Apprentice Telecommunications Technician Test (CTT)

Study Guide

Study Guide for
Pacific Gas & Electric Company
Apprentice Telecommunications Technician
Qualifying Test
(CTT)

About the Test

The test consists of 36 multiple choice questions to be completed within a 3½ hour time limit. A passing score is 26 questions answered correctly. Questions emphasize electronic circuit analysis and problem solving. A scientific calculator is the only material permitted. A Texas Instruments TI 30X Calculator (or comparable) is sufficient to perform calculations. Be sure to show your work.

This test allows you to demonstrate your knowledge and understanding of the fundamentals of basic electricity and electronics as well as your preparedness for advanced technical training in complex communications systems that are maintained and operated by skilled Telecommunications Technicians.

References

The Internet is an excellent resource for much of the information to prepare for this test. Many excellent basic electricity and electronics books are available from libraries, bookstores, and on-line resources. Electronics and its principles are governed by the laws of physics, not the author. This generally makes all electronics technical books appropriate for the subject matter they are covering.

A general reference book is invaluable as a supplement to other textbooks from classes or specific subjects, and as an instrument for general review in preparing for qualifying tests. However, it is not a substitute for formal education and training in basic electricity and basic electronics.

These four books cover most areas of the test:

Digital Principles and Applications, by Donald P. Leach and Albert Paul Malvino
Understanding Electricity and Electronics, by Peter Buban
Basic Electronics, by Bernard Grob
Electronic Communication, by Robert L. Shrader

Material Covered in the Test

I. Basic Electricity

A. Electrical Units of Measure (Voltage, Current, Resistance, Power)
B. AC and DC Series and Parallel Circuits
C. Ohm's Law and Calculations
D. Battery Basics
    1. Various Series and Parallel Circuit Combinations

Material Covered in the Test (continued)

II. Basic Electronics

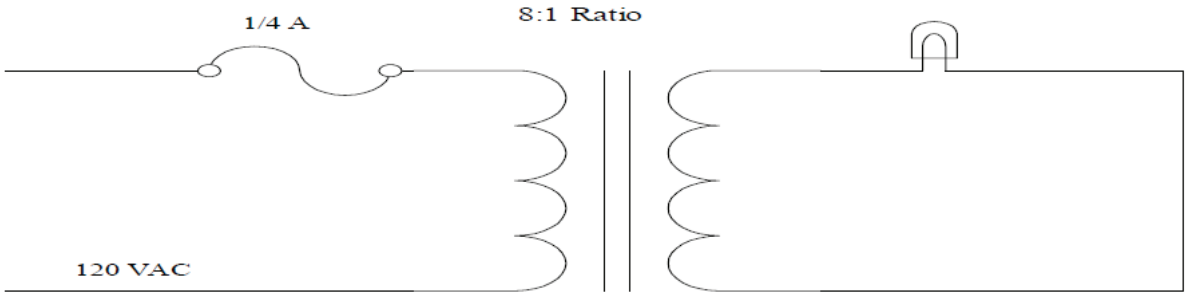
A. Electronic Components (All Types)
B. Reactive and Non-Reactive Components
C. Resistors, Inductors, and Capacitors, in Various Series and Parallel Circuit Combinations
D. Resonance and its Effect on Circuits
E. Various Diodes and their Characteristics
F. Electronic Circuits (Recognition - Theory of Operation - Analysis)
G. Harmonic Frequencies
H. Frequency Shift Keying
I. Frequency Time and Period Measurements
J. Decibel Gain and Loss
    1. Power and Voltage
K. Impedance
L. Amplifiers

III. Digital Electronics

A. Numbering Systems using Hexadecimal, Octal, Binary, and Binary Coded Decimal
    1. Converting between numbering systems
B. Basic Logic Circuits
    1. Logic Gates
    2. Truth Tables
    3. Boolean Algebra
    4. Complements
    5. Parity

Sample Test Questions

These are representative of questions you can expect to find on the qualifying test. Although they do not appear in the actual test, they are typical in nature and difficulty. Complete these questions to evaluate your general knowledge of electronics and your preparedness for the Apprentice Telecommunications Technician Program. Answers to questions are at the end of this Study Guide



1) You have a box of various wattage incandescent lamps of the correct voltage for the above circuit. The box contains 10 watt, 20 watt, 35 watt, 50 watt, and 100 watt lamps. Select the largest wattage lamp that can be used without exceeding the fuse rating in the primary.

   A) 10 watt

   B) 20 watt

   C) 35 watt

   D) 50 watt

   E) 100 watt

   F) Any 15 volt lamp will be OK

   G) Not enough information given

2) In a series circuit with unequal resistances:

   A) The lowest resistance has the highest voltage

   B) The highest resistance has the highest voltage

   C) The lowest resistance has the most current

   D) The highest resistance has the most current

3) In a parallel circuit with unequal branch resistances:

A) The current is highest in the highest resistance

B) The current is equal in all the branches

C) The voltage is highest across the lowest resistance

D) The current is highest in the lowest resistance

4) 161 decimal is _____in binary, _____ in hexadecimal.

