Chapter 9 Physics Midterm #2 Monique Perez

1a) $\tau = RC \quad C = \frac{\tau}{R}$

$$C = \frac{100\times10^{-6}s}{1.00\times10^{3}\Omega} = (1.0\times10^{-7}F)\left(\frac{1.0\times10^{9}nF}{1F}\right)$$

$$= 1.0\times10^{-7}F \text{ or } 100nF$$

The maximum capacitance is $1.0\times10^{-7}F$ or $100nF$.

b) It would not be difficult to limit the capacitance, because you can easily limit the capacitance of the capacitor range from nF to mF in the ECG monitor system. One way of doing this is by adding more resistance.

c) $R = 1000\Omega$, max amp $= 60mV$ $C = 1.0\times10^{-7}F$

$RC = (1000\Omega)(1.0\times10^{-7}F) = 1.0\times10^{-4}$

* remember $t = RC$ *

$V_c(t) = \mathcal{E}_i(1-e^{(-t/\tau)})$ $\tau = 1.0\times10^{-4}$

$$\frac{0.003V}{0.006V} = \frac{0.006V(1-e^{-t/1.0\times10^{-4}s})}{0.006V}$$

$$0.5V = 1-e^{-t/1.0\times10^{-4}s}$$

$$\ln(e^{-t/1.0\times10^{-4}s}) = \ln(0.5)$$

$$1.0\times10^{-4} \times \frac{-t}{1.0\times10^{-4}s} = \ln(0.5)$$

$$-t = \ln(0.5)(1.0\times10^{-4}s)$$

$$\frac{-t}{-1} = \frac{-6.93\times10^{-5}}{-1}$$

$$\boxed{t = 6.93\times10^{-5}\text{ sec}}$$

1

2

$V(t) = V_0 \sin(2\pi f t + \phi)$ $V_0 = 120\ V$

$f = 60\ Hz$

a) $V(t) = 120 \sin(2\pi f t)$ $\therefore$ $\phi = 0$

$V(t) = 0$ when and

$\sin(2\pi f t) = \sin(2\pi n)$

where n is any real number such as 0, 1, 2... $\boxed{t = \frac{n}{f}}$

b) $R = 1000\ \Omega$ $\frac{V}{R} = \frac{IR}{R}$ $\frac{\Delta V}{R} = \Delta I = V(t)$

$i(t) = \frac{V(t)}{R} \sin(2\pi f t + \phi)$

$i(t) = \frac{120V}{1000\ \Omega} (\sin(2\pi(60)(t) + \phi))$

$i(t) = 0.12\ A$ now remembering

$P = IV$ and $V = IR$

$\therefore$

$P = I^2 R$

$P = (0.12\ A)^2 \times 1000\ \Omega$

$\boxed{P = 14.4\ \text{Watts}}$

c) $P = \frac{(0.12\ A)^2 \cdot 1000\ \Omega}{2}$ $V = \frac{IR}{2}$

$P = \frac{(I)^2 R}{2}$ where $I^2 = 0.0144\ A$ and $R = 1000\ \Omega$

$P = \frac{0.0144\ A \times 1000\ \Omega}{2}$

$\boxed{P = 7.2\ \text{Watts}}$

2

3. $I = 3.00\ A$ and $P = IV$
$V = 110\ V$

$$P = (3.00\ A)(110\ V)$$
$$\boxed{= 330\ \text{Watts}}$$

$$P_{total} = 330\ W + 60\ W + 100\ W + 3.00\ W$$
$$= 493\ W$$
$$= 0.493\ kW$$

$$0.493\ kW \times \frac{\$0.2}{kW \cdot hr} \times \frac{12\ hr}{1\ day} \times 30\ days$$

$\boxed{\text{The student spends } \approx \$35.50}$

Ch 10

(1) $R = k\Omega$, $V = 12\ V$ and $I = \frac{V}{R}$

$$I_1 = (I_2 + I_3)$$

$$E - I_3\left(\frac{1}{2R} + \frac{1}{2R}\right) - I_1 R = 0$$

$$E - I_3\left(\frac{1}{2R} + \frac{1}{2R}\right) - (I_2 + I_3)R = 0$$

$$E - I_3\left(\frac{1}{2R} + \frac{1}{2R}\right) + I_2 R + I_3 R = 0$$

$$E - I_3\left(\frac{1}{2R} + \frac{1}{2R} + R\right) + I_2 R = 0$$

$$\frac{1}{R} = \frac{1}{2R} + \frac{1}{2R}$$
$$R = \frac{2P}{P} = 1000\Omega$$

$$12\ V = I_3(1000\Omega + 1000\Omega)$$

$$\boxed{12\ V = I_3(2000\Omega) + 1000 R I_2}$$

now remembering that $\boxed{I_1} = I_2 + I_3$
we can plug into $E - I_2 R - \boxed{I_1} R = 0$

