when the input is logic “1” >
5.5

5
A-002-010-005
****
What is an EXCLUSIVE OR gate?

- A circuit that produces a logic “0” at its output when only one of the inputs is logic “1”
- A circuit that produces a logic “1” at its output when all of the inputs are logic “ 1”
- A circuit that produces a logic “1” at its output when all of the inputs are logic “0”
- A circuit that produces a logic “1” at its output when only one of the inputs is logic “1”

< A circuit that produces a logic “1” at its output when only one of the inputs is logic “1” >
5.6

5
A-002-010-006
****
What is an EXCLUSIVE NOR gate?

- A circuit that produces a logic “1” at its output when all of the inputs are logic “1”
- A circuit that produces a logic “1” at its output when only one of the inputs is logic “0”
- A circuit that produces a logic “1” at its output when only one of the inputs are logic “1”
- A circuit that produces a logic “0” at its output when all of the inputs are logic “1”

< A circuit that produces a logic “1” at its output when all of the inputs are logic “1” >
5.6

5
A-002-010-007
****
What is an AND gate?

- A circuit that produces a logic “1” at the output if at least one input is a logic “0”
- A circuit that produces a logic “1” at its output only if one of its inputs is logic “ 1”
- A circuit that produces a logic “1” at its output if all inputs are logic “0”
- A circuit that produces a logic “1” at its output only if all its inputs are logic “1”

< A circuit that produces a logic “1” at its output only if all its inputs are logic “1” >
5.5

5
A-002-010-008
****
What is a flip-flop circuit?

- A binary sequential logic element with eight stable states
- A binary sequential logic element with two stable states
- A binary sequential logic element with four stable states
- A binary sequential logic element with one stable state

< A binary sequential logic element with two stable states >
5.10

5
A-002-010-009
****
What is a bistable multivibrator?

- A flip-flop
- An OR gate
- An AND gate
- A clock

< A flip-flop >
5.10

5
A-002-010-010
****
What type of digital logic is also known as a latch?

- A decade counter
- An OR gate
- A flip-flop
- An op-amp

< A flip-flop >
5.10

5
A-002-010-011
****
In a multivibrator circuit, when one transistor conducts, the other is:

- saturated
- reverse-biased
- cut off
- forward-biased

< cut off >
5.10

2-11 Quartz crystal - properties and applications

1
A-002-011-001
****
What is a crystal lattice filter?

- A filter with wide bandwidth and shallow skirts made using quartz crystals
- An audio filter made with four quartz crystals that resonate at 1 kHz intervals
- A filter with narrow bandwidth and steep skirts made using quartz crystals
- A power supply filter made with interlaced quartz crystals

< A filter with narrow bandwidth and steep skirts made using quartz crystals >
1.17

1
A-002-011-002
****
What factor determines the bandwidth and response shape of a crystal lattice filter?

- The relative frequencies of the individual crystals
- The centre frequency chosen for the filter
- The gain of the RF stage following the filter
- The amplitude of the signals passing through the filter

< The relative frequencies of the individual crystals >
1.17

1
A-002-011-003
****
For single-sideband phone emissions, what would be the bandwidth of a good crystal lattice filter?

- 15 kHz
- 500 Hz
- 2.4 kHz
- 6 kHz

< 2.4 kHz >
1.17

7
A-002-011-004
****
The main advantage of a crystal oscillator over a tuned LC oscillator is:

- longer life under severe operating use
- freedom from harmonic emissions
- simplicity
- much greater frequency stability

< much greater frequency stability >
7.2

1
A-002-011-005
****
A quartz crystal filter is superior to an LC filter for narrow bandpass applications because of the:

- crystal’s low Q
- LC circuit’s high Q
- crystal’s simplicity
- crystal’s high Q

< crystal’s high Q >
1.17

7
A-002-011-006
****
Piezoelectricity is generated by:

- touching crystals with magnets
- adding impurities to a crystal
- deforming certain crystals
- moving a magnet near a crystal

< deforming certain crystals >
7.2

7
A-002-011-007
****
Electrically, what does a crystal look like?

- A very high Q tuned circuit
- A very low Q tuned circuit
- A variable capacitance
- A variable tuned circuit

< A very high Q tuned circuit >
7.2

7
A-002-011-008
****
Crystals are sometimes used in a circuit which has an output an integral multiple of the crystal frequency. This circuit is called:

- a crystal multiplier
- a crystal lattice
- a crystal ladder
- an overtone oscillator

< an overtone oscillator >
7.2

7
A-002-011-009
****
Which of the following properties does not apply to a crystal when used in an oscillator circuit?

- High power output
- Good frequency stability
- Very low noise because of high Q
- Good frequency accuracy

< High power output >
7.2

7
A-002-011-010
****
Crystal oscillators, filters and microphones depend upon which principle?

- Piezoelectric effect
- Hertzberg effect
- Ferro-resonance
- Overtone effect

< Piezoelectric effect >
7.2

7
A-002-011-011
****
Crystals are <u>not</u> applicable to which of the following?

- Active filters
- Microphones
- Lattice filters
- Oscillators

< Active filters >
7.2

2-12 Advanced filter circuits - AF, RF

1
A-002-012-001
****
What are the three general groupings of filters?

- Hartley, Colpitts and Pierce
- Audio, radio and capacitive
- High-pass, low-pass and band-pass
- Inductive, capacitive and resistive

< High-pass, low-pass and band-pass >
1.17

1
A-002-012-002
****
What are the distinguishing features of a Butterworth filter?

- The product of its series and shunt-element impedances is a constant for all frequencies
- It only requires conductors
- It has a maximally flat response over its pass-band
- It only requires capacitors

< It has a maximally flat response over its pass-band >
1.17

1
A-002-012-003
****
Which filter type is described as having ripple in the passband and a sharp cutoff?

- An active LC filter
- A passive op-amp filter
- A Chebyshev filter
- A Butterworth filter

< A Chebyshev filter >
1.17

1
A-002-012-004
****
What are the distinguishing features of a Chebyshev filter?

- It requires only inductors
- It allows ripple in the passband in return for steeper skirts
- It requires only capacitors
- It has a maximally flat response in the passband

< It allows ripple in the passband in return for steeper skirts >
1.17

1
A-002-012-005
****
Resonant cavities are used by amateurs as a:

- power line filter
- low pass-filter below 30 MHz
- narrow bandpass filter at VHF and higher frequencies
- high pass-filter above 30 MHz

< narrow bandpass filter at VHF and higher frequencies >
1.16

1
A-002-012-006
****
On VHF and above, 1/4 wavelength coaxial cavities are used to give protection from high-level signals. For a frequency of approximately 50 MHz, the diameter of such a device would be about 10 cm (4 in). What would be its approximate length?

- 1.5 metres (5 ft)
- 0.6 metres (2 ft)
- 2.4 metres (8 ft)
- 3.7 metres (12 ft)

< 1.5 metres (5 ft) >
1.16

The mention of the diameter in this question is a distraction. You ignore it and treat the question like any other where you have to connect frequency and wavelength.

Since you know frequency, 50 MHz and it is above 30 MHz, wavelength will be 300/50 = 6 m. Since the cavity is to be ¼ wavelength in length it will be (6) x (1/4) = 1.5 metres.

1
A-002-012-007
****

A device which helps with receiver overload and spurious responses at VHF, UHF and above may be installed in the receiver front end. It is called a:

- helical resonator
- diplexer
- directional coupler
- duplexer

< helical resonator >
1.16

1
A-002-012-008
****

Where you require bandwidth at VHF and higher frequencies about equal to a television channel, a good choice of filter is the:

- resonant cavity
- Butterworth
- Chebyshev
- none of the other answers

< none of the other answers >
1.17

1
A-002-012-009
****

What is the primary advantage of the Butterworth filter over the Chebyshev filter?

- It allows ripple in the passband in return for steeper skirts
- It requires only inductors
- It requires only capacitors
- It has maximally flat response over its passband

< It has maximally flat response over its passband >
1.17

1
A-002-012-010
****
What is the primary advantage of the Chebyshev filter over the Butterworth filter?

- It requires only capacitors
- It requires only inductors
- It allows ripple in the passband in return for steeper skirts
- It has maximally flat response over the passband

< It allows ripple in the passband in return for steeper skirts >
1.17

1
A-002-012-011
****
Which of the following filter types is NOT suitable for use at audio and low radio frequencies?

- Elliptical
- Chebyshev
- Cavity
- Butterworth

< Cavity >
1.16

Measurements - 003

3-1 AC - peak, peak-to-peak, average, RMS

11
A-003-001-001
****
What is the easiest amplitude dimension to measure by viewing a pure sine wave on an oscilloscope?

- Peak-to-peak voltage
- Peak voltage
- RMS voltage
- Average voltage

< Peak-to-peak voltage >
11.8

1
A-003-001-002
****
What is the RMS value of a 340 volt peak-to-peak pure sine wave?

- 170 volts
- 240 volts
- 300 volts
- 120 volts

< 120 volts >
1.4, 11.4.2

1
A-003-001-003
****
What is the equivalent to the RMS value of an AC voltage?

- The AC voltage found by taking the square root of the peak AC voltage
- The AC voltage causing the same heating of a given resistor as a DC voltage of the same value
- The DC voltage causing the same heating of a given resistor as the peak AC voltage
- The AC voltage found by taking the square root of the average AC value

< The AC voltage causing the same heating of a given resistor as a DC voltage of the same value >
1.4, 11.4.2

1
A-003-001-004
****
If the peak value of a 100 Hz sinusoidal waveform is 20 volts, the RMS value is:

- 28.28 volts
- 7.07 volts
- 16.38 volts
- 14.14 volts

< 14.14 volts >
1.4, 11.4.2

1
A-003-001-005
****
In applying Ohm’s law to AC circuits, current and voltage values are:

- average values
- average values times 1.414
- none of the proposed answers
- peak values times 0.707

< peak values times 0.707 >
1.4, 11.4.2

1
A-003-001-006
****
The effective value of a sine wave of voltage or current is:

- 50% of the maximum value
- 70.7% of the maximum value
- 100% of the maximum value
- 63.6% of the maximum value

< 70.7% of the maximum value >
1.4, 11.4.2

11
A-003-001-007
****
AC voltmeter scales are usually calibrated to read:

- peak voltage
- instantaneous voltage
- RMS voltage
- average voltage

< RMS voltage >
11.4.2

11
A-003-001-008
****
An AC voltmeter is calibrated to read the:

- peak-to-peak value
- average value
- effective value
- peak value

< effective value >
11.4.2

1
A-003-001-009
****
Which AC voltage value will produce the same amount of heat as a DC voltage, when applied to the same resistance?

- The average value
- The RMS value
- The peak value
- The peak-to-peak value

< The RMS value >
1.4

1
A-003-001-010
****
What is the peak-to-peak voltage of a sine wave that has an RMS voltage of 120 volts?

- 84.8 volts
- 169.7 volts
- 204.8 volts
- 339.5 volts

< 339.5 volts >
1.4, 11.4.2

11
A-003-001-011
****
A sine wave of 17 volts peak is equivalent to how many volts RMS?

- 24 volts
- 12 volts
- 34 volts
- 8.5 volts

< 12 volts >
1.4, 11.4.2

3-2 PEP, PEP relative to average power, PEP relative to voltage across load

11
A-003-002-001
****
The power supplied to the antenna transmission line by a transmitter during an RF cycle at the highest crest of the modulation envelope is known as:

- peak-envelope power
- mean power
- carrier power
- full power

< peak-envelope power >
11.4.2

11
A-003-002-002
****
To compute one of the following, multiply the peak-envelope voltage by 0.707 to obtain the RMS value, square the result and divide by the load resistance. Which is the correct answer?

- PIV
- ERP
- PEP
- power factor

< PEP >
11.4.2

11
A-003-002-003
****
Peak-Envelope Power (PEP) for SSB transmission is:

- Peak-Envelope Voltage (PEV) multiplied by 0.707, squared and divided by the load resistance
- peak-voltage multiplied by peak current
- equal to the RMS power
- a hypothetical measurement

< Peak-Envelope Voltage (PEV) multiplied by 0.707, squared and divided by the load resistance >
11.4.2

11
A-003-002-004
****
The formula to be used to calculate the power output of a transmitter into a resistor load using a voltmeter is:

- P = EI/R
- P = (E exponent 2)/R
- P = EI cos 0
- P = IR

< P = (E exponent 2)/R >
11.4.2

11
A-003-002-005
****
How is the output Peak-Envelope Power of a transmitter calculated, if an oscilloscope is used to measure the Peak-Envelope Voltage across a dummy resistive load (where PEP = Peak-Envelope Power, PEV = Peak-Envelope Voltage, Vp = peak voltage, RL = load resistance)?

- PEP = [(0.707 PEV)(0.707 PEV)] / RL
- PEP = [(Vp)(Vp)] / (RL)
- PEP = (Vp)(Vp)(RL)
- PEP = [(1.414 PEV)(1.414 PEV)] / RL

< PEP = [(0.707 PEV)(0.707 PEV)] / RL >
11.4.2

11
A-003-002-006
****
What is the output PEP from a transmitter if an oscilloscope measures 200 volts peak-to-peak across a 50-ohm dummy load connected to the transmitter output?

- 400 watts
- 100 watts
- 1000 watts
- 200 watts

< 100 watts >
11.4.2

11
A-003-002-007
****
What is the output PEP from a transmitter if an oscilloscope measures 500 volts peak-to-peak across a 50-ohm dummy load connected to the transmitter output?

- 1250 watts
- 625 watts
- 2500 watts
- 500 watts

< 625 watts >
11.4.2

11
A-003-002-008
****
What is the output PEP of an unmodulated carrier transmitter if a wattmeter connected to the transmitter output indicates an average reading of 1060 watts?

- 2120 watts
- 1500 watts
- 1060 watts
- 530 watts

< 1060 watts >
11.4.2

Remember that an average reading wattmeter means that the power delivered by the transmitter to the load is averaged out over the cycle, and the reading is valid only for an unmodulated carrier.

11
A-003-002-009
****
What is the output PEP from a transmitter, if an oscilloscope measures 400 volts peak-to-peak across a 50 ohm dummy load connected to the transmitter output?

- 400 watts
- 200 watts
- 600 watts
- 1000 watts

< 400 watts >
11.4.2

11
A-003-002-010
****
What is the output PEP from a transmitter, if an oscilloscope measures 800 volts peak-to-peak across a 50 ohm dummy load connected to the transmitter output?

- 800 watts
- 1600 watts
- 6400 watts
- 3200 watts

< 1600 watts >
11.4.2

11
A-003-002-011
****
An oscilloscope measures 500 volts peak-to-peak across a 50 ohm dummy load connected to the transmitter output during unmodulated carrier conditions. What would an average-reading power meter indicate under the same transmitter conditions?

- 427.5 watts
- 884 watts
- 442 watts
- 625 watts

< 625 watts >
11.4.2

3-3 dip meter, signal generator

11
A-003-003-001
****
What is a dip meter?

- An SWR meter
- A marker generator
- A variable frequency oscillator with metered feedback current
- A field-strength meter

< A variable frequency oscillator with metered feedback current >
11.7

11
A-003-003-002
****
What does a dip meter do?

- It measures transmitter output power accurately
- It measures field strength accurately
- It measures frequency accurately
- It gives an indication of the resonant frequency of a circuit

< It gives an indication of the resonant frequency of a circuit >
11.7

11
A-003-003-003
****
What two ways could a dip meter be used in an amateur station?

- To measure resonant frequencies of antenna traps and to measure a tuned circuit resonant frequency
- To measure antenna resonance and impedance
- To measure antenna resonance and percentage modulation
- To measure resonant frequency of antenna traps and percentage modulation

< To measure resonant frequencies of antenna traps and to measure a tuned circuit resonant frequency >
11.7

11
A-003-003-004
****
A dip meter supplies the radio frequency energy, which enables you to check:

- the resonant frequency of a circuit
- the calibration of an absorption-type wavemeter
- the impedance mismatch in a circuit
- the adjustment of an inductor

< the resonant frequency of a circuit >
11.7

11
A-003-003-005
****
A dip meter may NOT be used directly to:

- measure the value of capacitance or inductance
- align transmitter-tuned circuits
- determine the frequency of oscillations
- align receiver-tuned circuits

< measure the value of capacitance or inductance >
11.7

11
A-003-003-006
****
The dial calibration on the output attenuator of a signal generator:

- always reads the true output of the signal generator
- reads twice the true output when the attenuator is properly terminated
- reads half the true output when the attenuator is properly terminated
- reads accurately only when the attenuator is properly terminated

< reads accurately only when the attenuator is properly terminated >
11.6.1

11
A-003-003-007
****
What is a signal generator?

- A low-stability oscillator which sweeps through a range of frequencies
- A high-stability oscillator which can produce a wide range of frequencies and amplitudes
- A low-stability oscillator used to inject a signal into a circuit under test
- A high-stability oscillator which generates reference signals at exact frequency intervals

< A high-stability oscillator which can produce a wide range of frequencies and amplitudes >
11.6.1

11
A-003-003-008
****
A dip meter:

- should be tightly coupled to the circuit under test
- may be used only with series tuned circuits
- accurately measures frequencies
- should be loosely coupled to the circuit under test

< should be loosely coupled to the circuit under test >
11.7

8
A-003-003-009
Which two instruments are needed to measure FM receiver sensitivity for a 12 dB SINAD ratio (signal + noise + distortion over noise + distortion)?

