In Nucleus

Mid Term 1

1. $2.00\,mC \cdot \frac{1\,C}{10^6\,mC} \cdot \frac{1\,e^-}{1.6\cdot10^{-19}\,C} = 1.25\cdot10^{13}\,e^-$ removed

$50.0\,g \cdot \frac{1\,mol}{63.5\,g} \cdot \frac{6.02\cdot10^{23}}{1\,mol} = 4.74\cdot10^{23}\,atom \cdot \frac{29\,p}{1\,atom} = 1.37\cdot10^{25}$

$\frac{1.25\cdot10^{13}}{1.37\cdot10^{25}} = \boxed{9.09\cdot10^{13}}$

10 cm

1 2 4

2. $F_{1,2} = \frac{k|q_1 q_2|}{r^2}$ $F_{1,2} = \frac{8.99\cdot10^9\,|6\cdot10^{-6}\cdot2\cdot10^{-6}|}{(0.05)^2}$

$F_{1,2} = 43.152\,N$

$F_{2,3} = \frac{k|q_2 q_3|}{r^2} = \frac{8.99\cdot10^9\,|2\cdot10^{-6}\cdot4\cdot10^{-6}|}{(0.05)^2}$

$F_{2,3} = 28.76\,N$

$43.152 - 28.76 = \boxed{14.4\,N}$

b. away

3. $\frac{8.99\cdot10^9\,|1\cdot10^{-6}\cdot2\cdot10^{-6}|}{0.03^2} - \frac{8.99\cdot10^9\,|1\cdot10^{-6}\cdot2\cdot10^{-6}|}{0.05^2}$

$\boxed{F_3 = 12.8\,N}$

4. $F_2 + F_3 + F_4 - F_1 = F_T$

$k\left(\frac{5\cdot10^{-9}}{0.06^2} + \frac{1.5\cdot10^{-9}}{0.03^2} + \frac{5\cdot10^{-9}}{0.03^2} - \frac{1\cdot10^{-9}}{0.1^2}\right) = \boxed{2.03\cdot10^5}$

5. $0.05^2 + 0.05^2 = C^2$

$C = 0.0707\,m$

$F = \frac{8.99\cdot10^9\,(7.5\cdot10^{-6}\cdot2\cdot10^{-6})}{0.0707^2} = \boxed{26.97\,N = F_q}$

$F_{qy} = 26.97\cos(45) = 19.07\,N\cdot4 = \boxed{76.3 = F_T}$

4. $\Delta V = \frac{\Delta PE}{qE}$

$40{,}000 = \frac{\Delta PE}{1.6 \cdot 10^{-19}}$

$\Delta PE = 6.4 \cdot 10^{-15}\ J$

$V = \sqrt{\frac{2(6.4 \cdot 10^{-15}}{9.11 \cdot 10^{-31}}} = \boxed{1.18 \cdot 10^{8}} = KE$

b. $\frac{V}{m} = \frac{N}{C}$

$\frac{J}{C \cdot kg} = \frac{N}{C} = \boxed{\frac{N \cdot K}{C \cdot K} = \frac{N}{C}}$

7. $V_{AB} = Ed$

$V_{AB} = 7.5 \cdot 10^{4}(0.04$

$\boxed{V_{AB} = 3{,}000\ V}$

b. $\frac{1}{4}(3{,}000) = 750\ V$

c. $V_{AB} = Ed$

$E = \frac{0.08}{9 \cdot 10^{-9}}$ $\boxed{E = 8.89 \cdot 10^{6}\ V/m}$

8. $q = 2(1.6 \cdot 10^{-9}\ C) = 3.2 \cdot 10^{-9}\ C$

$E = 32.0\ KeV \cdot \frac{1000\ eV}{1\ KeV} \cdot \frac{1.6 \cdot 10^{-9}\ J}{1\ eV} = 5.12 \cdot 10^{-15}\ J$