$$E - I_2 R - (I_2 + I_3)R = 0$$

$$E - I_2 R - I_2 R - I_3 R = 0$$

3

$E = I_2 R + I_2 R + I_3 R$

$E = I_2 (R + R) + I_3 R$

$\boxed{12\ V = I_2 (2000\ \Omega) + 1000\ \Omega \times I_3}$

using the eqns in purple

$2(12\ V) = (2000\ \Omega I_2 + 1000\ \Omega I_3)2$

$24\ V = 4000\ \Omega I_2 + 2000\ \Omega I_3$

$-\ 12\ V = 1000\ \Omega I_2 + 2000\ \Omega I_3$

$12\ V = 3000\ \Omega I_2 + 0$

$\frac{12\ V}{3000\ \Omega} = I_2 \therefore \boxed{I_2 = 0.004\ A}$!

now that we have I_2 we can solve for I_3 & I_1.

$12V = 1000\ \Omega I_2 + 2000\ \Omega I_3$

$12V = 1000\ \Omega (0.004\ A) + 2000\ \Omega I_3$

$12V = 4 + 2000\ \Omega I_3$

$-4 \quad -4$

$\frac{8}{2000\ \Omega} = \frac{2000\ \Omega I_3}{2000\ \Omega}$ $\boxed{I_3 = 0.004\ A}$!

now that we have I_2 and I_3 we can find I_1!

$I_1 = 0.004\ A + 0.004\ A$

$\boxed{I_1 = 0.008\ A}$!

4

now we can solve P for I_1, I_2, and I_3!

I_1) $P = (0.008\,A)^2(1000\,\Omega) = 0.064$ Watts

I_2) $P = (0.004\,A)^2(1000\,\Omega) = 0.016$ Watts

now to solve for P_{total} since $P = I_3 (R_{total})$

I_3) $P_{tot} = (0.004\,A)^2(1000\,\Omega) = 0.016$ Watts total

now that we have total P now we can solve for the power in each resistor

$$\frac{0.016 \text{ Watts}}{2} = \boxed{0.008 \text{ watts for each resistor!}}$$

both resistors

Ch10

2) $\mathcal{E} = 1.5V$ $r = 0.25\,\Omega$ $R = 50\,\Omega$

$\mathcal{E}_1 - I_1 r_1 + I_2 r_2 - \mathcal{E}_2 = 0$ now rearranging this

$I_1 r_1 - I_2 r_2 + \mathcal{E}_2 - \mathcal{E}_1 = 0$

$0.25 I_1 - 0.25 I_2 + 1.5 - 1.5 = 0$

and ☆ $I_1 = I_2$ ☆ will use I_2 to represent I_1 and I_2!

$I_2 r_2 + (I_2 + I_2)R - E_2 = 0$

☆ $0.25 I_2 + (I_2 + I_2)(50) - 1.5 = 0$

I_1 and $I_2 = 0.015\,A$

Since we are solving for current

$I_{tot} = I_1 + I_2 = 0.015 + 0.015 = 0.030\,A$

$\boxed{\text{Current flow} = 0.030\,A}$

5

2b) $q = 2.5\,A\,hr$ since there is 2 batteries $\hookrightarrow 2q$

$\Delta Q = I \Delta t$ and $I = \frac{2q}{t}$

$t = \frac{2q}{I} = \frac{2(2.5)}{0.030}$

$\boxed{t = 166.7\ h}$

Ch 11

① a) Since the particle bends to the left after passing through the plate and the magnetic field is into the plate, we can infer that the particle is moving upward. Furthermore if the particle is moving upwards and again bends to the left, the particle is positively charged.

b) the mass of the particle (given that it has a mass of an electron as stated) is about 9.1×10^{-31} kg

This information however doesn't coincide with the fact that an electron is negatively charged. Therefore, since the mass is positive and an e⁻ in negative ($q = -1.6 \times 10^{-19}$ C) it doesn't seem likely that this particle can have the mass of an electron.

However what could make this hold true is if the particle is an antiparticle in which $q = +1.6 \times 10^{-19}$ C

6

1c) $B = 0.05\,T$, $V = 10^6\,m/s$

$q = +1.6 \times 10^{-19}\,C$

additionally since the angle between B and V is $90°$

we can now solve this using this equation

$F = q \times V \times B \sin\theta$

where $\theta = 90°$

and $\sin 90° = 1$

now

$F = (1.6 \times 10^{-19}\,C) \times (1.0 \times 10^{6}\,m/s) \times (0.05)1$

$F = 8.0 \times 10^{-15}\,N$

and the direction of the force is to the left