- Oscilloscope and spectrum analyzer
- Receiver noise bridge and total harmonic distortion analyzer
- Calibrated RF signal generator with FM tone modulation and total harmonic distortion (THD) analyzer
- RF signal generator with FM tone modulation and a deviation meter

< Calibrated RF signal generator with FM tone modulation and total harmonic distortion (THD) analyzer >
1st Ed. – see below; 2nd Ed. – S8.2.2

Add to S8.2.2 after the last paragraph. For FM the noise is measured using a parameter called ***SINAD****, (****S****ignal +* ***N****oise* ***A****nd* ***D****istortion, which is measured in dB. SINAD = (signal + noise + distortion) / noise + distortion) dB. Distortion is included with the noise for this measurement because both are considered to be unwanted components of the received signal. An adequate SINAD specification is 12 dB for speech. If the signal level is strong with respect to the noise, then this test approximates the S/N (signal to noise) ratio of the receiver. To measure SINAD, an RF signal generator and accurate step attenuator insert a signal into the antenna input of the receiver under test. The output of the receiver is connected to an audio distortion meter or total harmonic distortion analyzer. A 1000 Hz tone FM modulates the signal generator. The test is made by adjusting the inserted signal level to result in a 12 dB distortion reading on the analyzer.*

Most Amateurs will not have the equipment to make this test; commercial radio shops have test equipment designed to perform it that contain the RF generator, modulator, attenuator, and analyzer in *one box.*

11
A-003-003-010
****
The dip meter is most directly applicable to:

- operational amplifier circuits
- digital logic circuits
- parallel tuned circuits
- series tuned circuits

< parallel tuned circuits >
11.7

11
A-003-003-011
****
Which of the following IS NOT a factor affecting the frequency accuracy of a dip meter?

- Hand capacity
- Stray capacity
- Over coupling
- Transmitter power output

< Transmitter power output >
11.7

3-4 Crystal calibrator, marking generator, frequency counter

11
A-003-004-001
****
What does a frequency counter do?

- It measures frequency deviation
- It makes frequency measurements
- It generates broad-band white noise for calibration
- It produces a reference frequency

< It makes frequency measurements >
11.5

11
A-003-004-002
****
What factors limit the accuracy, frequency response and stability of a frequency counter?

- Time base accuracy, temperature coefficient of the logic and time base stability
- Number of digits in the readout, speed of the logic, and time base stability
- Number of digits in the readout, external frequency reference and temperature coefficient of the logic
- Time base accuracy, speed of the logic, and time base stability

< Time base accuracy, speed of the logic, and time base stability >
11.5

11
A-003-004-003
****
How can the accuracy of a frequency counter be improved?

- By using slower digital logic
- By using faster digital logic
- By improving the accuracy of the frequency response
- By increasing the accuracy of the time base

< By increasing the accuracy of the time base >
11.5

11
A-003-004-004
****
If a frequency counter with a time base accuracy of +/- 0.1 PPM (parts per million) reads 146 520 000 Hz, what is the most that the actual frequency being measured could differ from that reading?

- 0.1 MHz
- 1.4652 Hz
- 1.4652 kHz
- 14.652 Hz

< 14.652 Hz >
11.5

Before you start ensure that all values are in the same units. 0.1 ppm means 0.1 part in 1 000 000, 1 part in 10 000 000, or as a fraction, 1/10 000 000. This fraction of 146 520 000 Hz is 14.652 Hz.

11
A-003-004-005
****
If a frequency counter, with a time base accuracy of 10 PPM (parts per million) reads 146 520 000 Hz, what is the most the actual frequency being measured could differ from that reading?

- 1465.2 Hz
- 146.52 Hz
- 146.52 kHz
- 1465.2 kHz

< 1465.2 Hz >
11.5

Before you start ensure that all values are in the same units . 10 ppm means 10 parts in 1 000 000, or as fractions, 10/1 000 000 or 1/100 000. This fraction of 146 520 000 Hz is 1465.2 Hz.

11
A-003-004-006
****
The clock in a frequency counter normally uses a:

- crystal oscillator
- self-oscillating Hartley oscillator
- mechanical tuning fork
- free-running multivibrator

< crystal oscillator >
11.5

11
A-003-004-007
****
The frequency accuracy of a frequency counter is determined by:

- the size of the frequency counter
- type of display used in the counter
- the characteristics of the internal time-base generator
- the number of digits displayed

< the characteristics of the internal time-base generator >
11.5

11
A-003-004-008
Which device relies on a stable low-frequency oscillator, with harmonic output, to facilitate the frequency calibration of receiver dial settings?

- Signal generator
- Harmonic calibrator
- Frequency counter
- Frequency-marker generator

< Frequency-marker generator >
11.6.2

11
A-003-004-009
What is the traditional way of verifying the accuracy of a crystal calibrator?

- Compare the oscillator with your transmitter
- Use a dip-meter to determine the oscillator's fundamental frequency
- Compare the oscillator with your receiver
- Zero-beat the crystal oscillator against a standard frequency as WWV

< Zero-beat the crystal oscillator against a standard frequency as WWV >
11.6.2

7
A-003-004-010
Out of the following oscillators, one is NOT, by itself, considered a high-stability reference:

- oven-controlled crystal oscillator (OCXO)
- GPS disciplined oscillator (GPSDO)
- voltage-controlled crystal oscillator (VCXO)
- temperature compensated crystal oscillator (TCXO)

< voltage-controlled crystal oscillator (VCXO) >
7.3.5, 7.4

Just because an oscillator has been set to a specific frequency there is no guarantee that it will stay on that frequency. The ability of an oscillator to stay on a specific frequency over a long period of time is referred to as frequency stability. There are myriad features of an oscillator that can contribute to this frequency drift. Among them are:

The quality of the circuit components: The better the quality, the less drift.

Inter-element capacitance: This is the unwanted capacitance that exists between the parts of an electronic component or circuit simply because of their proximity to each other.

Mechanical vibrations

Heat build-up over time: This changes the values of the components integral to determination of the frequency.

Poorly regulated power supply.

No one oscillator is, of itself, the "gold standard" of stability. This is why the most stable oscillators are *located in environments that minimize the features above. So you will see reference to such circuits as "oven-controlled crystal oscillator (OCXO)", or the "temperature compensated crystal oscillator (TCXO)". In picking the correct answer for this question note that the VCXO is the only oscillator without "add-ons".*

11
A-003-004-011
You want to calibrate your station to the WWV signal on your receiver. The resulting beat tone must be:

- a combined frequency above both
- the mathematical mean of both frequencies
- at the highest audio frequency possible
- of a frequency as low as possible and with a long a period as possible

< of a frequency as low as possible and with a long a period as possible >
11.6.2

3-5 Oscilloscope

11
A-003-005-001
****
If a 100 Hz signal is fed to the horizontal input of an oscilloscope and a 150 Hz signal is fed to the vertical input, what type of pattern should be displayed on the screen?

- A rectangular pattern 100 mm wide and 150 mm high
- A looping pattern with 3 horizontal loops, and 2 vertical loops
- An oval pattern 100 mm wide and 150 mm high
- A looping pattern with 100 horizontal loops and 150 vertical loops

< A looping pattern with 3 horizontal loops, and 2 vertical loops >
11.4.3

11
A-003-005-002
****
What factors limit the accuracy, frequency response and stability of an oscilloscope?

- Deflection amplifier output impedance and tube face frequency increments
- Accuracy of the time base and the linearity and bandwidth of the deflection amplifiers
- Accuracy and linearity of the time base and tube face voltage increments
- Tube face voltage increments and deflection amplifier voltages

< Accuracy of the time base and the linearity and bandwidth of the deflection amplifiers >
11.5

11
A-003-005-003
****
How can the frequency response of an oscilloscope be improved?

- By using a crystal oscillator as the time base and increasing the vertical sweep rate
- By increasing the horizontal sweep rate and the vertical amplifier frequency response
- By increasing the vertical sweep rate and the horizontal amplifier frequency response
- By using triggered sweep and a crystal oscillator for the time base

< By increasing the horizontal sweep rate and the vertical amplifier frequency response >
11.4

11
A-003-005-004
****
You can use an oscilloscope to display the input and output of a circuit at the same time by:

- measuring the input on the X axis and the output on the Y axis
- measuring the input on the X axis and the output on the Z axis
- utilizing a dual trace oscilloscope
- measuring the input on the Y axis and the output on the X axis

< utilizing a dual trace oscilloscope >
11.4

11
A-003-005-005
****
An oscilloscope cannot be used to:

- measure frequency
- measure DC voltage
- determine FM carrier deviation directly
- determine the amplitude of complex voltage wave forms

< determine FM carrier deviation directly >
11.4

This is a classic "wrong answer" type of question. You have to evaluate each of the answers in turn and decide whether it makes sense.

To review, an oscilloscope is used to:

- *measure AC and DC voltages*

- *measure frequency*

- *display voltage with respect to time as a graph*

Looking at the possible answers, < measure frequency > and < measure DC voltage > are obviously correct. To determine amplitude of a waveform is to measure its voltage so < determine the amplitude of complex voltage wave forms > is also correct.

As a check, can an oscilloscope measure FM carrier deviation? Without special adaptors the answer is no. It could if equipped with a spectrum analyzer front end but we don't think this is what ISED has in mind. That leaves < determine FM carrier deviation directly > as the correct response.

11
A-003-005-006
****

The bandwidth of an oscilloscope is:

- directly related to gain compression
- indirectly related to screen persistence
- the highest frequency signal the scope can display
- a function of the time base accuracy

< the highest frequency signal the scope can display >
11.4

11
A-003-005-007
****

When using Lissajous figures to determine phase differences, an indication of zero or 180 degrees is represented on the screen of an oscilloscope by:

- a horizontal straight line
- an ellipse
- a diagonal straight line
- a circle

< a diagonal straight line >
11.4.3

11
A-003-005-008
****

A 100-kHz signal is applied to the horizontal channel of an oscilloscope. A signal of unknown frequency is applied to the vertical channel. The resultant wave form has 5 loops displayed vertically and 2 loops horizontally. The unknown frequency is:

- 20 kHz
- 50 kHz
- 40 kHz
- 30 kHz

< 40 kHz >
11.4.3

11
A-003-005-009
An oscilloscope probe must be compensated:

- every time the probe is used with a different oscilloscope
- when measuring a sine wave
- through the addition of a high-value series resistor
- when measuring a signal whose frequency varies

< every time the probe is used with a different oscilloscope >
1st Ed. – see below plus S11.4; 2nd Ed. - S11.4

We have some concerns about this question. The probe must ALWAYS be compensated if one is to see the correct waveform on the screen! We think that the question really wants to know is when the compensation has to be adjusted. Since the input capacitance and resistance of the scope is constant, only when the probe is used on another scope. Once you've got it right, you've got it right and it won't change. Most scopes provide a square wave test signal for adjusting probe compensation. That said, go with the answer ISED wants

11
A-003-005-010
****

What is the best instrument to use to check the signal quality of a CW or single-sideband phone transmitter?

- A sidetone monitor
- An oscilloscope
- A signal tracer and an audio amplifier
- A field-strength meter

< An oscilloscope >
11.4

11
A-003-005-011
What is the best signal source to connect to the vertical input of an oscilloscope for checking the quality of a transmitted signal?

- The RF signals of a nearby receiving antenna
- The IF output of a monitoring receiver
- The audio input of the transmitter
- The RF output of the transmitter through a sampling device

< The RF output of the transmitter through a sampling device >
11.6.3

2nd Printing – see below 3rd Printing - S11.6.3

Add to S11.6.3 after the first paragraph on page 11-11 re probes. If you have a requirement to check the quality of a transmitted signal, for most Amateur transmitters you cannot just connect the probe to the transmitter output. The voltage is too high, the probe capacitance might detune the transmitter final, and it would be dangerous. Also, you will need to decide whether you want to look at the RF waveform or the modulation. If you want to look at the RF waveform be sure that the bandwidth of the oscilloscope's vertical amplifier is at least 4 times the frequency of the RF or you will see a sine wave no matter what.

In most cases you will want to see the result of the modulation and so some form of demodulating probe will be required.

In either case, the RF must be sampled with a small loop or other device so that only the minimum amount of RF is captured.

3-6 Meters, multimeter, power meter

11
A-003-006-001
****
A meter has a full-scale deflection of 40 microamps and an internal resistance of 96 ohms. You want it to read 0 to 1 mA. The value of the shunt to be used is:

- 24 ohms
- 16 ohms
- 4 ohms
- 40 ohms

< 4 ohms >
11.2.1

Analysis

We have a meter with a maximum current rating of 40 µA, which is to be used to measure current in a circuit where a maximum of 1 mA will flow. We need to find a shunt resistor such that when full current flows in the circuit, 40 µA will flow through the meter and the balance through the resistor.

Calculation

In most questions of this type you have to convert to base units before doing the math but in this case you can work with a ratio of currents. You do need to be careful that the underlying numbers are in the same units however.

Since the smallest number is in µA, convert the other current to the same units:

1 mA = 1000 µA

If 40 µA flows through the meter, then 1 000 - 40 = 960 µA will flow through the shunt.

We have to put 960/40 = 24 times as much current through the shunt as through the meter.

From Ohm's law we know that current and resistance are inversely proportional, therefore the resistance of the shunt will have to be 40/960 or 0.0.04167 of the resistance of the meter movement. Since we know the resistance of the meter movement to be 96 ohms we can calculate the shunt resistance as:

0.04167 × 96 ohms = 4 ohms

11
A-003-006-002
****

A moving-coil milliammeter having a full-scale deflection of 1 mA and an internal resistance of 0.5 ohms is to be converted to a voltmeter of 20 volts full-scale deflection. It would be necessary to insert a:

- series resistance of 1 999.5 ohms
- series resistance of 19 999.5 ohms
- shunt resistance of 19 999.5 ohms
- shunt resistance of 19.5 ohms

< series resistance of 19 999.5 ohms >
11.2.2

A solution to this problem involves conversion to an Ohm's law question. In this case, interpret the question as "What series resistance will allow 1 mA of current flow with 20 V applied?".

Now plug in the known values:

• maximum voltage to be measured = 20 V

• maximum current through the meter = 1 mA = 0.001 A

R = E/I

R = 20 V / 0.001 A

R = 20,000 Ω

Now subtract the meter resistance from the multiplier resistance, because they are in series. For this meter and range the required external resistor is 20000 – 0.5 =19999.5 Ohms. For most practical work the nearest standard value (20K Ω) is appropriate.

11
A-003-006-003
****

A voltmeter having a range of 150 volts and an internal resistance of 150 000 ohms is to be extended to read 750 volts. The required multiplier resistor would have a value of:

- 1 500 ohms
- 750 000 ohms
- 1 200 000 ohms
- 600 000 ohms

< 600 000 ohms >
11.2.2

Another Ohm's Law Question, actually two. First let's find out how much current is flowing in the circuit.

I = 150 V/150 000 Ω = 0.001 A

Now we want 750 V so the total resistance for 0.001 A to flow would be

750 V/0.001 A = 750 000 Ω

Since we already have 150000 Ω in the circuit we would have to add 750 000 –150 000= 600 000 Ω.

11
A-003-006-004
****
The sensitivity of an ammeter is an expression of:

- the amount of current causing full-scale deflection
- the resistance of the meter
- the loading effect the meter will have on a circuit
- the value of the shunt resistor

< the amount of current causing full-scale deflection >
11.2

11
A-003-006-005
****
Voltmeter sensitivity is usually expressed in ohms per volt. This means that a voltmeter with a sensitivity of 20 kilohms per volt would be a:

- 50 microampere meter
- 1 milliampere meter
- 50 milliampere meter
- 100 milliampere meter

< 50 microampere meter >
11.2

11
A-003-006-006
****
The sensitivity of a voltmeter, whose resistance is 150 000 ohms on the 150-volt range, is:

- 100 000 ohms per volt
- 1000 ohms per volt
- 10 000 ohms per volt
- 150 ohms per volt

< 1000 ohms per volt >
11.3

11
A-003-006-007
****
The range of a DC ammeter can easily be extended by:

- connecting an external resistance in series with the internal resistance
- changing the internal inductance of the meter
- connecting an external resistance in parallel with the internal resistance
- changing the internal capacitance of the meter to resonance

< connecting an external resistance in parallel with the internal resistance >
11.2.1

11
A-003-006-008
****
What happens inside a multimeter when you switch it from a lower to a higher voltage range?

- Resistance is reduced in series with the meter
- Resistance is added in series with the meter
- Resistance is reduced in parallel with the meter
- Resistance is added in parallel with the meter

< Resistance is added in series with the meter >
11.2.2

11
A-003-006-009
****
How can the range of an ammeter be increased?

- By adding resistance in parallel with the meter
- By adding resistance in series with the circuit under test
- By adding resistance in parallel with the circuit under test
- By adding resistance in series with the meter

< By adding resistance in parallel with the meter >
11.2.1

11
A-003-006-010
****
Where should an RF wattmeter be connected for the most accurate readings of transmitter output power?

- One-half wavelength from the transmitter output
- At the transmitter output connector
- One-half wavelength from the antenna feed point
- At the antenna feed point

< At the transmitter output connector >
11.4.2

11
A-003-006-011
****

At what line impedance do most RF wattmeters usually operate?