A) 10100011, 091

B) 10100001, 0A1

C) 10101001, 0B1

D) 10101101, 091

E) 10100001, 0A0

5) Determine the total resistance (R_T) and total current (I_T) in the circuit below.

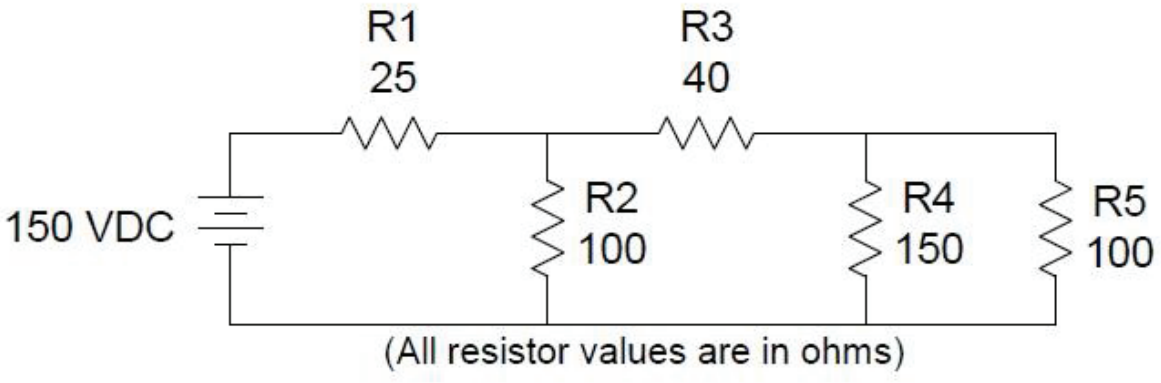
A) R_T = 415 Ω; I_T = 2.8 A

B) R_T = 103 Ω; I_T = 1.5 A

C) R_T = 75 Ω; I_T = 2.0 A

D) R_T = 150 Ω; I_T = 1.0 A

E) R_T = 75 Ω; I_T = 3.0 A



6) In a series AC circuit, X_L = 2350 ohms, C = 0.005μF, and R = 500 Ω. What is the impedance at resonance?

A) The frequency must be known.

B) 2.1 KΩ

C) 4200 Ω

D) 0.5 KΩ

E) 1.85 KΩ

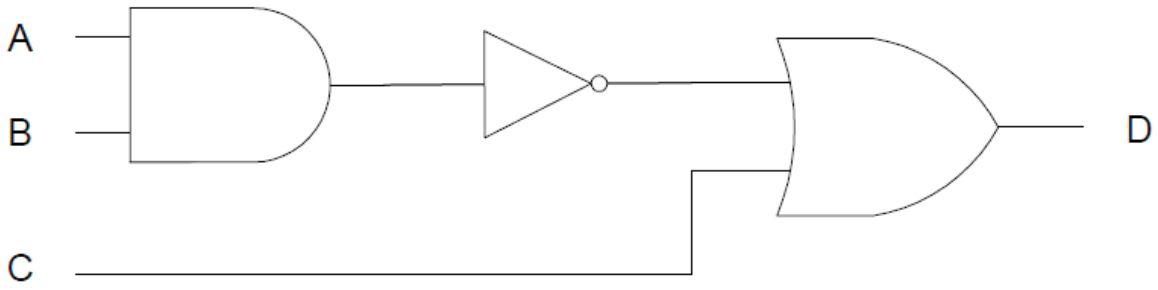
7) Which is the correct equation for the logic diagram shown below?

A) $\overline{A} + \overline{B} + C = D$

B) $A + B \bullet C = D$

C) $A + B + C = D$

D) $A \bullet B + C = D$



8) A 10 mh coil has a resistance of 100 ohms. At what frequency does X_L = R?

