Unit 14

Answers: Electrical Circuits

Quick checks

1 **c**

2 **b**

3 **a**

4 **a** $\frac{5}{15} = \frac{l}{100 - l}$ $15l = 500 - 5l$ $l = 25$

5 **b**

6 **c**

7 **b** $22 = 5 + I_4$ $I_4 = 17$

8 **a**

9 **b**

10 **a** $E = kl$ $E \propto l$

11 **c** $r = \left(\frac{l_1}{l_2} - 1\right) R = \left(\frac{650}{520} - 1\right) \times 8 = 0.25 \times 8 = 2$

12 **a**

13 **a** $\frac{5}{15} = \frac{l}{100 - l} \Rightarrow 15l = 500 - 5l \Rightarrow l = 25$

14 **a** $k = \dfrac{I\rho}{A} = \dfrac{0.2 \times 40 \times 10^{-8}}{8 \times 10^{-6}} = 0.2 \times 0.05 = 0.01$

15 **b** $k = \dfrac{2}{4} = 0.5$

16 **d**

17 **c**

18 **b**

19 **d** $I_g = 0.1I \quad S = \dfrac{I_g G}{I - I_g} = \dfrac{0.1I \times 99}{0.9I} = \dfrac{9.9}{0.9} = 11$

14.

$i_1 + i_2$

$35 = 3i_1 + 2(i_1 + i_2) \Rightarrow 5i_1 + 2i_2 = 35$

$40 = 4i_2 + 2(i_1 + i_2) \Rightarrow 2i_1 + 6i_2 = 40 \Rightarrow i_1 + 3i_2 = 20$

$i_1 = 20 - 3i_2 \qquad 100 - 15i_2 + 2i_2 = 35 \qquad 13i_2 = 65 \;\; i_2 = 5 \qquad i_1 = 5$

$i_1 + i_2 = \mathbf{10\ A}$

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15. $\dfrac{E}{1.02} = \dfrac{82.3}{67.3} \qquad E = 1.02 \times \dfrac{82.3}{67.3} = \mathbf{1.25\ V}$

16.

$$V = kl$$

$$k = V/l \qquad\qquad k = \frac{I\rho}{A}$$

$$\frac{E}{1.50} = \frac{25.00}{34.5} \qquad E = 1.50 \times \frac{25.00}{34.5} = \mathbf{1.09\ V}$$

17.

$$V \propto l$$

$$\frac{R}{X} = \frac{20}{80} = \frac{1}{4}$$

$$\frac{8R}{2R} = \frac{l'}{100 - l'} \Rightarrow 4(100 - l') = l' \Rightarrow l' = \mathbf{80\ cm}$$

$$P/Q = X/R$$

18.

$$\frac{R}{S} = \frac{60}{40} \Rightarrow R = 1.5S$$

$$\frac{R}{S+5} = \frac{50}{50} \Rightarrow R = S + 5$$

$$1.5S = S + 5 \;\; S = \mathbf{10\ \Omega} \qquad R = \mathbf{15\ \Omega}$$

19.

l_1 $E = kl_1$ $V = IR$ l_2 $V = kl_2$ $E = I(R+r)$ $V = IR$

$$\frac{E}{V} = \frac{R+r}{R} \Rightarrow r = \left(\frac{E}{V} - 1\right) R = \left(\frac{l_1}{l_2} - 1\right) R$$

$V = I_g(G+R)$

$$R = \frac{V}{I_g} - G$$

20.

$V = kl$ $E - Ir$

$$\frac{E}{1.02} = \frac{75}{50} \qquad E = 1.02 \times 1.5 = \mathbf{1.53\ V}$$

21.

$$\sum E = \sum IR$$
$$E_1 + E_2 = I_1(R_1 + R_2) + I_3R_3$$

$I_1P = I_2X$ $I_3Q = I_4R$ $I_1 = I_3$ $I_2 = I_4$ $\frac{P}{Q} = \frac{X}{R}$

$$X = \frac{P}{Q}R$$

$X = \frac{l}{100 - l}R$

22.

$$\frac{E}{1.50} = \frac{25.0}{37.5} \qquad E = 1.50 \times \frac{25.0}{37.5} = \mathbf{1.00\ V}$$

$E - Ir$

23.

$$-I_1P - I_gG + I_2X = 0$$

$$-I_3Q + I_4R + I_gG = 0 \qquad I_1 = I_g + I_3 \qquad I_4 = I_g + I_2$$

$$I_g = 0 \quad I_1P = I_2X \;\; I_3Q = I_4R \;\; I_1 = I_3 \quad I_2 = I_4 \quad I_1Q = I_2R$$

$$\frac{P}{Q} = \frac{X}{R}$$

$$0.30 \times 15 = 4.5$$

$$I = \frac{0.075}{4.5\ \Omega} = \frac{1}{60}$$

$$\frac{2}{R+15} = \frac{1}{60} \qquad R + 15 = 120$$

$$S = I_gG/(I - I_g)$$

24.

$$I_1 = \frac{12 - V}{2}, \qquad I_2 = \frac{6 - V}{1}, \qquad R:\ \frac{V}{4} = I_1 + I_2$$

$$\frac{V}{4} = 6 - \frac{V}{2} + 6 - V \Rightarrow V\left(\frac{1}{4} + \frac{1}{2} + 1\right) = 12 \Rightarrow V = \frac{12}{1.75} = 6.86$$

$$I_2 = 6 - 6.86 = -0.86$$

$$r = \left(\frac{l_1}{l_2} - 1\right) R \qquad \begin{matrix} l_1 \\ \\ \end{matrix} \qquad l_2$$

$$R = V/I_g - G$$

25.

$$6.0 - 4.0I = 0 \qquad I = \mathbf{1.5\ A}$$

$$6.0 + 6.0 = I(4.0 + R + 1.5) \qquad 12 = 1.5(5.5 + R) \;\; 5.5 + R = 8.0$$

26.

$$\frac{6.0}{2.4} = 2.5 \qquad \frac{6.0}{1.2} = 5.0$$

$$9.0 - 6.0 = 3.0 \qquad R = \frac{3.0}{7.5} = \mathbf{0.40\ \Omega}$$

$$P = \frac{V^2}{R_X} = \frac{6.0^2}{2.4} = \mathbf{15\ W}$$

27.

$$2.0 = I(4.0 + 2.5 + 0.50) = 7.0I \qquad I = \frac{2.0}{7.0} = \mathbf{0.29\ A}$$

$$\frac{0.90}{1.00} \times 4.0 = 3.6 \qquad V = IR = 0.286 \times 3.6 = \mathbf{1.03\ V}$$

$$Ir = 0$$

28.

$$P = \frac{V^2}{R} \qquad P \propto V^2$$

$$\frac{P_1 - P_2}{P_1} = \frac{230^2 - 220^2}{230^2} = \frac{52\,900 - 48\,400}{52\,900} = \frac{4500}{52\,900} = 0.085 = \mathbf{8.5\ \%}$$

$$I = \frac{1.5}{5.0} = \mathbf{0.30\ A}$$

L (cm)	0	20	40	50	60	80	100

$$V = IR = 0.12 \times 5.0 = \mathbf{0.60\ V}$$

$$1.5 \times \tfrac{1.67}{4.17} = 0.60$$