- 25 ohms
- 100 ohms
- 300 ohms
- 50 ohms

< 50 ohms >
11.4.2

Power Supplies - 004

4-1 Transformer and rectifier circuits, voltage doubler circuit, PIP

3
A-004-001-001
****

For the same transformer secondary voltage, which rectifier has the highest average output voltage?

- Half-wave
- Quarter-wave
- Bridge
- Full-wave centre-tap

< Bridge >
3.7

3
A-004-001-002
****

In a half-wave power supply with a capacitor input filter and a load drawing little or no current, the peak inverse voltage (PIV) across the diode can reach ________ times the RMS voltage.

- 0.45
- 2.8
- 5.6
- 1.4

< 2.8 >
3.5

3
A-004-001-003
****
In a full-wave centre-tap power supply, regardless of load conditions, the peak inverse voltage (PIV) will be ________ times the RMS voltage:

- 0.636
- 2.8
- 0.707
- 1.4

< 2.8 >
3.5

3
A-004-001-004
****
A full-wave bridge rectifier circuit makes use of both halves of the AC cycle, but unlike the full-wave centre-tap rectifier circuit it does not require:

- any output filtering
- a centre-tapped primary on the transformer
- a centre-tapped secondary on the transformer
- diodes across each leg of the transformer

< a centre-tapped secondary on the transformer >
3.7

3
A-004-001-005
****
For a given transformer the maximum output voltage available from a full-wave bridge rectifier circuit will be:

- double that of the full-wave centre-tap rectifier
- half that of the full-wave centre-tap rectifier
- the same as the full-wave centre-tap rectifier
- the same as the half-wave rectifier

< double that of the full-wave centre-tap rectifier >
3.7

3
A-004-001-006
****
The ripple frequency produced by a full-wave power supply connected to a normal household circuit is:

- 120 Hz
- 60 Hz
- 90 Hz
- 30 Hz

< 120 Hz >
3.7

3
A-004-001-007
****
The ripple frequency produced by a half-wave power supply connected to a normal household circuit is:

- 90 Hz
- 60 Hz
- 120 Hz
- 30 Hz

< 60 Hz >
3.5

3
A-004-001-008
****
Full-wave voltage doublers:

- create four times the output voltage of half-wave doublers
- use less power than half-wave doublers
- use both halves of an AC wave
- are used only in high-frequency power supplies

< use both halves of an AC wave >
3.9

3
A-004-001-009
****
What are the two major ratings that must not be exceeded for silicon-diode rectifiers used in power-supply circuits?

- Average power; average voltage
- Capacitive reactance; avalanche voltage
- Peak load impedance; peak voltage
- Peak inverse voltage; average forward current

< Peak inverse voltage; average forward current >
3.5

3
A-004-001-010
****
In a high voltage power supply, why should a resistor and capacitor be wired in parallel with power-supply rectifier diodes?

- To smooth the output waveform
- To equalize voltage drops and guard against transient voltage spikes
- To decrease the output voltage
- To ensure that the current through each diode is about the same

< To equalize voltage drops and guard against transient voltage spikes >
3.7

3
A-004-001-011
****
What is the output waveform of an unfiltered full-wave rectifier connected to a resistive load?

- A steady DC voltage
- A sine wave at half the frequency of the AC input
- A series of pulses at twice the frequency of the AC input
- A series of pulses at the same frequency as the AC input

< A series of pulses at twice the frequency of the AC input >
3.6

4-2 Filter circuits, bleeder resistor function

3
A-004-002-001
****
Filter chokes are rated according to:

- reactance at 1000 Hz
- power loss
- breakdown voltage
- inductance and current-handling capacity

< inductance and current-handling capacity >
3.8.2

3
A-004-002-002
****
Which of the following circuits gives the best regulation, under similar load conditions?

- A half-wave bridge rectifier with a capacitor input filter
- A half-wave rectifier with a choke input filter
- A full-wave rectifier with a choke input filter
- A full-wave rectifier with a capacitor input filter

< A full-wave rectifier with a choke input filter >
3.8.2, 3.8.3

3
A-004-002-003
****
The advantage of the capacitor input filter over the choke input filter is:

- better filtering action or smaller ripple voltage
- improved voltage regulation
- lower peak rectifier currents
- a higher terminal voltage output

< a higher terminal voltage output >
3.8.3

3
A-004-002-004
****
With a normal load, the choke input filter will give the:

- best regulated output
- greatest percentage of ripple
- greatest ripple frequency
- highest output voltage

< best regulated output >
3.8.2

3
A-004-002-005
****

There are two types of filters in general use in a power supply. They are called:

- choke output and capacitor output
- choke input and capacitor input
- choke input and capacitor output
- choke output and capacitor input

< choke input and capacitor input >
3.8.2, 3.8.3

3
A-004-002-006
****

The main function of the bleeder resistor in a power supply is to provide a discharge path for the capacitor in the power supply. But it may also be used for a secondary function, which is to:

- improve voltage regulation
- provide a ground return for the transformer
- inhibit the flow of current through the supply
- act as a secondary smoothing device in conjunction with the filter

< improve voltage regulation >
3.10

1
A-004-002-007
****

In a power supply, series chokes will:

- readily pass the DC but will impede the flow of the AC component
- readily pass the DC and the AC component
- impede the passage of DC but will pass the AC component
- impede both DC and AC

< readily pass the DC but will impede the flow of the AC component >
1.10

3
A-004-002-008
****

When using a choke input filter, a minimum current should be drawn all the time when the device is switched on. This can be accomplished by:

- utilizing a full-wave bridge rectifier circuit
- placing an ammeter in the output circuit
- increasing the value of the output capacitor
- including a suitable bleeder resistance

< including a suitable bleeder resistance >
3.10

3
A-004-002-009
****
In the design of a power supply, the designer must be careful of resonance effects because the ripple voltage could build up to a high value. The components that must be carefully selected are:

- the bleeder resistor and the first choke
- first capacitor and second capacitor
- first choke and first capacitor
- first choke and second capacitor

< first choke and first capacitor >
3.8.2

3
A-004-002-010
****
Excessive rectifier peak current and abnormally high peak inverse voltages can be caused in a power supply by the filter forming a:

- short circuit across the bleeder
- parallel resonant circuit with the first choke and second capacitor
- series resonant circuit with the first choke and first capacitor
- tuned inductance in the filter choke

< series resonant circuit with the first choke and first capacitor >
3.8.2

3
A-004-002-011
****
In a properly designed choke input filter power supply, the no load voltage across the filter capacitor will be about nine-tenths of the AC RMS voltage; yet it is advisable to use capacitors rated at the peak transformer voltage. Why is this large safety margin suggested?

- Resonance can be set up in the filter producing high voltages
- Under heavy load, high currents and voltages are produced
- Under no-load conditions and a burned-out bleeder, voltages could reach the peak transformer voltage
- Under no-load conditions, the current could reach a high level

< Under no-load conditions and a burned-out bleeder, voltages could reach the peak transformer voltage >
3.8.3

4-3 Linear and switching voltage regulator circuits

3
A-004-003-001
****
What is one characteristic of a linear electronic voltage regulator?

- The conduction of a control element is varied in direct proportion to the line voltage or load current
- It has a ramp voltage at its output
- A pass transistor switches from its “on” state to its “off” state
- The control device is switched on or off, with the duty cycle proportional to the line or load conditions

< The conduction of a control element is varied in direct proportion to the line voltage or load current >
3.11.3

3
A-004-003-002
****
What is one characteristic of a switching voltage regulator?

- The control device is switched on and off, with the duty cycle proportional to the line or load conditions
- The conduction of a control element is varied in direct proportion to the line voltage or load current
- It provides more than one output voltage
- It gives a ramp voltage at its output

< The control device is switched on and off, with the duty cycle proportional to the line or load conditions >
3.14

3
A-004-003-003
****
What device is typically used as a stable reference voltage in a linear voltage regulator?

- An SCR
- A varactor diode
- A junction diode
- A Zener diode

< A Zener diode >
2.5, 3.11.1

3
A-004-003-004
****
What type of linear regulator is used in applications requiring efficient utilization of the primary power source?

- A shunt regulator
- A constant current source
- A shunt current source
- A series regulator

< A series regulator >
3.11.3

3
A-004-003-005
****
What type of linear voltage regulator is used in applications requiring a constant load on the unregulated voltage source?

- A constant current source
- A shunt current source
- A shunt regulator
- A series regulator

< A shunt regulator >
3.11.1

3
A-004-003-006
****
How is remote sensing accomplished in a linear voltage regulator?

- An error amplifier compares the input voltage to the reference voltage
- A load connection is made outside the feedback loop
- A feedback connection to an error amplifier is made directly to the load
- By wireless inductive loops

< A feedback connection to an error amplifier is made directly to the load >
3.11.3

3
A-004-003-007
****
What is a three-terminal regulator?

- A regulator that supplies three voltages at a constant current
- A regulator containing a voltage reference, error amplifier, sensing resistors and transistors, and a pass element
- A regulator containing three error amplifiers and sensing transistors
- A regulator that supplies three voltages with variable current

< A regulator containing a voltage reference, error amplifier, sensing resistors and transistors, and a pass element >
3.11.3

3
A-004-003-008
****
In addition to an input voltage range what are the important characteristics of a three-terminal regulator?

- Output voltage and minimum output current
- Output voltage and maximum output current
- Maximum output voltage and minimum output current
- Minimum output voltage and maximum output current

< Output voltage and maximum output current >
3.11.3

3
A-004-003-009
****
What type of voltage regulator contains a voltage reference, error amplifier, sensing resistors and transistors, and a pass element in one package?

- An op-amp regulator
- A three-terminal regulator
- A switching regulator
- A Zener regulator

< A three-terminal regulator >
3.11.3

3
A-004-003-010
****
When extremely low ripple is required, or when the voltage supplied to the load must remain constant under conditions of large fluctuations of current and line voltage, a closed-loop amplifier is used to regulate the power supply. There are two main categories of electronic regulators. They are:

- linear and switching
- non-linear and switching
- linear and non-linear
- stiff and switching

< linear and switching >
3.2

3
A-004-003-011
****
A modern type of regulator, which features a reference, high-gain amplifier, temperature-compensated voltage sensing resistors and transistors as well as a pass-element is commonly referred to as a:

- nine-pin terminal regulator
- three-terminal regulator
- twenty-four pin terminal regulator
- six-terminal regulator

< three-terminal regulator >
3.11.3

Note that there appears to be a typographical error in the Question Bank. The "six-terminal regulator" is given as "regulator six-terminal regulator" and "twenty-four pin terminal regulator" is given as "twenty-four pin terminal".

4-4 Regulated power supplies

3
A-004-004-001
****
In a series-regulated power supply, the power dissipation of the pass transistor is:

- the inverse of the load current and the input/output voltage differential
- directly proportional to the load current and the input/output voltage differential
- dependent upon the peak inverse voltage appearing across the Zener diode
- indirectly proportional to the load voltage and the input/output voltage differential

< directly proportional to the load current and the input/output voltage differential >
3.11.2

3
A-004-004-002
****
In any regulated power supply, the output is cleanest and the regulation is best:

- at the point where the sampling network or error amplifier is connected
- across the secondary of the pass transistor
- across the load
- at the output of the pass transistor

< at the point where the sampling network or error amplifier is connected >
3.11.3

3
A-004-004-003
****
When discussing a power supply the _______ resistance is equal to the output voltage divided by the total current drawn, including the current drawn by the bleeder resistor.

- load
- ideal
- rectifier
- differential

< load >
3.3

3
A-004-004-004
****
The regulation of long-term changes in the load resistance of a power supply is called:

- active regulation
- analog regulation
- static regulation
- dynamic regulation

< static regulation >
3.11

3
A-004-004-005
****
The regulation of short-term changes in the load resistance of a power supply is called:

- dynamic regulation
- static regulation
- analog regulation
- active regulation

< dynamic regulation >
3.11

3
A-004-004-006
****
The dynamic regulation of a power supply is improved by increasing the value of:

- the choke
- the input capacitor
- the output capacitor
- the bleeder resistor

< the output capacitor >
3.11

3
A-004-004-007
****
The output capacitor, in a power supply filter used to provide power for an SSB or CW transmitter, will give better dynamic regulation if:

- the negative terminal of the electrolytic capacitor is connected to the positive and the positive terminal to ground
- a battery is placed in series with the output capacitor
- it is placed in series with other capacitors
- the output capacitance is increased

< the output capacitance is increased >
3.11

3
A-004-004-008
****
In a regulated power supply, four diodes connected together in a BRIDGE act as:

- equalization across the transformer
- matching between the secondary of the power transformer and the filter
- a rectifier
- a tuning network

< a rectifier >
3.7

3
A-004-004-009
****
In a regulated power supply, components that conduct alternating current at the input before the transformer and direct current before the output are:

- capacitors
- diodes
- fuses
- chokes

< fuses >
3.15

3
A-004-004-010
****
In a regulated power supply, the output of the electrolytic filter capacitor is connected to the:

- voltage regulator
- pi filter
- solid-state by-pass circuit
- matching circuit for the load

< voltage regulator >
3.11.3

3
A-004-004-011
****
In a regulated power supply, a diode connected across the input and output terminals of a regulator is used to:

- provide an RF by-pass for the voltage control
- provide additional capacity
- protect the regulator from voltage fluctuations in the primary of the transformer
- protect the regulator from reverse voltages

< protect the regulator from reverse voltages >
3.11.3

Transmitters, Modulation and Processing - 005

5-1 Oscillator circuits, phase locked loop (PLL)

7
A-005-001-001
****
How is the positive feedback coupled to the input in a Hartley oscillator?

- Through a tapped coil
- Through a capacitive divider
- Through link coupling
- Through a neutralizing capacitor

< Through a tapped coil >
7.3.1

7
A-005-001-002
****
How is positive feedback coupled to the input in a Colpitts oscillator?

- Through a tapped coil
- Through a neutralizing capacitor
- Through a link coupling
- Through a capacitive divider

< Through a capacitive divider >
7.2.2

7
A-005-001-003
****
How is positive feedback coupled to the input in a Pierce oscillator?

- Through a neutralizing capacitor
- Through link coupling
- Through capacitive coupling
- Through a tapped coil

< Through capacitive coupling >
7.2.1

7
A-005-001-004
****
Why is the Colpitts oscillator circuit commonly used in a VFO?

- It can be used with or without crystal lock-in
- It is stable
- The frequency is a linear function with load impedance
- It has high output power

< It is stable >
7.2.2

7
A-005-001-005
****
Why must a very stable reference oscillator be used as part of a phase-locked loop (PLL) frequency synthesizer?

- Any phase variations in the reference oscillator signal will produce harmonic distortion in the modulating signal
- Any phase variations in the reference oscillator signal will produce phase noise in the synthesizer output
- Any amplitude variations in the reference oscillator signal will prevent the loop from changing frequency
- Any amplitude variations in the reference oscillator signal will prevent the loop from locking to the desired signal

< Any phase variations in the reference oscillator signal will produce phase noise in the synthesizer output >
7.4

7
A-005-001-006
****
Positive feedback from a capacitive divider indicates the oscillator type is:

- Pierce
- Hartley
- Miller
- Colpitts

< Colpitts >
7.2.2

7
A-005-001-007
****
In an RF oscillator circuit designed for high stability, the positive feedback is drawn from two capacitors connected in series. These two capacitors would most likely be:

- ceramic
- electrolytics
- Mylar
- silver mica

< silver mica >
7.1

7
A-005-001-008
****
In an oscillator circuit where positive feedback is obtained through a single capacitor in series with the crystal, the type of oscillator is:

- Colpitts
- Hartley
- Miller
- Pierce

< Pierce >
7.2.1

7
A-005-001-009
****
A circuit depending on positive feedback for its operation would be a:

- mixer
- detector
- variable-frequency oscillator
- audio amplifier

< variable-frequency oscillator >
7.1

9
A-005-001-010
****
An apparatus with an oscillator and a class C amplifier would be:

- a two-stage CW transmitter
- a fixed-frequency single-sideband transmitter
- a two-stage frequency-modulated transmitter
- a two-stage regenerative receiver

< a two-stage CW transmitter >
9.3

7
A-005-001-011
****
In an oscillator where positive feedback is provided through a capacitor in series with a crystal, that type of oscillator is a:

- Colpitts
- Hartley
- Franklin
- Pierce

< Pierce >
7.2.1

5-2 RF power amplifiers

9
A-005-002-001
****
The output tuning controls on a transmitter power amplifier with an adjustable PI network:

- allow switching to different antennas
- allow efficient transfer of power to the antenna
- reduce the possibility of cross-modulation in adjunct receivers
- are involved with frequency multiplication in the previous stage

< allow efficient transfer of power to the antenna >
9.1.5

4
A-005-002-002
****
The purpose of using a centre-tap return connection on the secondary of transmitting tube's filament transformer is to:

- prevent modulation of the emitted wave by the alternating current filament supply
- reduce the possibility of harmonic emissions
- keep the output voltage constant with a varying load
- obtain optimum power output

< prevent modulation of the emitted wave by the alternating current filament supply >
4.16

4
A-005-002-003
****
In a grounded grid amplifier using a triode vacuum tube, the input signal is applied to:

- the cathode
- the plate
- the control grid
- the filament leads

< the cathode >
4.16

4
A-005-002-004
****
In a grounded grid amplifier using a triode vacuum tube, the plate is connected to the pi-network through a:

- by-pass capacitor
- tuning capacitor
- electrolytic capacitor
- blocking capacitor

< blocking capacitor >
4.16

4
A-005-002-005
****
In a grounded grid amplifier using a triode vacuum tube, the plate is connected to a radio frequency choke. The other end of the radio frequency choke connects to the:

- filament voltage
- B+ (high voltage)
- ground
- B- (bias)

< B+ (high voltage) >
4.16

4
A-005-002-006
****
In a grounded grid amplifier using a triode vacuum tube, the cathode is connected to a radio frequency choke. The other end of the radio frequency choke connects to the:

- ground
- filament voltage
- B- (bias)
- B+ (high voltage)

< B- (bias) >
4.16

4
A-005-002-007
****
In a grounded grid amplifier using a triode vacuum tube, the secondary winding of a transformer is connected directly to the vacuum tube. This transformer provides:

- B- (bias)
- B+ (high voltage)
- Screen voltage
- filament voltage

< filament voltage >
4.16

4, 1
A-005-002-008
****
In a grounded grid amplifier using a triode vacuum tube, what would be the approximate B+ voltage required for an output of 400 watts at 400 mA with approximately 50 percent efficiency?