A) 15915.5 Hz

B) 7957.7 Hz

C) 31830.9 Hz

D) 1591.5 Hz

9) In the circuit shown below, the source frequency is below the resonant frequency of L and C. If this frequency is now gradually increased through resonance without changing the amplitude of E, the voltage at the output would:

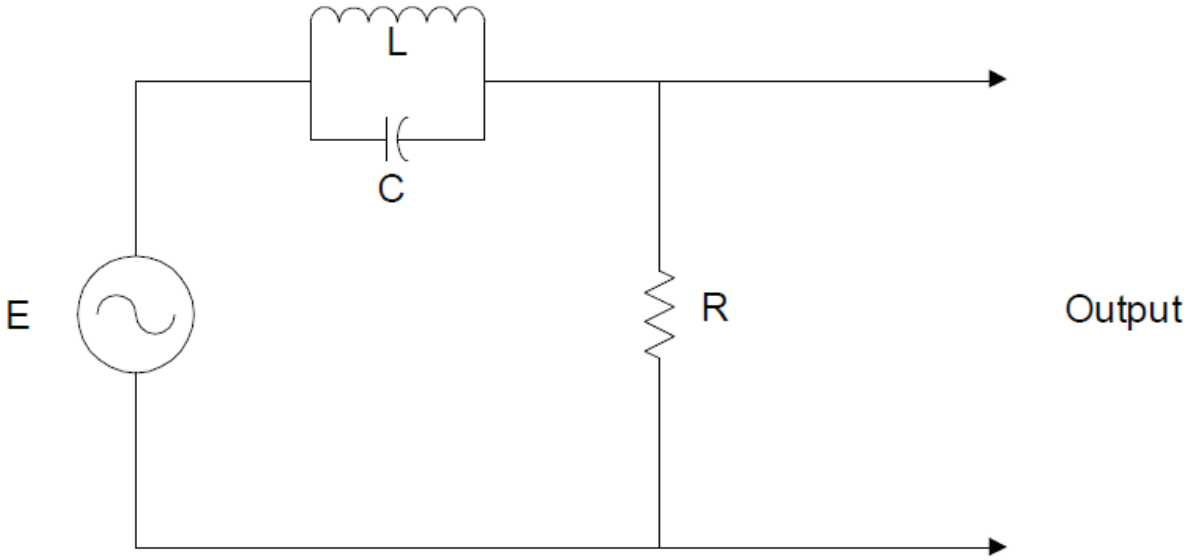
A) Decrease at first and then increase

B) Increase at first and then decrease

C) Decrease continuously

D) Increase continuously

E) Remain constant



10) When observing a 500 KHz square wave with an oscilloscope, what period would you expect to see? (For a full cycle)

A) 5 microseconds

B) 200 nanoseconds

C) 2 microseconds

D) 200 nanoseconds

E) It depends on the amplitude

11) A base radio is rated at a 50 watt output. The measured output of this radio is 20 watts. The output of this base radio is:

A) Down 7.5 dB

B) Down 3.25 dB

C) Down 4 dB

D) Down 9 dB

E) Down 12 dB

12) A) Convert 167 decimal to binary _____

B) Convert 167 decimal to octal _____

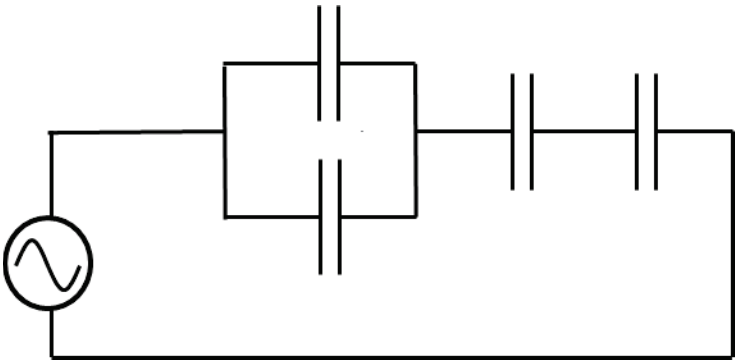
C) Convert 167 decimal to hexadecimal _____

13) Convert 356 decimal to a BCD number _____

14) A 2 ufd and a 3 ufd capacitor are in parallel. In series with them, are a 4 ufd and a 5 ufd capacitor.

Complete the circuit below, using the values given above.

What is the total capacitance of this circuit? _____



15) The batteries shown below are 12 Volt, 10 Amp Hour Batteries.

Problem:

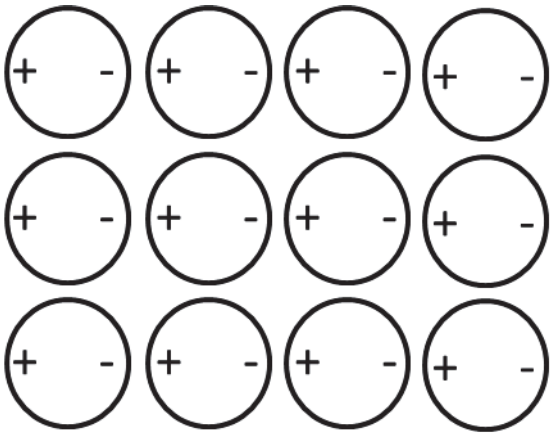
A) Connect the first line of batteries for a total of 12 volts, 30 amps

B) Connect the second line of batteries for 24 volts

C) Connect the third line of batteries for 48 volts

D) How many amps of current are available from the third string at 48 Vdc?

