

The Guide to the Mathematic Equations for the 2014-2018 Technician (Element 2) Exam

This supplement to your study for the Technician class (Element 2) exam contains each question from the Technician (Element 2) Question Pool (ARRL, 2014) that requires mathematical formulas to answer. The references that were used in the development of this supplement are listed below.¹

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Table of Metric Multiplication Factors

Multiplication Factor	Prefix	Symbol
1,000,000,000 = 10^9	giga	G
1,000,000 = 10^6	mega	M
1,000 = 10^3	kilo	k
100 = 10^2	hecto	h
1		
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000001 = 10^{-6}	micro	μ
0.000000001 = 10^{-9}	nano	η
0.000000000001 = 10^{-12}	pico	p

References

Silver NOAX, W. (2014). *The ARRL Ham Radio License Manual, 3rd Ed.* (M. Wilson K1RO, Ed.) Newington, CT: The National Association for Amateur Radio.

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Section T5: Electrical Principles

T5B09: What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts? (p. 4-7)

$$dB = 10 \log \left(\frac{P_{out}}{P_{in}} \right) = 10 \log \left(\frac{10 W}{5 W} \right) = 3 dB$$

where: P = power in Watts

T5B10: What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts? (p. 4-7)

$$dB = 10 \log \left(\frac{P_{out}}{P_{in}} \right) = 10 \log \left(\frac{3 W}{12 W} \right) = -6 dB \equiv \text{decrease of 6 db}$$

T5B11: What is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts? (p. 4-7)

$$dB = 10 \log \left(\frac{P_{out}}{P_{in}} \right) = 10 \log \left(\frac{200 W}{20 W} \right) = 10 dB$$

T5C09: How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes? (p. 3-5)

$$P = E \times I = (13.8 V) \times (10 A) = 138 W$$

where: P = power in Watts
E = voltage in volts
I = current in amperes

T5C10: How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes? (p. 3-5)

$$P = E \times I = (12 V) \times (2.5 A) = 30 W$$

where: P = power in Watts
E = voltage in volts
I = current in amperes

T5C11: How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts? (p. 3-5)

$$I = \frac{P}{E} = \frac{120 W}{12 V} = 10 A$$

where: P = power in Watts
E = voltage in volts
I = current in amperes

T5D04: What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts? (p. 3-4)

$$R = \frac{E}{I} = \frac{90 V}{3 A} = 30 \Omega$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D05: What is the resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes? (p. 3-4)

$$R = \frac{E}{I} = \frac{12 V}{1.5 A} = 8 \Omega$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D06: What is the resistance of a circuit that draws 4 amperes from a 12-volt source? (p. 3-4)

$$R = \frac{E}{I} = \frac{12 V}{4 A} = 3 \Omega$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D07: What is the current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms? (p. 3-4)

$$I = \frac{E}{R} = \frac{120 V}{80 \Omega} = 1.5 A$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D08: What is the current flowing through a 100-ohm resistor connected across 200 volts? (p. 3-4)

$$I = \frac{E}{R} = \frac{200 V}{100 \Omega} = 2 A$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D09: What is the current flowing through a 24-ohm resistor connected across 240 volts? (p. 3-4)

$$I = \frac{E}{R} = \frac{240 V}{24 \Omega} = 10 A$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D10: What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it? (p. 3-4)

$$E = R \times I = (2 \Omega) \times (0.5 A) = 1 V$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D11: What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it? (p. 3-4)

$$E = R \times I = (10 \Omega) \times (1 A) = 10 V$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes

T5D12: What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it? (p. 3-4)

$$E = R \times I = (10 \Omega) \times (2 A) = 20 V$$

where: R = resistance in ohms
E = voltage in volts
I = current in amperes