- 500 volts
- 2000 volts
- 3000 volts
- 1000 volts

< 2000 volts >
4.16, 1.2

4
A-005-002-009
****
In a grounded grid amplifier using a triode vacuum tube, each side of the filament is connected to a capacitor whose other end is connected to ground. These are:

- tuning capacitors
- by-pass capacitors
- electrolytic capacitors
- blocking capacitors

< by-pass capacitors >
4.16

4
A-005-002-010
****
After you have opened a VHF power amplifier to make internal tuning adjustments, what should you do before you turn the amplifier on?

- Make sure that the power interlock switch is bypassed so you can test the amplifier
- Be certain all amplifier shielding is fastened in place
- Be certain no antenna is attached so that you will not cause any interference
- Remove all amplifier shielding to ensure maximum cooling

< Be certain all amplifier shielding is fastened in place >
4.16

9
A-005-002-011
****
Harmonics produced in an early stage of a transmitter may be reduced in a later stage by:

- larger value coupling capacitors
- greater input to the final stage
- tuned circuit coupling between stages
- transistors instead of tubes

< tuned circuit coupling between stages >
9.7

5-3 Transmitters, neutralization

9
A-005-003-001
****

In a simple 2 stage CW transmitter circuit, the oscillator stage and the class C amplifier stage are inductively coupled by a RF transformer. Another role of the RF transformer is to:

- act as part of a pi filter
- be part of a tuned circuit
- provide the necessary feedback for oscillation
- act as part of a balanced mixer

< be part of a tuned circuit >
9.3

9
A-005-003-002
****

In a simple 2 stage CW transmitter, current to the collector of the transistor in the class C amplifier stage flows through a radio frequency choke (RFC) and a tapped inductor. The RFC, on the tapped inductor side, is also connected to grounded capacitors. The purpose of the RFC and capacitors is to:

- provide negative feedback
- form a low-pass filter
- form a key-click filter
- form a RF-tuned circuit

< form a low-pass filter >
9.3

9
A-005-003-003
****

In a simple 2 stage CW transmitter, the transistor in the second stage would act as:

- a frequency multiplier
- the master oscillator
- a power amplifier
- an audio oscillator

< a power amplifier >
9.3

9
A-005-003-004
****
An advantage of keying the buffer stage in a transmitter is that:

- key clicks are eliminated
- changes in oscillator frequency are less likely
- the radiated bandwidth is restricted
- high RF voltages are not present

< changes in oscillator frequency are less likely >
9.3

4,7
A-005-003-005
****
As a power amplifier is tuned, what reading on its grid-current meter indicates the best neutralization?

- Minimum grid current
- A minimum change in grid current as the output circuit is changed
- Maximum grid current
- A maximum change in grid current as the output circuit is changed

< A minimum change in grid current as the output circuit is changed >
1st Ed. - 4.14, 7.7; 2nd Ed. - 4.14, 7.8

4,7
A-005-003-006
****
What does a neutralizing circuit do in an RF amplifier?

- It eliminates AC hum from the power supply
- It cancels the effects of positive feedback
- It reduces incidental grid modulation
- It controls differential gain

< It cancels the effects of positive feedback >
1st Ed. - 7.7; 2nd Ed. - 7.8

4,7
A-005-003-007
****
What is the reason for neutralizing the final amplifier stage of a transmitter?

- To limit the modulation index
- To cut off the final amplifier during standby periods
- To keep the carrier on frequency
- To eliminate parasitic oscillations

< To eliminate parasitic oscillations >
1st Ed. - 4.14, 7.7; 2nd Ed. - 4.14,7.8

4,7
A-005-003-008
****
Parasitic oscillations are usually generated due to:

- harmonics from some earlier multiplier stage
- excessive drive or excitation to the power amplifier
- accidental resonant frequencies in the power amplifier
- a mismatch between power amplifier and transmission line

< accidental resonant frequencies in the power amplifier >
1st Ed. - 4.14,7.7; 2nd Ed. - 4.14,7.8

4,7
A-005-003-009
****
Parasitic oscillations would tend to occur mostly in:

- high gain audio output stages
- high voltage rectifiers
- mixer stages
- RF power output stages

< RF power output stages >
1st Ed. - 4.14,7.7; 2nd Ed. - 4.14,7.8

4,7
A-005-003-010
****
Why is neutralization necessary for some vacuum-tube amplifiers?

- To reduce grid-to-cathode leakage
- To cancel oscillation caused by the effects of interelectrode capacitance
- To cancel AC hum from the filament transformer
- To reduce the limits of loaded Q

< To cancel oscillation caused by the effects of interelectrode capacitance >
1st Ed. - 4.14,7.7; 2nd Ed. - 4.14,7.8

4,7
A-005-003-011
****
Parasitic oscillations in an RF power amplifier may be caused by:

- overdriven stages
- poor voltage regulation
- lack of neutralization
- excessive harmonic production

< lack of neutralization >
1st Ed. - 4.14,7.7; 2nd Ed. - 4.14,7.8

5-4 AM, single sideband, linearity, two-tone test

9
A-005-004-001
****
What type of signal does a balanced modulator produce?

- FM with balanced deviation
- Double sideband, suppressed carrier
- Full carrier
- Single sideband, suppressed carrier

< Double sideband, suppressed carrier >
9.5

9
A-005-004-002
****
How can a single-sideband phone signal be produced?

- By driving a product detector with a DSB signal
- By using a loop modulator followed by a mixer
- By using a balanced modulator followed by a filter
- By using a reactance modulator followed by a mixer

< By using a balanced modulator followed by a filter >
9.6

9
A-005-004-003
****
Carrier suppression in a single-sideband transmitter takes place in:

- the carrier decouple stage
- the balanced modulator stage
- the mechanical filter
- the frequency multiplier stage

< the balanced modulator stage >
9.5

9
A-005-004-004
****
Transmission with SSB, as compared to conventional AM transmission, results in:

- 6 dB gain in the receiver
- 6 dB gain in the transmitter and 3 dB gain in the receiver
- a greater bandpass requirement in the receiver
- 3 db gain in the transmitter

< 6 dB gain in the transmitter and 3 dB gain in the receiver >
9.6

11
A-005-004-005
****
The peak power output of a single-sideband transmitter, when being tested by a two-tone generator is:

- equal to the RF peak output power of any of the tones
- one-half of the RF peak output power of any of the tones
- twice the RF power output of any of the tones
- one-quarter of the RF peak output power of any of the tones

< twice the RF power output of any of the tones >
11.6.3

11
A-005-004-006
****
What kind of input signal is used to test the amplitude linearity of a single-sideband phone transmitter while viewing the output on an oscilloscope?

- An audio-frequency sine wave
- Two audio-frequency sine waves
- An audio-frequency square wave
- Normal speech

< Two audio-frequency sine waves >
11.6.3

11
A-005-004-007
****
When testing the amplitude linearity of a single-sideband transmitter what audio tones are fed into the microphone input and on what kind of instrument is the output observed?

- Two non-harmonically related tones are fed in, and the output is observed on an oscilloscope
- Two harmonically related tones are fed in, and the output is observed on an oscilloscope
- Two harmonically related tones are fed in, and the output is observed on a distortion analyzer
- Two non-harmonically related tones are fed in, and the output is observed on a distortion analyzer

< Two non-harmonically related tones are fed in, and the output is observed on an oscilloscope >
11.6.3

11
A-005-004-008
****

What audio frequencies are used in a two-tone test of the linearity of a single-sideband phone transmitter?

- 20 Hz and 20 kHz tones must be used
- 1200 Hz and 2400 Hz tones must be used
- Any two audio tones may be used, but they must be within the transmitter audio passband, and must be harmonically related
- Any two audio tones may be used, but they must be within the transmitter audio passband, and should not be harmonically related

< Any two audio tones may be used, but they must be within the transmitter audio passband, and should not be harmonically related >
11.6.3

11
A-005-004-009
****

What measurement can be made of a single-sideband phone transmitter's amplifier by performing a two-tone test using an oscilloscope?

- Its frequency deviation
- Its percent of carrier phase shift
- Its linearity
- Its percent of frequency modulation

< Its linearity >
11.6.3

9
A-005-004-010
****

How much is the carrier suppressed below peak output power in a single-sideband phone transmission?

- At least 40 dB
- No more than 20 dB
- No more than 30 dB
- At least 60 dB

< At least 40 dB >
9.5

9
A-005-004-011
****
What is meant by “flat-topping” in a single-sideband phone transmission?

- Signal distortion caused by excessive drive
- Signal distortion caused by insufficient collector current
- The transmitter’s automatic level control is properly adjusted
- The transmitter’s carrier is properly suppressed

< Signal distortion caused by excessive drive >
9.6

5-5 FM deviation, modulation index, deviation ratio, deviation meter

9
A-005-005-001
****
In an FM phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency, what is the modulation index, when the modulating frequency is 1000 Hz?

- 3
- 0.3
- 3000
- 1000

< 3 >
9.2.2

9
A-005-005-002
****
What is the modulation index of an FM phone transmitter producing an instantaneous carrier deviation of 6 kHz when modulated with a 2 kHz modulating frequency?

- 0.333
- 2000
- 3
- 6000

< 3 >
9.2.2

9
A-005-005-003
****
What is the deviation ratio of an FM phone transmitter having a maximum frequency swing of plus or minus 5 kHz and accepting a maximum modulation rate of 3 kHz?

- 60
- 0.16
- 0.6
- 1.66

< 1.66 >
9.2.2

9
A-005-005-004
****
What is the deviation ratio of an FM phone transmitter having a maximum frequency swing of plus or minus 7.5 kHz and accepting a maximum modulation rate of 3.5 kHz?

- 0.47
- 2.14
- 47
- 0.214

< 2.14 >
9.2.2

9
A-005-005-005
****
When the transmitter is not modulated, or the amplitude of the modulating signal is zero, the frequency of the carrier is called its:

- frequency deviation
- frequency shift
- modulating frequency
- centre frequency

< centre frequency >
9.2.2

9
A-005-005-006
****
In a FM transmitter system, the amount of deviation from the centre frequency is determined solely by the:

- amplitude of the modulating frequency
- frequency of the modulating frequency
- amplitude and the frequency of the modulating frequency
- modulating frequency and the amplitude of the centre frequency

< amplitude of the modulating frequency >
9.2.2

9
A-005-005-007
****
Any FM wave with single-tone modulation has:

- two sideband frequencies
- four sideband frequencies
- one sideband frequency
- an infinite number of sideband frequencies

< an infinite number of sideband frequencies >
9.7

11
A-005-005-008
****
Some types of deviation meters work on the principle of:

- detecting the frequencies in the sidebands
- the amplitude of power in the sidebands
- a carrier null and multiplying the modulation frequency by the modulation index
- a carrier peak and dividing by the modulation index

< a carrier null and multiplying the modulation frequency by the modulation index >
11.8

11
A-005-005-009
****
When using some deviation meters, it is important to know:

- modulating frequency and the modulation index
- modulation index
- modulating frequency
- pass-band of the IF filter

< modulating frequency and the modulation index >
11.8

9
A-005-005-010
****
What is the significant bandwidth of an FM-phone transmission having a +/- 5-kHz deviation and a 3-kHz modulating frequency?

- 8 kHz
- 5 kHz
- 16 kHz
- 3 kHz

< 16 kHz >
9.2.2

When a carrier is frequency modulated, a series of sidebands are generated at multiples of the modulating frequency from the carrier's rest frequency. The amplitude and phase of these sidebands depends on the modulation index. FM also causes the carrier to change in amplitude and phase and it may, under some circumstances, disappear completely.

We have to use the formula in S9.2.2, which is called Carson's Rule.

BW = 2(deviation + f_m) where f_m is the modulating frequency.

Using the data we have been given, 5-kHz deviation and a 3-kHz modulating frequency, and the formula above we get the following:

BW = 2(5 + 3) = 16 kHz.

9
A-005-005-011
****
What is the frequency deviation for a 12.21-MHz reactance-modulated oscillator in a +/- 5-kHz deviation, 146.52-MHz FM-phone transmitter?

- +/- 12 kHz
- +/- 5 kHz
- +/- 416.7 Hz
- +/- 41.67 Hz

< +/- 416.7 Hz >
9.2.2

The deviation is increased by the same amount as the frequency, so if you double the frequency you also double the deviation. In this question the oscillator frequency, 12.21 MHz, is multiplied by 12 to get to 146.52 MHz. So the deviation at the modulator will be 12 times the deviation in the oscillator. Since you want 5 kHz deviation in the modulator, the deviation in the oscillator will have be one-twelfth of the deviation in the modulator. Doing the math, we get 5 kHz/12 = 0.416666 kHz. Rounding up and converting to Hz we get 416.7 Hz.

5-6 FM transmitter, repeater circuits

8
A-005-006-001
****
If the signals of two repeater transmitters mix together in one or both of their final amplifiers and unwanted signals at the sum and difference frequencies of the original signals are generated, what is this called?

- Neutralization
- Intermodulation interference
- Adjacent channel interference
- Amplifier desensitization

< Intermodulation interference >
8.9

8
A-005-006-002
****
How does intermodulation interference between two repeater transmitters usually occur?

- When the signals are reflected in phase by aircraft passing overhead
- When they are in close proximity and the signals cause feedback in one or both of their final amplifiers
- When they are in close proximity and the signals mix in one or both of their final amplifiers
- When the signals are reflected out of phase by aircraft passing overhead

< When they are in close proximity and the signals mix in one or both of their final amplifiers >
8.9

12
A-005-006-003
****
How can intermodulation interference between two repeater transmitters in close proximity often be reduced or eliminated?

- By installing a low-pass filter in the antenna transmission line
- By installing a high-pass filter in the antenna transmission line
- By installing a terminated circulator or ferrite isolator in the transmission line to the transmitter and duplexer
- By using a Class C final amplifier with high driving power

< By installing a terminated circulator or ferrite isolator in the transmission line to the transmitter and duplexer >
12.2

8
A-005-006-004
****
If a receiver tuned to 146.70 MHz receives an intermodulation product signal whenever a nearby transmitter transmits on 146.52, what are the two most likely frequencies for the other interfering signal?

- 146.88 MHz and 146.34 MHz
- 146.01 MHz and 147.30 MHz
- 73.35 MHz and 239.40 MHz
- 146.34 MHz and 146.61 MHz

< 146.34 MHz and 146.61 MHz >
8.9

As a first step, you should be aware that intermodulation interference arises when two frequencies, usually from separate sources, are mixed together in some non-linear device leading to undesired sum and difference frequencies being created. The `non-linear device` *in this case is usually not intended to be a radio device and may be as simple as a corroded downspout or fence wire connection. Usually, but not always, fairly strong signals are required, such as near a repeater site which has many transmitters.*

In any case, the first problem you have is to find the probable interfering frequencies so you can isolate the transmitters.

You need to take advantage of the fact that you are looking for either a sum or a difference of frequencies, or their harmonics. That is, you have to find some integer multiple of one frequency that added or subtracted to an integer multiple of the other frequency will give the frequency of the interfering signal. Fortunately, it isn't as hard as it sounds!

You have two of the three frequencies given in the question:

• the first interfering frequency is 146.52 MHz

• the resultant Intermodulation product is 146.70 MHz

From the ARRL Handbook, page 8.20, we have the following.

"If multiple frequencies are present in the modulation, however, then intermodulation distortion (IMD) products are produced. IMD occurs when a nonlinear amplifier or other device acts as a mixer, producing sum and difference frequencies of all the pairs of frequencies and their harmonics. For example if two frequencies, F1 and F2 > F1, are present, then IMD will cause spurious frequencies to appear at F1 + F2, F2 – F1, 2F1, 2F2, 2F1 –F2, 2F2 – F1, 2F2 – 2F1, 3F1, 3F2, and so on."

Now set up the equation to solve the question, where the two underlined products are going to be used to solve our problem.

There are a couple of useful tricks that you can use here. First, since the frequencies are so close to each other, either m or n will probably be 1 and the other will be 2. Higher orders are possible but keep it as simple as possible initially. Second, ISED has indicated in the possible answers that both frequencies are Amateur frequencies. This simplifies where you will have to look because higher order harmonics are less likely to fall in an Amateur band. So, let's try m = 2 and n =1 for a start.