Note: Connect only the batteries needed.



= 12V 30 Amps

= 24V

= 48V

= _____ Amps

16) Given:

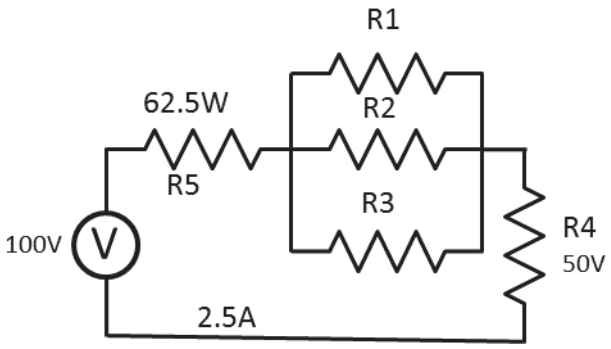
1. R1 ,R2, & R3 are all equal value resistors
2. Total resistance of R1, R2, and R3 is 10 ohms
3. The voltage across R4 is 50 volts
4. The power dissipated across R5 is 62.5 watts
5. The Source Voltage is 100 Volts

Find:

A) The resistance values of R1, R2, and R3 _____

B) The resistance values of R4 _____, R5 _____

C) The power dissipation of R4 _____



17) The fourth harmonic of a fundamental frequency is 512 Hz

What is the fundamental frequency?

A) 256 Hz

B) 126 Hz

C) 102.4 Hz

D) 128 Hz

E) 170.7 Hz

18) Which statement below best describes Frequency Shift Keying?

A) The carrier frequency remains constant; a second frequency is introduced to produce a “Space”

B) The carrier frequency remains constant; a second frequency is introduced to produce a “Mark”

C) The carrier frequency is left on and shifted in frequency to produce a “Mark”

D) The carrier frequency is left on and shifted in frequency to produce a “Space”

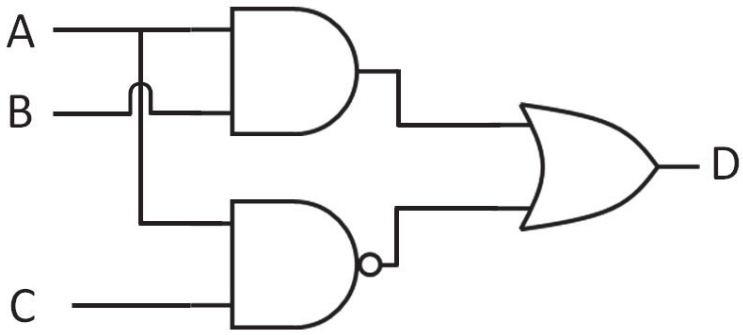
19) Which is the correct Boolean Expression for the Logic Circuit below?

A) $AB + \overline{AC} = D$

B) $\overline{AB} + AC = D$

C) $\overline{AB} + AC = D$

D) None of the above



Answers to sample test questions:

1)	B	13)		0011 0101 0110
2)	B	14)		1.54 ufd
3)	D	15)	a)	Any 3 batteries connected in Parallel, (+ to +, - to -)
4)	B	15)	b)	Any 2 batteries connected in Series, (+ to -, + to -)
5)	C	15)	c)	All 4 Batteries connected in Series, (+ to -)
6)	D	15)	d)	10 amps
7)	A	16)	a)	30 ohms
8)	D	16)	b)	R4 = 20 ohms,…..R5 =10 ohms
9)	A	16)	c)	R5 = 125 watts
10)	C	17)		D
11)	C	18)		C
12)	10100111	19)		A

Formula Sheet

Series Resistance: $RT = R1 + R2 + R3 + \text{etc.}$ In OHMS

Parallel Resistance: $RT = \frac{R1 \times R2}{R1 + R2}$ In OHMS

Parallel Resistance with 3 or more resistors: $\frac{1}{RT} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}, \text{etc.}$ In OHMS

Inductive Reactance: $XL = 2 \pi FL$ In OHMS

Capacitive Reactance: $Xc = \frac{1}{2 \pi FC}$ In OHMS

Impedance: $Z = \sqrt{R^2 + (XL - XC)^2}$ In OHMS

Power (In Watts): $P = E \times I \quad P = I^2 \times R \quad P = \frac{E^2}{R}$

Decibel dB: $dB = 10 \text{ Log } \frac{Pout}{Pin} \quad dB = 20 \text{ Log } \frac{Eout}{Ein}$

Remember….. ½ Power = - 3dB 2 x Power = + 3dB

Ohms Law:

Meter Sensitivity: = Ohms x Volts, or $\frac{1}{\text{Full scale deflection in (ua)}}$

Note: Expressed in Ohms/Volt