

Answers to Assignment 13 14

18.14

a)

$$KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 6.64 \times 10^{-27} \times (0.02 \times 3 \times 10^8) = 1.195 \times 10^{-13} \text{ J.}$$

b)

$$E = \frac{KE}{e} = \frac{1.195 \times 10^{-13}}{-1.6 \times 10^{-19}} = -7.47 \times 10^5 \text{ eV.}$$

c)

$$V = \frac{E}{2} = \frac{-7.47 \times 10^5}{2} = -3.74 \times 10^5 \text{ V.}$$

18.31

$$V = k \frac{q}{r},$$

$$\text{so } q = \frac{Vr}{k} = \frac{500 \times 15}{9 \times 10^9} = 8.33 \times 10^{-7} \text{ C} = 0.833 \mu\text{C}.$$

18.70

Left:

$$C_l = \frac{5.0 \times 3.5}{5.0 + 3.5} = 2.0588 \mu\text{F},$$

Right:

$$C_R = \frac{1.5 \times (0.75 + 15)}{1.5 + (0.75 + 15)} = 1.3696 \mu\text{F},$$

Total:

$$C_T = 2.0588 + 1.3696 + 8 = 11.43 \mu\text{F}.$$

19.37

a)

$$R = R_0(1 + \alpha \Delta T)$$

$$\Delta T = \frac{1}{a} \left(\frac{R}{R_0} - 1 \right) = \frac{1}{-0.06} (0.82 - 1) = 3^\circ \text{C}'$$

$$\text{so } T = T_0 + \Delta T = 37 + 3 = 40^\circ \text{C}.$$

b)

since resistance can't become negative,

$$R_0(1 + \alpha\Delta T) > 0$$

$$\Delta T < -\frac{1}{a} = -\frac{1}{-0.06} = 16.6^\circ C$$

19.41

$$I = 600/1800 = 0.333A$$

$$P = IV = 0.333 \times 3.00 = 1.00W$$

20.6

a)

$$R = R_1 + R_2 = 24 + 96 = 120\Omega$$

$$I = \frac{V}{R} = \frac{48.0}{120} = 0.4A$$

$$P = IV = 0.4 \times 48.0 = 19.2W$$

b)

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{24 \times 96}{24 + 96} = 19.2\Omega$$

$$I = \frac{V}{R} = \frac{48.0}{19.2} = 2.5A$$

$$P = IV = 2.5 \times 48.0 = 120W$$

20.22

a)

$$I = \frac{V}{R+r} = \frac{12}{0.05 + 0.01} = 200A$$

b)

$$V_1 = IR = 200 \times 0.05 = 10V$$

c)

$$P = IV_1 = 200 \times 10 = 2000W$$

d)

(i)

$$I = \frac{V}{R_1 + R_2 + r} = \frac{12}{0.05 + 0.09 + 0.01} = 80A$$

(ii)

$$V_1 = I(R_1 + R_2) = 80 \times (0.05 + 0.09) = 11.2V$$

(iii)

$$P = IV_1 = 80 \times 11.2 = 896\text{W}.$$

20.29

$$I_3 = I_1 + I_2$$

20.30

For loop a b c d e f g h i j a:

$$\begin{aligned}-I_1R_1 + E_1 - I_1r_1 - I_1R_5 - I_3r_4 - E_4 - I_3r_3 + E_3 - I_3R_3 &= 0 \\ -I_1(R_1 + r_1 + R_5) - I_3(r_4 + r_3 + R_3) + E_1 - E_4 + E_3 &= 0 \\ -I_1 \times (5 + 0.1 + 20) - I_3 \times (0.2 + 0.05 + 78) + 24 - 36 + 6 &= 0 \\ 25.1I_1 + 78.25I_3 &= -6\end{aligned}$$

20.31

For loop a k l e d c b a:

$$\begin{aligned}-I_2(r_2 + R_2) + I_1(R_5 + r_1 + R_1) + E_2 - E_1 &= 0 \\ -I_2 \times (0.5 + 40) + I_1 \times (20 + 0.1 + 5) + 48 - 24 &= 0 \\ 25.1I_1 - 40.5I_2 &= -24\end{aligned}$$

20.32

$$\begin{cases} I_1 + I_2 = I_3 \\ 25.1I_1 + 78.25I_3 = -6 \\ 25.1I_1 - 40.5I_2 = -24 \end{cases}$$

Solve the equation, and we have

$$\begin{cases} I_1 = -0.345\text{A} \\ I_2 = 0.379\text{A} \\ I_3 = 0.034\text{A} \end{cases}$$