Using 2F1-F2 as shown above as a possible combination, we have

$2 \times 146.52 - f_2 = 146.70$

$293.04 - f_2 = 146.70$

$293.04 - 146.70 = f_2$

$f_2 = 146.34$

This is part of answer < 146.34 MHz and 146.61 MHz >. Now check your result by finding the other possible interfering frequency. Hint: try letting m=1 and n=2.

Now, try the other underlined combination, 2F2-F1

$2 \times f_2 - 1 \times f_1 = 146.70$

$f_2 = (146.70 + 146.52) / 2$

$f_2 = 146.61$ MHz

This is the other half of answer < 146.34 MHz and 146.61 MHz >.

9
A-005-006-005
****
What type of circuit varies the tuning of an amplifier tank circuit to produce FM signals?

- A phase modulator
- A balanced modulator
- A double balanced mixer
- An audio modulator

< A phase modulator >
9.7

9
A-005-006-006
****
What audio shaping network is added at an FM transmitter to attenuate the lower audio frequencies?

- An audio prescaler
- A heterodyne suppressor
- A pre-emphasis network
- A de-emphasis network

< A pre-emphasis network >
9.7

12
A-005-006-007
****
Which type of filter would be best to use in a 2-metre repeater duplexer?

- A DSP filter
- A cavity filter
- An L-C filter
- A crystal filter

< A cavity filter >
12.2, 1.16

9
A-005-006-008
****
The characteristic difference between a phase modulator and a frequency modulator is:

- pre-emphasis
- the centre frequency
- de-emphasis
- frequency inversion

< pre-emphasis >
9.7

9
A-005-006-009
****
In most modern FM transmitters, to produce a better sound, a compressor and a clipper are placed:

- between the multiplier and the PA
- between the modulator and the oscillator
- in the microphone circuit, before the audio amplifier
- between the audio amplifier and the modulator

< between the audio amplifier and the modulator >
9.8.1, 9.8.2

9
A-005-006-010
****
Three important parameters to be verified in an FM transmitter are:

- power, frequency deviation and frequency stability
- distortion, bandwidth and sideband power
- modulation, pre-emphasis and carrier suppression
- frequency stability, de-emphasis and linearity

< power, frequency deviation and frequency stability >
9.1, 9.2.2

9
A-005-006-011
****
Intermodulation interference products are not typically associated with which of the following:

- intermediate frequency stage
- final amplifier stage
- receiver front end
- passive intermodulation

< intermediate frequency stage >
9.7

5-7 Signal processing - AF, IF, and RF

9
A-005-007-001
****
Maintaining the peak RF output of a SSB transmitter at a relatively constant level requires a circuit called the:

- automatic level control (ALC)
- automatic gain control (AGC)
- automatic output control (AOC)
- automatic volume control (AVC)

< automatic level control (ALC) >
9.8.2

9
A-005-007-002
****
Speech compression associated with SSB transmission implies:

- full amplification of low level signals and reducing or eliminating amplification of high level signals
- full amplification of high level signals and reducing or eliminating signals amplification of low level
- a lower signal-to-noise ratio
- circuit level instability

< full amplification of low level signals and reducing or eliminating amplification of high level signals >
9.8.2

13
A-005-007-003
****
Which of the following functions is <u>not</u> included in a typical digital signal processor?

- Aliasing amplifier
- Analog to digital converter
- Digital to analog converter
- Mathematical transform

< Aliasing amplifier >
13.2

13
A-005-007-004
****
How many bits are required to provide 256 discrete levels, or a ratio of 256:1?

- 6 bits
- 16 bits
- 8 bits
- 4 bits

< 8 bits >
13.3

13
A-005-007-005
****
Adding one bit to the word length, is equivalent to adding ________ dB to the dynamic range of the digitizer:

- 1 dB
- 4 dB
- 6 dB
- 3 dB

< 6 dB >
13.3

13
A-005-007-006
****
What do you call the circuit which employs an analog to digital converter, a mathematical transform, a digital to analog converter and a low pass filter?

- Digital formatter
- Mathematical transformer
- Digital signal processor
- Digital transformer

< Digital signal processor >
13.2

7
A-005-007-007
****
Which principle is not associated with analog signal processing?

- Compression
- Frequency division
- Bandwidth limiting
- Clipping

< Frequency division >
7.5, 5.11

This is a classic wrong number question and frankly we hate them as much as you do!

The best way to attack this type of question, even if you think you have already spotted the odd one out, is to check each possible answer choice. In this case we are looking for processes that change an analogue signal waveform in some way.

Compression increases or decreases the amplitude of the signal waveform at various points to maintain as constant an amplitude as possible. This is signal processing.

Frequency division does not change the signal waveform in any way; it changes the base frequency or rate at which the wave form is presented. This is not signal processing.

Bandwidth limiting changes the waveform of a signal by eliminating frequencies outside the desired range. This is signal processing.

Clipping chops the peaks off portions of the signal waveform that exceed a particular amplitude. This changes the waveform and is signal processing.

Frequency division is not a signal processing technique, analog or otherwise. We discuss frequency division in Chapter 5 when we discuss shift registers in 5.11 and also in several places in Chapter 7; look at 7.5 for example.

As you probably already suspected, < frequency division > is the correct answer.

7
A-005-007-008
****
Which of the following is not a method used for peak limiting, in a signal processor?

- RF clipping
- Frequency clipping
- Compression
- AF clipping

< Frequency clipping >
7.5, 5.11 and 9.8

This is one of those questions where you have to eliminate everything to get the answer.

9
A-005-007-009
****
What is the undesirable result of AF clipping in a speech processor?

- Reduced average power
- Increased average power
- Increased harmonic distortion
- Reduction in peak amplitude

< Increased harmonic distortion >
9.8.1

9
A-005-007-010
****
Which description is <u>not</u> correct? You are planning to build a speech processor for your transceiver. Compared to AF clipping, RF clipping:

- has less distortion
- is more expensive to implement
- is more difficult to implement
- is easier to implement

< is easier to implement >
9.8.1, 9.8.2

We think this question is wrong. They mean "compression", NOT "clipping" and this is covered in S9.8.2. RF clipping would result in massive interference to everyone on the bands, much like splatter. RF Compression is easier to do. That said, give ISED the answer they want.

9
A-005-007-011
****
Automatic Level Control (ALC) is another name for:

- RF compression
- AF compression
- RF clipping
- AF clipping

< RF compression >
9.8.2

5-8 Codes and protocols, Baudot, ASCII, parity, CRC, X.25, ISO layers

6
A-005-008-001
****

What digital code consists of elements having unequal lengths?

- Baudot
- ASCII
- Varicode
- AX.25

< Varicode >
1st Ed. – see below; 2nd Ed. – S6.8

Add the following to S6.8 after the third paragraph in Section 6.8. Varicode is a Huffman code for use in PSK31. It supports all ASCII characters, but the characters used most frequently have unequal lengths. The space between characters is indicated by a 00 sequence, a variation of Fibonacci coding. Originally created for speeding up real-time keyboard-to-keyboard exchanges over low bandwidth links, it is a very useful format to shrink text files..

6
A-005-008-002 (New Question)
****

Open Systems Interconnection (OSI) model standardizes communications functions as layers within a data communications system. Amateur digital radio systems often follow the OSI model in structure. What is the base layer of the OSI model involving the interconnection of a packet radio TNC to a computer terminal?

- The link layer
- The physical layer
- The network layer
- The transport layer

< The physical layer >
6.11

6
A-005-008-003
****

What is the purpose of a Cyclic Redundancy Check (CRC)?

- Lossy compression
- Error correction
- Lossless compression
- Error detection

< Error detection >
1st Ed. – see below; 2nd Ed – S10.3

Add to S10.3: A CRC, used for error checking, is generated using one of a class of mathematical algorithms called hash functions. A hash function is any algorithm that maps data of arbitrary length to a fixed length.

A hash is not reversible; that is, given the hash you cannot reconstruct original data.

6
A-005-008-004
****
What is one advantage of using ASCII rather than Baudot code?

- It includes both upper and lower case text characters in the code
- ASCII includes built-in error correction
- ASCII characters contain fewer information bits
- The larger character set allows store-and-forward

< It includes both upper and lower case text characters in the code >
6.8

10
A-005-008-005
****
What type of error control system is used in AMTOR ARQ (Mode A)?

- The receiving station checks the frame check sequence (FCS) against the transmitted FCS
- Each character is sent twice
- The receiving station automatically requests repeats when needed
- Mode A AMTOR does not include an error control system

< The receiving station automatically requests repeats when needed >
10.4

10
A-005-008-006
****
What error-correction system is used in AMTOR FEC (Mode B)?

- Mode B AMTOR does not include an error-correction system
- The receiving station automatically requests repeats when needed
- The receiving station checks the frame check sequence (FCS) against the transmitted FCS
- Each character is sent twice

< Each character is sent twice >
10.4

6
A-005-008-007
****
APRS (Automatic Packet Reporting System) does NOT support which one of these functions?

- Automatic link establishment
- Two-way messaging
- Telemetry
- Amateur-specific local information broadcast

< Automatic link establishment >
1st Ed.-see below; 2nd Ed. S10.6

Add as S10.8: Automatic Packet Reporting System (APRS) is an amateur radio-based system for real time tactical digital communications of information of immediate value in the local area. In addition, all such data is ingested into the APRS Internet System (APRS-IS) and distributed globally for ubiquitous and immediate access. Along with messages, alerts, announcements, and bulletins, the most visible aspect of APRS is its map display. Anyone may place any object or information on his or her map, and it is distributed to all maps of all users in the local RF network or monitoring the area via the Internet. Any station, radio, or object that has an attached GPS is automatically tracked. Other prominent map features are weather stations, alerts and objects and other map-related amateur radio volunteer activities including Search and Rescue and signal direction finding. As a multi-user data network, it is quite different from conventional packet radio in that it does not automatically establish links. Rather than using connected data streams where stations connect to each other and packets are acknowledged and retransmitted if lost, APRS operates entirely in an unconnected broadcast fashion, using unnumbered AX.25 frames.

A-005-008-008
****

Which algorithm may be used to create a Cyclic Redundancy Check (CRC)?

- Convolution code
- Lempel-Ziv routine
- Hash function
- Dynamic Huffman code

< Hash function >
1st Ed. – see below; 2nd Ed. – S10.3

*Add to S10.3: A **hash function** is any <u>algorithm</u> that maps <u>data</u> of arbitrary length to data of a fixed length. The values returned by a hash function are called **hash values, hash codes, hash sums,** <u>checksums</u> or simply **hashes**.*

A-005-008-009
****

The designator AX.25 is associated with which amateur radio mode?

- Packet
- RTTY
- ASCII
- Spread spectrum speech

< Packet >
6.7

6
A-005-008-010
****
How many information bits are included in the Baudot code?

- 7
- 5
- 8
- 6

< 5 >
6.8

6
A-005-008-011
****
How many information bits are included in the ISO-8859 extension to the ASCII code?

- 8
- 7
- 6
- 5

< 8 >
6.8

The question asks you how many information (data) bits are included in the ASCII code. When it was first defined and approved by the US National Bureau of Standards in the early 1970's computers were not as endemic as they are now. The primary use of ASCII was on Teletype machines which used 8-bit transmission with one bit reserved for a parity (error checking) bit. Thus ANSI defined the ASCII code as a 7-bit code. Some implementations were limited to 6-bits, which is adequate for character and number only transmission in most western languages. It was not until the personal computer became common with its 8-bit word length that ASCII was commonly extended to 8-bit. Since the given answer to the question is 8-bit, we suggest that you just memorize it and keep the other choices in your mind as interesting history!

5-9 Spread spectrum - frequency hopping, direct sequence

6
A-005-009-001
****
What term describes a wide-band communications system in which the RF carrier varies according to some predetermined sequence?

- Spread spectrum communication
- Amplitude-companded single sideband
- AMTOR
- Time domain frequency modulation

< Spread spectrum communication >
6.5

6
A-005-009-002
****
What is the term used to describe a spread spectrum communications system where the centre frequency of a conventional carrier is changed many times per second in accordance with a pseudorandom list of channels?

- Direct sequence
- Time-domain frequency modulation
- Frequency companded spread spectrum
- Frequency hopping

< Frequency hopping >
6.5

6
A-005-009-003
****
What term is used to describe a spread spectrum communications system in which a very fast binary bit stream is used to shift the phase of an RF carrier?

- Frequency hopping
- Phase companded spread spectrum
- Direct sequence
- Binary phase-shift keying

< Direct sequence >
6.5

6
A-005-009-004
****
Frequency hopping is used with which type of transmission?

- Spread spectrum
- AMTOR
- Packet
- RTTY

< Spread spectrum >
6.5

6
A-005-009-005
****
Direct sequence is used with which type of transmission?

- Spread spectrum
- AMTOR
- Packet
- RTTY

< Spread spectrum >
6.5

6
A-005-009-006
****
Which type of signal is used to produce a predetermined alteration in the carrier for spread spectrum communication?

- Frequency-companded sequence
- Quantizing noise
- Pseudo-random sequence
- Random noise sequence

< Pseudo-random sequence >
6.5

6
A-005-009-007
****
Why is it difficult to monitor a spread spectrum transmission?

- It requires narrower bandwidth than most receivers have
- It varies too quickly in amplitude
- The signal is too distorted for comfortable listening
- Your receiver must be frequency-synchronized to the transmitter

< Your receiver must be frequency-synchronized to the transmitter >
6.5

6
A-005-009-008
****
What is frequency hopping spread spectrum?

- The carrier is amplitude-modulated over a wide range called the spread
- The carrier is frequency-companded
- The carrier frequency is changed in accordance with a pseudo-random list of channels
- The carrier is phase-shifted by a fast binary bit stream

< The carrier frequency is changed in accordance with a pseudo-random list of channels >
6.5

6
A-005-009-009
****
What is direct-sequence spread spectrum?

- The carrier is amplitude modulated over a range called the spread
- The carrier is frequency-companded
- The carrier is phase-shifted by a fast binary bit stream
- The carrier is altered in accordance with a pseudo-random list of channels

< The carrier is phase-shifted by a fast binary bit stream >
6.5

6
A-005-009-010
****
Why are received spread-spectrum signals so resistant to interference?

- The receiver is always equipped with a special digital signal processor (DSP) interference filter
- Signals not using the spectrum-spreading algorithm are suppressed in the receiver
- If interference is detected by the receiver, it will signal the transmitter to change frequencies
- The high power used by a spread-spectrum transmitter keeps its signal from being easily overpowered

< Signals not using the spectrum-spreading algorithm are suppressed in the receiver >
6.5

6
A-005-009-011
****
How does the spread-spectrum technique of frequency hopping (FH) work?

- The frequency of an RF carrier is changed very rapidly according to a particular pseudo-random sequence
- If interference is detected by the receiver, it will signal the transmitter to change frequency
- If interference is detected by the receiver, it will signal the transmitter to wait until the frequency is clear
- A pseudo-random bit stream is used to shift the phase of an RF carrier very rapidly in a particular sequence

< The frequency of an RF carrier is changed very rapidly according to a particular pseudo-random sequence >
6.5

Receivers - 006

6-1 Single, double conversion superheterodyne architecture

8
A-006-001-001
****
What are the advantages of the frequency-conversion process in a superheterodyne receiver?

- Automatic detection in the RF amplifier and increased sensitivity
- Automatic soft-limiting and automatic squelching
- Increased selectivity and optimal tuned circuit design
- Automatic squelching and increased sensitivity

< Increased selectivity and optimal tuned circuit design >
8.5

8
A-006-001-002
****
What factors should be considered when selecting an intermediate frequency?

- Image rejection and responses to unwanted signals
- Noise figure and distortion
- Interference to other services
- Cross-modulation distortion and interference

< Image rejection and responses to unwanted signals >
8.5.3

8
A-006-001-003
****
One of the greatest advantages of the double-conversion over the single-conversion receiver is that it:

- is much more stable
- is much more sensitive
- greater reduction of image interference for a given front end selectivity
- produces a louder signal at the output

< greater reduction of image interference for a given front end selectivity >
8.5.3

8
A-006-001-004
****
In a communications receiver, a crystal filter would be located in the:

- IF circuits
- local oscillator
- audio output stage
- detector

< IF circuits >
8.5.4

8
A-006-001-005
****
A multiple conversion superheterodyne receiver is more susceptible to spurious responses than a single-conversion receiver because of the:

- additional oscillators and mixing frequencies involved in the design
- poorer selectivity in the IF caused by the multitude of frequency changes
- greater sensitivity introducing higher levels of RF to the receiver
- AGC being forced to work harder causing the stages concerned to overload

< additional oscillators and mixing frequencies involved in the design >
8.5.3

8
A-006-001-006
In a dual-conversion superheterodyne receiver what are the respective aims of the first and second conversion:

- selectivity and dynamic range
- image rejection and noise figure
- image rejection and selectivity
- selectivity and image rejection

< image rejection and selectivity >
8.5.3

8
A-006-001-007
****
Which stage of a receiver has its input and output circuits tuned to the received frequency?

- The local oscillator
- The audio frequency amplifier
- The detector
- The RF amplifier

< The RF amplifier >
8.5

8
A-006-001-008
****
Which stage of a superheterodyne receiver lies between a tuneable stage and a fixed tuned stage?

- Radio frequency amplifier
- Intermediate frequency amplifier
- Local oscillator
- Mixer

< Mixer >
8.5

8
A-006-001-009
****
A single conversion receiver with a 9 MHz IF has a local oscillator operating at 16 MHz. The frequency it is tuned to is:

- 16 MHz
- 21 MHz
- 9 MHz
- 7 MHz

< 7 MHz >
8.5.2

8
A-006-001-010
****
A double conversion receiver designed for SSB reception has a beat frequency oscillator and:

- one IF stage and one local oscillator
- two IF stages and two local oscillators
- two IF stages and three local oscillators
- two IF stages and one local oscillator

< two IF stages and two local oscillators >
8.5.3

8
A-006-001-011
****
The advantage of a double conversion receiver over a single conversion receiver is that it:

- does not drift off frequency
- suffers less from image interference for a given front end sensitivity
- is a more sensitive receiver
- produces a louder audio signal

< suffers less from image interference for a given front end sensitivity >
8.5.3

6-2 Oscillators, mixers, tuning

8
A-006-002-001
****
The mixer stage of a superheterodyne receiver is used to:

- allow a number of IF frequencies to be used
- remove image signals from the receiver
- produce an audio frequency for the speaker
- change the frequency of the incoming signal to that of the IF

< change the frequency of the incoming signal to that of the IF >
8.5

8
A-006-002-002
****
A superheterodyne receiver designed for SSB reception must have a beat-frequency oscillator (BFO) because:

- the suppressed carrier must be replaced for detection
- it phases out the unwanted sideband signal
- it reduces the pass-band of the IF stages
- it beats with the receiver carrier to produce the missing sideband

< the suppressed carrier must be replaced for detection >
8.6.1

8
A-006-002-003
****
The first mixer in the receiver mixes the incoming signal with the local oscillator to produce:

- an audio frequency
- a radio frequency
- a high frequency oscillator (HFO) frequency
- an intermediate frequency

< an intermediate frequency >
8.5

8
A-006-002-004
****
If the incoming signal to the mixer is 3 600 kHz and the first IF is 9 MHz, at which one of the following frequencies would the local oscillator (LO) operate?

- 5 400 kHz
- 3 400 kHz
- 10 600 kHz
- 21 600 kHz

< 5 400 kHz >
8.5.2

8
A-006-002-005
****
The BFO is off-set slightly (500 - 1 500 Hz) from the incoming signal to the detector. This is required:

- to beat with the incoming signal
- to pass the signal without interruption
- to provide additional amplification
- to protect the incoming signal from interference

< to beat with the incoming signal >
8.4

8
A-006-002-006
****
It is very important that the oscillators contained in a superheterodyne receiver are:

- stable and spectrally pure
- sensitive and selective
- stable and sensitive
- selective and spectrally pure

< stable and spectrally pure >
8.2.3, 8.5.2

7
A-006-002-007
****
In a superheterodyne receiver, a stage before the IF amplifier has a variable capacitor in parallel with a trimmer capacitor and an inductance. The variable capacitor is for:

- tuning both the antenna and the BFO
- tuning of the beat-frequency oscillator (BFO)
- tuning both the antenna and the LO
- tuning of the local oscillator (LO)

< tuning of the local oscillator (LO) >
7.3.2, 7.3.3

First, consider the stages that can occur before the IF amplifier in a superheterodyne receiver:

- *RF amplifier stage*

- *Mixer stage*

- *Local oscillator stage*

Of these, the one that requires the closest control of its tuning is the oscillator. The input to the mixer is relatively broad banded because it must be able to accept any frequency passed by the RF amplifier; or if the receiver has no RF amplifier, from the antenna.

The RF amplifier relies upon the IF to provide band restriction of the received signal and so has relatively broad tuning.

The oscillator, on the other hand, must be very accurately on frequency and must be adjustable so that it exactly covers the band in synchronization with the dial markings. These objectives require fine tuning independent of the main frequency control capacitor. This is done with small set and forget trimmer capacitors. The capacitance of these capacitors is a small fraction of the capacitance of the main tuning capacitor, usually about 1/10 or so.

In figure 7-6 the trimmer would appear just to the left of the diode and in parallel with the tuning capacitor, before the DC blocking capacitor. In figure 7-7, the trimmer would be in parallel with the variable capacitor that is in series with the tuning coil (inductor).

8
A-006-002-008
****
In a superheterodyne receiver without an RF amplifier, the input to the mixer stage has a variable capacitor in parallel with an inductance. The variable capacitor is for:

- tuning both the antenna and the local oscillator
- tuning the beat-frequency oscillator
- tuning both the antenna and the beat-frequency oscillator
- tuning the receiver preselector to the reception frequency

< tuning the receiver preselector to the reception frequency >
8.5.5

In a previous version of the question bank, the correct answer was given as < tuning of the antenna >, *whereas now it is < tuning the receiver preselector to the reception frequency >*

Here we have to cover the difference between reality and common language! Specifically, the use of the word tuning when applied to an antenna.

First, let us refer you to a mixer circuit in a front end without an RF stage; this is shown in figure 8-10A in section 8.5.5. Notice the parallel tuned circuit connected to the antenna. It is this capacitor and tuned circuit to which the question refers.

The purpose of this tuned circuit is to select the band of RF frequencies that will be presented to the mixer. There is no way that this capacitor can tune the antenna; that is fixed by the length and physical environment of the antenna! Nonetheless, the expression tuning the antenna persists in electronic terminology.

8
A-006-002-009
****

What receiver stage combines a 14.25 MHz input signal with a 13.795 MHz oscillator signal to produce a 455-kHz intermediate frequency (IF) signal?

- BFO
- VFO
- Multiplier
- Mixer

< Mixer >
8.5

8
A-006-002-010
****

Which two stages in a superheterodyne receiver have input tuned circuits tuned to the same frequency?

- IF and local oscillator
- RF and IF
- RF and local oscillator
- RF and first mixer

< RF and first mixer >
8.5

8
A-006-002-011
****

The mixer stage of a superheterodyne receiver:

- produces an intermediate frequency
- produces spurious signals
- acts as a buffer stage
- demodulates SSB signals

< produces an intermediate frequency >
8.5

6-3 RF, IF amplifiers, selectivity

8
A-006-003-001
****
What is meant by the noise floor of a receiver?

- The weakest signal that can be detected under noisy atmospheric conditions
- The minimum level of noise that will overload the receiver RF amplifier stage
- The amount of noise generated by the receiver local oscillator
- The weakest signal that can be detected above the receiver internal noise

< The weakest signal that can be detected above the receiver internal noise >
8.2.2

8
A-006-003-002
****
Which of the following is a purpose of the first IF amplifier stage in a receiver?

- To tune out cross-modulation distortion
- To improve selectivity and gain
- To increase dynamic response
- To improve noise figure performance

< To improve selectivity and gain >
8.5

8
A-006-003-003
****
How much gain should be used in the RF amplifier stage of a receiver?

- As much gain as possible, short of self-oscillation
- Sufficient gain to allow weak signals to overcome noise generated in the first mixer stage
- It depends on the amplification factor of the first IF stage
- Sufficient gain to keep weak signals below the noise of the first mixer stage

< Sufficient gain to allow weak signals to overcome noise generated in the first mixer stage >
8.5.5

8
A-006-003-004
****
What is the primary purpose of an RF amplifier in a receiver?

- To vary the receiver image rejection by using the AGC
- To develop the AGC voltage
- To provide most of the receiver gain
- To improve the receiver noise figure

< To improve the receiver noise figure >
8.5.5

8
A-006-003-005
How is receiver sensitivity often expressed for UHF FM receivers?

- Noise Figure in decibels
- Overall gain in decibels
- RF level for 12 dB SINAD
- RF level for a given Bit Error Rate (BER)

< RF level for 12 dB SINAD >
1st Ed.-see below; 2nd Ed. – S8.2.2

Add the following information to S8.2.2, after the last paragraph. ***Signal-to-noise and distortion ratio (SINAD)*** *is a measure of the quality of a signal from a communications device, often defined as:*

SINAD = (Signal + Noise +Distortion)/(Noise + Distortion)

SINAD is usually expressed in dB and is quoted alongside the receiver RF sensitivity, to give a quantitative evaluation of the receiver sensitivity. By convention, the minimum acceptable SINAD level that will not swamp intelligible speech in an FM receiver is 12 dB.

8
A-006-003-006
****
What is the term used for the decibel difference (or ratio) between the largest tolerable receiver input signal (without causing audible distortion products) and the minimum discernible signal (sensitivity)?

- Design parameter
- Dynamic range
- Stability
- Noise figure

< Dynamic range >
8.2.2

8
A-006-003-007
****
The lower the receiver noise figure becomes, the greater will be the receiver's _________ :

- rejection of unwanted signals
- selectivity
- sensitivity
- stability

< sensitivity >
8.2.2

8
A-006-003-008
****
The noise generated in a receiver of good design originates in the:

- detector and AF amplifier
- BFO and detector
- RF amplifier and mixer
- IF amplifier and detector

< RF amplifier and mixer >
8.2.2

8
A-006-003-009
****
Why are very low noise figures relatively unimportant for a high frequency receiver?

- Ionospheric distortion of the received signal creates high noise levels
- External HF noise, man-made and natural, are higher than the internal noise generated by the receiver
- The use of SSB and CW on the HF bands overcomes the noise
- Regardless of the front end, the succeeding stages when used on HF are very noisy

< External HF noise, man-made and natural, are higher than the internal noise generated by the receiver >
8.2.2

8
A-006-003-010
****
The term which relates specifically to the amplitude levels of multiple signals that can be accommodated during reception is called:

- dynamic range
- AGC
- cross-modulation index
- noise figure

< dynamic range >
8.2.2

8
A-006-003-011
****
Normally, front-end selectivity is provided by the resonant networks both before and after the RF stage in a superheterodyne receiver. This whole section of the receiver is often referred to as the:

- preamble
- preamplifier
- pass-selector
- preselector

< preselector >
8.5.1

6-4 Detection, audio, automatic gain control

8
A-006-004-001
****
What audio shaping network is added at an FM receiver to restore proportionally attenuated lower audio frequencies?

- A pre-emphasis network
- A de-emphasis network
- An audio prescaler
- A heterodyne suppressor

< A de-emphasis network >
8.7

8
A-006-004-002
****
What does a product detector do?

- It provides local oscillations for input to a mixer
- It amplifies and narrows band-pass frequencies
- It detects cross-modulation products
- It mixes an incoming signal with a locally generated carrier

< It mixes an incoming signal with a locally generated carrier >
8.6.1

8
A-006-004-003
****
Distortion in a receiver that only affects strong signals usually indicates a defect in or misadjustment of the:

- IF amplifier
- automatic gain control (AGC)
- AF amplifier
- RF amplifier

< automatic gain control (AGC) >
8.5.6

8
A-006-004-004
****
In a superheterodyne receiver with automatic gain control (AGC), as the strength of the signal increases, the AGC:

- reduces the receiver gain
- increases the receiver gain
- distorts the signal
- introduces limiting

< reduces the receiver gain >
8.5.6

8
A-006-004-005
****
The amplified IF signal is applied to the ___________ stage in a superheterodyne receiver.

- RF amplifier
- detector
- audio output
- LO

< detector >
8.5

8
A-006-004-006
****
The low-level output of a detector is:

- applied to the AF amplifier
- grounded via the chassis
- fed directly to the speaker
- applied to the RF amplifier

< applied to the AF amplifier >
8.5

8
A-006-004-007
****

The overall output of an AM/CW/SSB receiver can be adjusted by means of manual controls on the receiver or by use of a circuit known as:

- automatic frequency control
- inverse gain control
- automatic gain control
- automatic load control

< automatic gain control >
8.5.6

8
A-006-004-008
****

AGC voltage is applied to the:

- AF and IF amplifiers
- RF and AF amplifiers
- detector and AF amplifiers
- RF and IF amplifiers

< RF and IF amplifiers >
8.5.6

8
A-006-004-009
****

AGC is derived in a receiver from one of two circuits. Depending on the method used, it is called:

- RF derived or audio derived
- IF derived or audio derived
- IF derived or RF derived
- detector derived or audio derived

< IF derived or audio derived >
8.5

8
A-006-004-010
Which two variables primarily determine the behaviour of an automatic gain control (AGC) loop?

- Blanking level and slope
- Slope and bandwidth
- Clipping level and hang time
- Threshold and decay time

< Threshold and decay time >
1st Ed. – see below; 2nd Ed. S8.5.6

Add to S8.5.6: When a carrier is present, such as AM audio signals, the AGC voltage may follow the carrier *fairly quickly. In suppressed carrier modes or CW there are periods when no signal is present. To avoid raising the gain of the radio and bringing up the noise level during these no-signal periods a method called **fast-attack/slow-decay** is used. When the level of the signal reaches a certain level, called the **threshold**, the AGC voltage follows quickly (fast attack).*

8
A-006-004-011
****
What circuit combines signals from an IF amplifier stage and a beat-frequency oscillator (BFO), to produce an audio signal?

- An AGC circuit
- A power supply circuit
- A VFO circuit
- A product detector circuit

< A product detector circuit >
8.5

6-5 Performance limitations - instability, image, spurious, etc.

8
A-006-005-001
****
What part of a superheterodyne receiver determines the image rejection ratio of the receiver?

- Product detector
- AGC loop
- IF filter
- RF amplifier pre-selector

< RF amplifier pre-selector >
8.5.1

8
A-006-005-002
****
What is the term for the reduction in receiver sensitivity caused by a strong signal near the received frequency?

- Cross-modulation interference
- Desensitization
- Squelch gain rollback
- Quieting

< Desensitization >
8.9

8
A-006-005-003
****
What causes receiver desensitization?

- Squelch gain adjusted too high
- Squelch gain adjusted too low
- Strong near frequency signals
- Audio gain adjusted too low

< Strong near frequency signals >
8.9

8
A-006-005-004
****
What is one way receiver desensitization can be reduced?

- Decrease the receiver squelch gain
- Use a cavity filter
- Increase the receiver bandwidth
- Increase the transmitter audio gain

< Use a cavity filter >
8.9

8
A-006-005-005
****
What causes intermodulation in an electronic circuit?

- Nonlinear circuits or devices
- Too little gain
- Positive feedback
- Lack of neutralization

< Nonlinear circuits or devices >
8.9

8
A-006-005-006
****
Which of the following is an important reason for using a VHF intermediate frequency in an HF receiver?

- To move the image response far away from the filter passband
- To provide a greater tuning range
- To tune out cross-modulation distortion
- To prevent the generation of spurious mixer products

< To move the image response far away from the filter passband >
8.5

8
A-006-005-007
****
Intermodulation distortion is produced by:

- the interaction of products from high-powered transmitters in the area
- the mixing of two or more signals in the mixer of a superheterodyne receiver
- the high-voltage stages in the final amplifier of an amplitude or frequency-modulated transmitter
- the mixing of more than one signal in the first or second intermediate frequency amplifiers of a receiver

< the mixing of two or more signals in the mixer of a superheterodyne receiver >
8.9

8
A-006-005-008
****
Which of the following is NOT a direct cause of instability in a receiver?

- Mechanical rigidity
- Feedback components
- Temperature variations
- Dial display accuracy

< Dial display accuracy >
8.2.3, 7.1

8
A-006-005-009
****
Poor frequency stability in a receiver usually originates in the:

- detector
- local oscillator and power supply
- RF amplifier
- mixer

< local oscillator and power supply >
8.2.3

8
A-006-005-010
****
Poor dynamic range of a receiver can cause many problems when a strong signal appears within or near the front-end bandpass. Which of the following is NOT caused as a direct result?

- Desensitization
- Intermodulation
- Cross-modulation
- Feedback

< Feedback >
8.2.3

11
A-006-005-011
Which of these measurements is a good indicator of VHF receiver performance in an environment of strong out-of-band signals?

- Intermediate frequency rejection ratio
- Two-tone Third-Order IMD Dynamic Range, 10 MHz spacing
- Third-Order Intercept Point
- Blocking Dynamic Range

< Two-tone Third-Order IMD Dynamic Range, 10 MHz spacing >
1st Ed. – see below; 2nd Ed. – S8.9

Add to the end of S8.9: One of the tests used to measure Intermodulation Distortion in FM receivers is the Two Tone Third Order IMD Dynamic Range test with 10 MHz spacing. Since there is a question on the exam about it here is what the test is and how it works. Since we have to type the test name a number of times, let's abbreviate it to TTTOIMD! Commonly, the TTTOIMD test is conducted using two signal generators closely spaced, usually between 500 Hz and 20 kHz apart. Both signals are input to the receiver under test, which is tuned to the expected intermodulation frequency and the resulting spurious IMD signal is measured. The larger the dynamic range of the receiver the less spurious signal will be produced; ideally we want no IMD. The input signal is increased until either the distortion reaches 25% or the 12 db SINAD point is reached

The ARRL test laboratory, a common source of Amateur Radio product reviews, also performs this test with a spacing of 10 MHz, which is non-standard. This effectively measures the effect of out of band signals on the receiver's sensitivity. The rationale for this is that most Amateur receivers have bandpass front end filters wide enough to cover the entire band and the ultimate rejection is to out of band signals.

Feedlines - Matching and Antenna Systems - 007

7-1 Antenna tuner/transmatch, impedance matching circuits

14
A-007-001-001
****
For an antenna tuner of the “Transformer” type, which of the following statements is FALSE?

- The input is suitable for 50 ohm impedance
- The output is suitable for impedances from low to high
- The circuit is known as a Pi-type antenna tuner
- The circuit is known as a transformer-type antenna tuner

< The circuit is known as a Pi-type antenna tuner >
14.9.2

14
A-007-001-002
****
For an antenna tuner of the “Series” type, which of the following statements is FALSE?

- The circuit is known as a Series-type antenna tuner
- The output is suitable for impedances from low to high
- The input is suitable for impedance of 50 ohms
- The circuit is known as a Pi-type antenna tuner

< The circuit is known as a Pi-type antenna tuner >
14.12.5

14
A-007-001-003
****
For an antenna tuner of the “L” type, which of the following statements is FALSE?

- The transmitter input is suitable for 50 ohms impedance
- The antenna output is high impedance
- The circuit is suitable for matching to a vertical ground plane antenna
- The circuit is known as an L-type antenna tuner

< The circuit is suitable for matching to a vertical ground plane antenna >
14.12.2

14
A-007-001-004
****
For an antenna tuner of the “Pi” type, which of the following statements is FALSE?

- The transmitter input is suitable for impedance of 50 ohms
- The antenna output is suitable for impedances from low to high
- The circuit is a series-type antenna tuner
- The circuit is a Pi-type antenna tuner

< The circuit is a series-type antenna tuner >
14.12.1

14
A-007-001-005
****
What is a pi-network?

- An antenna matching network that is isolated from ground
- A network consisting of four inductors or four capacitors
- A network consisting of one inductor and two capacitors or two inductors and one capacitor
- A power incidence network

< A network consisting of one inductor and two capacitors or two inductors and one capacitor >
14.12.1

14
A-007-001-006
****
Which type of network offers the greatest transformation ratio?

- Chebyshev
- Butterworth
- Pi-network
- L-network

< Pi-network >
14.12.1

14
A-007-001-007
****
Why is an L-network of limited utility in impedance matching?

- It is thermally unstable
- It matches only a small impedance range
- It is prone to self-resonance
- It has limited power handling capability

< It matches only a small impedance range >
14.12.2

14
A-007-001-008
****
How does a network transform one impedance to another?

- It produces transconductance to cancel the reactive part of an impedance
- It introduces negative resistance to cancel the resistive part of an impedance
- It cancels the reactive part of an impedance and changes the resistive part
- Network resistances substitute for load resistances

< It cancels the reactive part of an impedance and changes the resistive part >
14.12

14
A-007-001-009
****
What advantage does a pi-L network have over a pi-network for impedance matching between a vacuum tube linear amplifier and a multiband antenna?

- Greater harmonic suppression
- Higher efficiency
- Lower losses
- Greater transformation range

< Greater harmonic suppression >
14.12.3

14
A-007-001-010
****
Which type of network provides the greatest harmonic suppression?

- Inverse pi-network
- Pi-network
- Pi-L network
- L-network

< Pi-L network >
14.12.3

14
A-007-001-011
A Smith Chart is useful:

- to solve problems in direct current circuits
- because it only works with complex numbers
- because it simplifies mathematical operations
- only to solve matching and transmission line problems

< because it simplifies mathematical operations >
1st Ed. – see below; 2nd Ed. – SA.3

Add as SA.3: It is a chart for understanding and explaining impedance matching and resonance. Originally *paper-based, the Smith Chart simplified complex mathematical operations. It has been replaced by computer programs. Use to your favourite search engine to see the original Smith Chart and learn more about the available software.*

7-2 Velocity factor, effect of line terminated in non-characteristic impedance

14
A-007-002-001
****

What kind of impedance does a quarter wavelength transmission line present to the source when the line is shorted at the far end?

- The same as the characteristic impedance of the transmission line
- The same as the output impedance of the source
- A very high impedance
- A very low impedance

< A very high impedance >
14.9.2

14
A-007-002-002
****

What kind of impedance does a quarter wavelength transmission line present to the source if the line is open at the far end?

- A very high impedance
- The same as the output impedance of the source
- The same as the characteristic impedance of the transmission line
- A very low impedance

< A very low impedance >
14.9.2

14
A-007-002-003
****

What kind of impedance does a half wavelength transmission line present to the source when the line is open at the far end?

- The same as the characteristic impedance of the transmission line
- The same as the output impedance of the source
- A very high impedance
- A very low impedance

< A very high impedance >
14.9.2

14
A-007-002-004
****
What kind of impedance does a half wavelength transmission line present to the source when the line is shorted at the far end?

- A very high impedance
- The same as the characteristic impedance of the transmission line
- A very low impedance
- The same as the output impedance of the source

< A very low impedance >
14.9.2

14
A-007-002-005
****
What is the velocity factor of a transmission line?

- The velocity of the wave on the transmission line multiplied by the velocity of light in a vacuum
- The index of shielding for coaxial cable
- The velocity of the wave on the transmission line divided by the velocity of light
- The ratio of the characteristic impedance of the line to the terminating impedance

< The velocity of the wave on the transmission line divided by the velocity of light >
14.3

14
A-007-002-006
****
What is the term for the ratio of the actual velocity at which a signal travels through a transmission line to the speed of light in a vacuum?

- Characteristic impedance
- Surge impedance
- Standing wave ratio
- Velocity factor

< Velocity factor >
14.3

14
A-007-002-007
****
What is a typical velocity factor for coaxial cable with polyethylene dielectric?

- 0.33
- 0.66
- 0.1
- 2.7

< 0.66 >
14.3

14
A-007-002-008
****
What determines the velocity factor in a transmission line?

- The line length
- The centre conductor resistivity
- The terminal impedance
- Dielectrics in the line

< Dielectrics in the line >
14.3

14
A-007-002-009
****
Why is the physical length of a coaxial cable shorter than its electrical length?

- The surge impedance is higher in the parallel feed line
- Skin effect is less pronounced in the coaxial cable
- The characteristic impedance is higher in a parallel feed line
- RF energy moves slower along the coaxial cable than in air

< RF energy moves slower along the coaxial cable than in air >
14.3

14
A-007-002-010
****
The reciprocal of the square root of the dielectric constant of the material used to separate the conductors in a transmission line gives the ________ of the line:

- velocity factor
- VSWR
- impedance
- hermetic losses

< velocity factor >
14.3

14
A-007-002-011
****
The velocity factor of a transmission line is the:

- ratio of the velocity of propagation in the transmission line to the velocity of propagation in free space
- impedance of the line, e.g. 50 ohm, 75 ohm, etc.
- speed at which the signal travels in free space
- speed to which the standing waves are reflected back to the transmitter

< ratio of the velocity of propagation in the transmission line to the velocity of propagation in free space >
14.3

7-3 Antenna feed arrangements - tee, gamma, stub

14
A-007-003-001
****
What term describes a method used to match a high-impedance transmission line to a lower impedance antenna by connecting the line to the driven element in two places, spaced a fraction of a wavelength on each side of the driven element centre?

- The gamma match
- The omega match
- The stub match
- The T match

< The T match >
14.10

14
A-007-003-002
****
What term describes an unbalanced feed system in which the driven element of an antenna is fed both at the centre and a fraction of a wavelength to one side of centre?

- The omega match
- The gamma match
- The stub match
- The T match

< The gamma match >
14.10

14
A-007-003-003
****
What term describes a method of antenna impedance matching that uses a short section of transmission line connected to the antenna feed line near the antenna and perpendicular to the feed line?

- The stub match
- The omega match
- The delta match
- The gamma match

< The stub match >
14.10

14
A-007-003-004
****
Assume a velocity factor of 0.66 what would be the physical length of a typical coaxial stub that is electrically one quarter wavelength long at 14.1 MHz?

- 20 metres (65.6 feet)
- 2.33 metres (7.64 feet)
- 0.25 metre (0.82 foot)
- 3.51 metres (11.5 feet)

< 3.51 metres (11.5 feet) >
14.9.2

14
A-007-003-005
****
The driven element of a Yagi antenna is connected to a coaxial transmission line. The coax braid is connected to the centre of the driven element and the centre conductor is connected to a variable capacitor in series with an adjustable mechanical arrangement on one side of the driven element. The type of matching is:

- gamma match
- lambda match
- T match
- zeta match

< gamma match >
14.10

14
A-007-003-006
****
A quarter-wave stub, for use at 15 MHz, is made from a coaxial cable having a velocity factor of 0.8. Its physical length will be:

- 12 m (39.4 ft)
- 8 m (26.2 ft)
- 4 m (13.1 ft)
- 7.5 m (24.6 ft)

< 4 m (13.1 ft) >
14.9.2

14
A-007-003-007
****
The matching of a driven element with a single adjustable mechanical and capacitive arrangement is descriptive of:

- a “gamma” match
- a “T” match
- an “omega” match
- a “Y” match

< a “gamma” match >
14.10

14
A-007-003-008
****
A Yagi antenna uses a gamma match. The coaxial braid connects to:

- the centre of the driven element
- the variable capacitor
- the adjustable gamma rod
- the centre of the reflector

< the centre of the driven element >
14.10

14
A-007-003-009
****
A Yagi antenna uses a gamma match. The centre of the driven element connects to:

- the coaxial line braid
- the coaxial line centre conductor
- the adjustable gamma rod
- a variable capacitor

< the coaxial line braid >
14.10

14
A-007-003-010
****
A Yagi antenna uses a gamma match. The adjustable gamma rod connects to:

- the coaxial line centre conductor
- the variable capacitor
- an adjustable point on the reflector
- the centre of the driven element

< the variable capacitor >
14.10

14
A-007-003-011
****
A Yagi antenna uses a gamma match. The variable capacitor connects to the:

- an adjustable point on the director
- coaxial line braid
- centre of the driven element
- adjustable gamma rod

< adjustable gamma rod >
14.10

7-4 Current and voltage distribution on antenna

15
A-007-004-001
****
In a half-wave dipole, the distribution of __________ is highest at each end.

- current
- inductance
- capacitance
- voltage

< voltage >
15.4

15
A-007-004-002
****
In a half-wave dipole, the distribution of __________ is lowest at each end.

- voltage
- inductance
- capacitance
- current

< current >
15.4

15
A-007-004-003
****
The feed point in a centre-fed half-wave antenna is at the point of:

- minimum current
- maximum current
- minimum voltage and current
- maximum voltage

< maximum current >
15.4

15
A-007-004-004
****
In a half-wave dipole, the lowest distribution of __________ occurs at the middle.

- capacity
- inductance
- current
- voltage

< voltage >
15.4

15
A-007-004-005
****
In a half-wave dipole, the highest distribution of _________ occurs at the middle.

- inductance
- voltage
- current
- capacity

< current >
15.4

15
A-007-004-006
****
A half-wave dipole antenna is normally fed at the point where:

- the current is maximum
- the voltage is maximum
- the resistance is maximum
- the antenna is resonant

< the current is maximum >
15.4

15
A-007-004-007
****
At the ends of a half-wave dipole:

- voltage and current are both high
- voltage and current are both low
- voltage is low and current is high
- voltage is high and current is low

< voltage is high and current is low >
15.4

15
A-007-004-008
****
The impedance of a half-wave antenna at its centre is low, because at this point:

- voltage and current are both high
- voltage and current are both low
- voltage is low and current is high
- voltage is high and current is low

< voltage is low and current is high >
15.4

15
A-007-004-009
****
In a half-wave dipole, where does minimum voltage occur?

- At the right end
- It is equal at all points
- The centre
- Both ends

< The centre >
15.4

15
A-007-004-010
****
In a half-wave dipole, where does the minimum current occur?

- At both ends
- At the centre
- It is equal at all points
- At the right end

< At both ends >
15.4

15
A-007-004-011
****
In a half-wave dipole, where does the minimum impedance occur?

- It is the same at all points
- At the centre
- At the right end
- At both ends

< At the centre >
15.4

7-5 Polarization, helical beam, parabolic antennas

15
A-007-005-001
****
What is meant by circularly polarized electromagnetic waves?

- Waves with an electric field bent into circular shape
- Waves that circle the earth
- Waves produced by a circular loop antenna
- Waves with a rotating electric field

< Waves with a rotating electric field >
15.11.1

15
A-007-005-002
What type of polarization is produced by crossed dipoles fed 90 degrees out of phase?

- Circular polarization
- Cross-polarization
- Perpendicular polarization
- None of the other answers, the two fields cancel out

< Circular polarization >
1st Ed. – see below; 2nd ED. - S15.2

Add to S15.2. Circular polarization of an electromagnetic wave is a polarization in which the electric field of the passing wave does not change strength but only changes direction in a rotary manner. It is produced by crossed dipoles fed 90 degrees out of phase.

15
A-007-005-003
Which of these antennas does not produce circular polarization?

- Lindenblad antenna
- Axial-mode helical antenna
- Loaded helical-wound antenna
- Crossed dipoles fed 90 degrees out of phase

< Loaded helical-wound antenna >
1st Ed. – see below; 2nd Ed. – S15.11.1, 15.11.2

Add to S15.11.1: The helical antenna comes in two flavours, ***normal-mode*** *and* ***axial-mode****. The dimensions of a normal-mode antenna are small when compared to the wavelength of the transmitted signal and it acts like a dipole. The dimensions of an axial-mode antenna are more or less equal to the wavelength of the transmitted signal and it acts like a directional antenna. The Lindenblad antenna is formed by four dipoles mounted at 30° from horizontal on the rim of a circle 0.3 λ in diameter. Its signal is circularly polarized. All but the loaded helical-wound antenna produce circular polarization.*

15
A-007-005-004
On VHF/UHF frequencies, Doppler shift becomes of consequence on which type of communication?

- Simplex line-of-sight contact between hand-held transceivers
- Contact with terrestrial mobile stations
- Contact via satellite
- Contact through a hilltop repeater

< Contact via satellite >
1st Ed. – see below; 2nd Ed. – S15.14

Add to C15 as S15.14: The Doppler effect (or Doppler shift), is named after the Austrian physicist Christian Doppler who proposed it in 1842 in Prague. It is the change in frequency of a wave (or other periodic event) for an observer moving relative to its source. It is commonly heard when a vehicle sounding a siren or horn approaches, passes, and recedes from an observer. Compared to the emitted frequency, the received frequency is higher during the approach, identical at the instant of passing by, and lower during the recession. Fast moving satellites can have a Doppler shift of dozens of kilohertz relative to a ground station.

15
A-007-005-005
For VHF and UHF signals over a fixed path, what extra loss can be expected when linearly-polarized antennas are crossed-polarized (90 degrees)?

- 6 dB
- 10 dB
- 20 dB or more
- 3 db

< 20 dB or more >
15.3.4

A linear polarized antenna radiates wholly in one plane containing the direction of propagation. In a circular polarized antenna, the plane of polarization rotates in a circle making one complete revolution during one period of the wave. The process of converting the former to the latter results in signal loss. In THEORY (not real life) there should be "infinite" attenuation due to cross polarization. However, since no antenna is "perfect," there will be a bit of vertically polarized radiation from a horizontally polarized antenna, and vice versa. In real life situations, the difference is typically 20-30 dB

15
A-007-005-006
Which of the following is NOT a valid parabolic dish illumination arrangement?

- Offset feed
- Cassegrain
- Newtonian
- Front feed

< Newtonian >
1st Ed.- see below; 2nd Ed. - S15.11.3

Add to S15.11.2. An off-axis or offset dish antenna is a type of parabolic antenna. It is so called because the antenna feed is offset to the side of the reflector, in contrast to the common front-fed parabolic antenna where the feed is in front of the dish, on its axis. The Cassegrain reflector is a combination of a primary concave surface and a secondary convex surface. This antenna design is utilized in satellite telecommunications earth station antennas and radio telescopes, ranging in size from 2.4 metres to 70 metres. "Newtonian" does not apply to any of these.

15
A-007-005-007
****
A parabolic antenna is very efficient because:

- a dipole antenna can be used to pick up the received energy
- no impedance matching is required
- a horn-type radiator can be used to trap the received energy
- all the received energy is focused to a point where the pick-up antenna is located

< all the received energy is focused to a point where the pick-up antenna is located >
15.11.2

15
A-007-005-008
****
A helical-beam antenna with right-hand polarization will best receive signals with:

- right-hand polarization
- left-hand polarization
- vertical polarization only
- horizontal polarization

< right-hand polarization >
15.11.1

15
A-007-005-009
****
One antenna which will respond simultaneously to vertically- and horizontally-polarized signals is the:

- helical-beam antenna
- folded dipole antenna
- ground-plane antenna
- quad antenna

< helical-beam antenna >
15.11.1

15
A-007-005-010
In amateur work, what is the surface error upper limit you should try not to exceed on a parabolic reflector?

- 0.25 lambda
- 5 mm (0.2 in) regardless of frequency
- 1% of the diameter
- 0.1 lambda

< 0.1 lambda >
1st Ed: - see below; 2nd Ed. - S15.11.3

Add to S15.11.2: Manufacturing the reflector of a parabolic can result in a less than ideal or perfect shape. This is called surface error and is expressed in wavelengths (lambda). The mathematics to analyze surface error are beyond daunting! For Amateur Radio purposes any parabolic antenna should not have a surface error greater than 0.1 wavelength (0.1 lambda).

15
A-007-005-011
You want to convert a surplus parabolic dish for amateur radio use, the gain of this antenna depends on:

- the material composition of the dish
- the diameter of the antenna in wavelengths
- the polarization of the feed device illuminating it
- the focal length of the antenna

< the diameter of the antenna in wavelengths >
1st Ed: - see below; 2nd Ed. - S15.11.3

Add to S15.11.2. Unlike resonant antennas such as the dipole antenna, which are typically approximately a half-wavelength long at the frequency of operation, the reflecting dish must be much larger than a wavelength in size. The dish is at least several wavelengths in diameter, but the diameter can be on the order of 100 wavelengths for very high gain dishes (>50 dB gain).

7-6 Losses in real antenna systems, effective radiated power

15
A-007-006-001
****

A transmitter has an output of 100 watts. The cable and connectors have a composite loss of 3 dB, and the antenna has a gain of 6 dBd. What is the Effective Radiated Power?

- 350 watts
- 200 watts
- 400 watts
- 300 watts

< 200 watts >
15.12

14
A-007-006-002
****

As standing wave ratio rises, so does the loss in the transmission line. This is caused by:

- high antenna currents
- high antenna voltage
- leakage to ground through the dielectric
- dielectric and conductor heat losses

< dielectric and conductor heat losses >
14.5

15
A-007-006-003
****

What is the Effective Radiated Power of an amateur transmitter, if the transmitter output power is 200 watts, the transmission line loss is 5 watts, and the antenna power gain is 3 dBd?

- 197 watts
- 228 watts
- 178 watts
- 390 watts

< 390 watts >
15.12

15
A-007-006-004
****
Effective Radiated Power means the:

- transmitter output power, minus line losses, plus antenna gain relative to a dipole
- power supplied to the antenna before the modulation of the carrier
- power supplied to the transmission line plus antenna gain
- ratio of signal output power to signal input power

< transmitter output power, minus line losses, plus antenna gain relative to a dipole >
15.12

15
A-007-006-005
****
A transmitter has an output power of 200 watts. The coaxial and connector losses are 3 dB in total, and the antenna gain is 9 dBd. What is the approximate Effective Radiated Power of this system?

- 3200 watts
- 1600 watts
- 800 watts
- 400 watts

< 800 watts >
15.12

15
A-007-006-006
****
A transmitter has a power output of 100 watts. There is a loss of 1.30 dB in the transmission line, a loss of 0.2 dB through the transmatch, and a gain of 4.50 dBd in the antenna. The Effective Radiated Power (ERP) is:

- 800 watts
- 400 watts
- 200 watts
- 100 watts

< 200 watts >
15.12

15
A-007-006-007
****
If the overall gain of an amateur station is increased by 3 dB the ERP (Effective Radiated Power) will:

- decrease by 3 watts
- remain the same
- double
- be cut in half

< double >
15.12

15
A-007-006-008
****
A transmitter has a power output of 125 watts. There is a loss of 0.8 dB in the transmission line, 0.2 dB in the transmatch, and a gain of 10 dBd in the antenna. The Effective Radiated Power (ERP) is:

- 1250
- 1125
- 134
- 1000

< 1000 >
15.12

15
A-007-006-009
****
If a 3 dB gain antenna is replaced with a 9 dBd gain antenna, with no other changes, the Effective Radiated Power (ERP) will increase by:

- 6
- 4
- 1.5
- 2

< 4 >
15.12

15
A-007-006-010
****

A transmitter has an output of 2000 watts PEP. The transmission line, connectors and transmatch have a composite loss of 1 dB, and the gain from the stacked Yagi antenna is 10 dBd. What is the Effective Radiated Power (ERP) in watts PEP?

- 18 000
- 20 000
- 2009
- 16 000

< 16 000 >
15.12

15
A-007-006-011
****

A transmitter has an output of 1000 watts PEP. The coaxial cable, connectors and transmatch have a composite loss of 1 dB, and the antenna gain is 10 dBd. What is the Effective Radiated Power (ERP) in watts PEP?

- 1009
- 10 000
- 8000
- 9000

< 8000 >
15.12

7-7 Ground and elevation effects, vertical radiation (take off) angle

15
A-007-007-001
****

For a 3-element Yagi antenna with horizontally mounted elements, how does the main lobe takeoff angle vary with height above flat ground?

- It decreases with increasing height
- It increases with increasing height
- It does not vary with height
- It depends on E-region height, not antenna height

< It decreases with increasing height >
15.10

15
A-007-007-002
****
Most simple horizontally polarized antennas do not exhibit any directivity unless they are:

- an eighth of a wavelength above the ground
- a quarter wavelength above the ground
- a half wavelength or more above the ground
- three-eighths of a wavelength above the ground

< a half wavelength or more above the ground >
15.6

15
A-007-007-003
****
The plane from which ground reflections can be considered to take place, or the effective ground plane for an antenna is:

- as much as 6 cm below ground depending upon soil conditions
- several centimeters to as much as 2 meters below ground, depending upon soil conditions
- as much as a meter above ground
- at ground level exactly

< several centimeters to as much as 2 meters below ground, depending upon soil conditions >
15.6

15
A-007-007-004
****
Why is a ground-mounted vertical quarter-wave antenna in reasonably open surroundings better for long distance contacts than a half-wave dipole at a quarter wavelength above ground?

- The radiation resistance is lower
- The vertical radiation angle is lower
- It has an omnidirectional characteristic
- It uses vertical polarization

< The vertical radiation angle is lower >
15.8

15
A-007-007-005
****
When a half-wave dipole antenna is installed one-half wavelength above ground, the:

- radiation pattern changes to produce side lobes at 15 and 50 degrees
- side lobe radiation is cancelled
- radiation pattern is unaffected
- vertical or upward radiation is effectively cancelled

< vertical or upward radiation is effectively cancelled >
15.6

15
A-007-007-006
****
How does antenna height affect the horizontal (azimuthal) radiation pattern of a horizontal dipole HF antenna?

- Antenna height has no effect on the pattern
- If the antenna is less than one-half wavelength high, reflected radio waves from the ground significantly distort the pattern
- If the antenna is less than one-half wavelength high, radiation off the ends of the wire is eliminated
- If the antenna is too high, the pattern becomes unpredictable

< If the antenna is less than one-half wavelength high, reflected radio waves from the ground significantly distort the pattern >
15.6

15
A-007-007-007
****
For long distance propagation, the vertical radiation angle of the energy from the antenna should be:

- more than 45 degrees but less than 90 degrees
- less than 30 degrees
- 90 degrees
- more than 30 degrees but less than 45 degrees

< less than 30 degrees >
15.8

15
A-007-007-008
****
Greater distance can be covered with multiple-hop transmissions by decreasing the:

- power applied to the antenna
- vertical radiation angle of the antenna
- main height of the antenna
- length of the antenna

< vertical radiation angle of the antenna >
15.8

15
A-007-007-009
****
The impedance at the centre of a dipole antenna more than 3 wavelengths above ground would be nearest to:

- 75 ohms
- 25 ohms
- 300 ohms
- 600 ohms

< 75 ohms >
15.7

15
A-007-007-010
Why can a horizontal antenna closer to the ground be advantageous for close range communications on lower HF bands?

- The ground tends to act as a reflector
- Lower antenna noise temperature
- Low radiation angle for closer distances
- The radiation resistance is higher

< The ground tends to act as a reflector >
1st Ed.-see below; 2nd Ed. S15.13

Add this to the end of Chapter 15 as S15.13. Whole books have been written about NVIS and you only have to deal with one question! NVIS, or Near Vertical Incidence Skywave, refers to a radio propagation mode which involves the use of antennas with a very high radiation angle, approaching or reaching 90 degrees (straight up), along with selection of an appropriate frequency below the critical frequency, to establish reliable communications over a radius of 0-300 km or so, give or take 150 km. Nearby contacts made on 160 meters or 80 meters at night, or 80 meters or 40 meters during the day are often due to NVIS. One might think of these nearby contacts as necessarily involving the use of groundwave propagation, but many such contacts involve no groundwave signal at all, or, if the groundwave signal is involved, it may hinder, instead of help. Deliberate exploitation of NVIS is best achieved using antenna installations which achieve some balance between minimizing groundwave (low takeoff angle) radiation, and maximizing near vertical incidence skywave (very high takeoff angle) radiation. One of the most effective antennas for NVIS is a dipole positioned from 0.1 to 0.25 wavelengths above ground. When a dipole is brought very close to the ground, some interesting things happen. The most interesting thing, from an NVIS perspective, is that the angle of radiation goes up. In the range of 0.1 to 0.25 wavelengths above ground, vertical and nearly vertical radiation reaches a maximum, at the expense of lower angle radiation. A dipole can be used *at even lower heights, resulting in some loss of vertical gain, but often, a more substantial reduction in noise and interference from distant regions. Heights of 1.5 to 2.5 m above ground are not unusual for NVIS setups, and some people use dipoles as low as 0.5 m high with good results. This provides relatively weak signals, but a very low noise floor.*

15
A-007-007-011
****

Which antenna system and operating frequency are most suitable for Near Vertical Incidence (NVIS) communications?

- A horizontal antenna at a height of half a wavelength and an operating frequency at the optimum working frequency.
- A vertical antenna and frequency below the maximum usable frequency.
- A vertical antenna and a frequency above the lowest usable frequency
- A horizontal antenna less than ¼ wavelength above ground and a frequency below the current critical frequency.

< A horizontal antenna less than ¼ wavelength above ground and a frequency below the current critical frequency. >
15.13

For now add this to the end of Chapter 15 as S15.13. Whole books have been written about NVIS and you only have to deal with one question! NVIS, or Near Vertical Incidence Skywave, refers to a radio propagation mode which involves the use of antennas with a very high radiation angle, approaching or reaching 90 degrees (straight up), along with selection of an appropriate frequency below the critical frequency, to establish reliable communications over a radius of 0-300 km or so, give or take 150 km. Nearby contacts made on 160 meters or 80 meters at night, or 80 meters or 40 meters during the day are often due to NVIS. One might think of these nearby contacts as necessarily involving the use of groundwave propagation, but many such contacts involve no groundwave signal at all, or, if the groundwave signal is involved, it may hinder, instead of help. Deliberate exploitation of NVIS is best achieved using antenna installations which achieve some balance between minimizing groundwave (low takeoff angle) radiation, and maximizing near vertical incidence skywave (very high takeoff angle) radiation. One of the most effective antennas for NVIS is a dipole positioned from 0.1 to 0.25 wavelengths above ground. When a dipole is brought very close to the ground, some interesting things happen. The most interesting thing, from an NVIS perspective, is that the angle of radiation goes up. In the range of 0.1 to 0.25 wavelengths above ground, vertical and nearly vertical radiation reaches a maximum, at the expense of lower angle radiation. A dipole can be used at even lower heights, resulting in some loss of vertical gain, but often, a more substantial reduction in noise and interference from distant regions. Heights of 1.5 to 2.5m above ground are not unusual for NVIS setups, and some people use dipoles as low as 0.5 m high with good results. This provides relatively weak signals, but a very low noise floor.

7-8 Radiation resistance, antenna efficiency, beamwidth

15
A-007-008-001
****
What is meant by the radiation resistance of an antenna?

- The resistance in the atmosphere that an antenna must overcome to be able to radiate a signal
- The specific impedance of an antenna
- The combined losses of the antenna elements and feed line
- The equivalent resistance that would dissipate the same amount of power as that radiated from an antenna

< The equivalent resistance that would dissipate the same amount of power as that radiated from an antenna >
15.3.2

15
A-007-008-002
****
Why would one need to know the radiation resistance of an antenna?

- To measure the near-field radiation density from a transmitting antenna
- To calculate the front-to-side ratio of the antenna
- To match impedances for maximum power transfer
- To calculate the front-to-back ratio of the antenna

< To match impedances for maximum power transfer >
15.3.2

15
A-007-008-003
****
What factors determine the radiation resistance of an antenna?

- Antenna location with respect to nearby objects and the conductors length/diameter ratio
- Transmission line length and antenna height
- Sunspot activity and time of day
- It is a physical constant and is the same for all antennas

< Antenna location with respect to nearby objects and the conductors length/diameter ratio >
15.3.2

15
A-007-008-004
****
What is the term for the ratio of the radiation resistance of an antenna to the total resistance of the system?

- Beamwidth
- Effective Radiated Power
- Radiation conversion loss
- Antenna efficiency

< Antenna efficiency >
15.3.2

15
A-007-008-005
****
What is included in the total resistance of an antenna system?

- Radiation resistance plus transmission resistance
- Radiation resistance plus ohmic resistance
- Transmission line resistance plus radiation resistance
- Radiation resistance plus space impedance

< Radiation resistance plus ohmic resistance >
15.3.2

15
A-007-008-006
****
How can the approximate beamwidth of a beam antenna be determined?

- Draw two imaginary lines through the ends of the elements and measure the angle between the lines
- Note the two points where the signal strength is down 3 dB from the maximum signal point and compute the angular difference
- Measure the ratio of the signal strengths of the radiated power lobes from the front and side of the antenna
- Measure the ratio of the signal strengths of the radiated power lobes from the front and rear of the antenna

< Note the two points where the signal strength is down 3 dB from the maximum signal point and compute the angular difference >
15.10

15
A-007-008-007
****
How is antenna percent efficiency calculated?

- (radiation resistance / transmission resistance) x 100
- (total resistance / radiation resistance) x 100
- (effective radiated power / transmitter output) x 100
- (radiation resistance / total resistance) x 100

< (radiation resistance / total resistance) x 100 >
15.3.3

15
A-007-008-008
****
What is the term used for an equivalent resistance which would dissipate the same amount of energy as that radiated from an antenna?

- Radiation resistance
- j factor
- Antenna resistance
- K factor

< Radiation resistance >
15.3.2

15
A-007-008-009
****
Antenna beamwidth is the angular distance between:

- the points on the major lobe at the half-power points
- the maximum lobe spread points on the major lobe
- the 6 dB power points on the major lobe
- the 3 dB power points on the first minor lobe

< the points on the major lobe at the half-power points >
15.10

15
A-007-008-010
****
If the ohmic resistance of a half-wave dipole is 2 ohms, and the radiation resistance is 72 ohms, what is the antenna efficiency?

- 74%
- 72%
- 97.3%
- 100%

< 97.3% >
15.3.3

15
A-007-008-011
****
If the ohmic resistance of a miniloop antenna is 2 milliohms and the radiation resistance is 50 milliohms, what is the antenna efficiency?

- 52%
- 96.15%
- 25%
- 50%

< 96.15% >
15.3.3

7-9 Waveguide, microstripline

14
A-007-009-001
****
Waveguide is typically used:

- at frequencies above 2 MHz
- at frequencies above 3000 MHz
- at frequencies below 150 MHz
- at frequencies below 1500 MHz

< at frequencies above 3000 MHz >
14.6

14
A-007-009-002
****
Which of the following is NOT CORRECT? Waveguide is an efficient transmission medium because it features:

- low radiation loss
- low dielectric loss
- low hysteresis loss
- low copper loss

< low hysteresis loss >
14.6

14
A-007-009-003
****
Which of the following is an advantage of waveguide as a transmission line?

- Frequency sensitive based on dimensions
- Low loss
- Expensive
- Heavy and difficult to install

< Low loss >
14.6

14
A-007-009-004
****
For rectangular waveguide to transfer energy, the cross-section should be at least:

- three-eighths wavelength
- one-eighth wavelength
- one-half wavelength
- one-quarter wavelength

< one-half wavelength >
14.6

14
A-007-009-005
****
Which of the following statements about waveguide IS NOT correct?

- In the transverse electric mode, a component of the magnetic field is in the direction of propagation
- Waveguide has high loss at high frequencies, but low loss below cutoff frequency
- In the transverse magnetic mode, a component of the electric field is in the direction of propagation
- Waveguide has low loss at high frequencies, but high loss below cutoff frequency

< Waveguide has high loss at high frequencies, but low loss below cutoff frequency >
14.6

14
A-007-009-006
****
Which of the following is a major advantage of waveguide over coaxial cable for use at microwave frequencies?

- Frequency response from 1.8 MHz to 24 GHz
- Easy to install
- Very low losses
- Inexpensive to install

< Very low losses >
14.6

14
A-007-009-007
****
What is printed circuit transmission line called?

- Dielectric substrate
- Microstripline
- Dielectric imprinting
- Ground plane

< Microstripline >
14.7

14
A-007-009-008
****
Compared with coaxial cable, microstripline:

- has poorer shielding
- has superior shielding
- must have much lower characteristic impedance
- must have much higher characteristic impedance

< has poorer shielding >
14.7

14
A-007-009-009
****
A section of waveguide:

- operates like a low-pass filter
- operates like a band-stop filter
- is lightweight and easy to install
- operates like a high-pass filter

< operates like a high-pass filter >
14.6

14
A-007-009-010
****
Stripline is a:

- small semiconductor family
- high power microwave antenna
- family of fluids for removing coatings from small parts
- printed circuit transmission line

< printed circuit transmission line >
14.7

14
A-007-009-011
****
What precautions should you take before beginning repairs on a microwave feed horn or waveguide?

- Be sure the weather is dry and sunny
- Be sure the transmitter is turned off and the power source is disconnected
- Be sure propagation conditions are unfavorable for tropospheric ducting
- Be sure to wear tight-fitting clothes and gloves to protect your body and hands from sharp edge

< Be sure the transmitter is turned off and the power source is disconnected >
14.6

You have reached the end of the Advanced Qualification Question Bank.

Congratulations!

Now go write and pass the exam.