$\Delta V = \frac{\Delta PE}{q} = \frac{5.12 \cdot 10^{-15}}{3.2 \cdot 10^{-9}} = 1.6 \cdot 10^{4}\ V$

$V_{AB} = EL = \frac{1.6 \cdot 10^{4}}{0.02} = \boxed{E = 8.0 \cdot 10^{5}\ V/q}$

d. $7\alpha^{+} = 1.264 \cdot 10^{-17}$

$E = 5\ MeV \cdot \frac{10^{6}\ eV}{1\ MeV} \cdot \frac{1.6 \cdot 10^{-19}}{1\ eV} = 8 \cdot 10^{-13}\ J$

$\Delta V = \frac{\Delta PE}{q} = \frac{8 \cdot 10^{-13}}{3.2 \cdot 10^{-9}} = 2.5 \cdot 10^{4}\ V$

$r = \frac{9 \cdot 10^9 (1.269 \cdot 10^{-17})}{2.5 \cdot 10^6}$

$r = 4.55 \cdot 10^{-14}$

Section 2

1. $C = \frac{Q}{V}$ $\quad C = \frac{3 \cdot 10^{-6}}{120}$ $\quad C = 2.5 \cdot 10^{-9} F$

2. $E = \frac{10 \cdot 10^{-6} (9 \cdot 10^3)^2}{2}$ $\quad E = 405 J$

b. $q = C \cdot V = 10 \cdot 10^{-6} (9 \cdot 10^3)$ $\quad 0.09 C$

c. $V = \sqrt{\frac{2(E)}{C}}$ $\quad q = 8 \cdot 10^{-6} (3.16 \cdot 10^3)$

$V = \sqrt{\frac{2(40)}{8 \cdot 10^{-6}}}$ $\quad q = 0.0253 C$

$V = 3.16 \cdot 10^3 V$

3 ?

4. $2 = \frac{(1.7 \cdot 10^{-8})(L)}{0.00000314}$ $\quad A = \pi (0.001)^2 = 0.00000314$

$\frac{2}{L} = 0.00541$

$L = 364.69 m$

5

Section 3

1. R_1 and R_2 parallel

$$\frac{50}{15} \cdot \frac{5 \cdot 10}{5+10} = 3.33$$

$$\frac{3.33K + R_3}{3.33K + R_3} = 2$$

$$R_3 = 5K\,R$$

3. $V = IR$

$12 = I\,2$

$I = 12\,m$

2

$I = 6\,mA$

c. $I_1 + I_2 + I_3 = 6$

$I_1 = 1.2$

$I_2 = 2.4$

$I_3 = 2.4$

$I_{R_1} = \frac{12}{10} = 1.2\,mA$

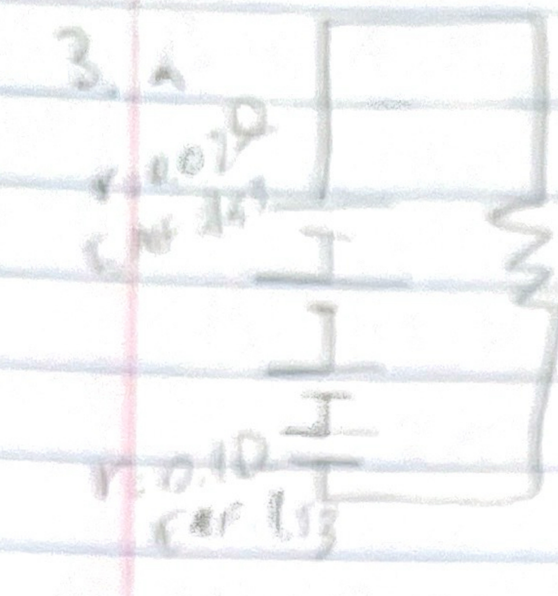
$I_{R_2, R_3} = \frac{12}{5} = 2.4$

2. $P = IV$

$I = \frac{V}{R}$ $\quad \frac{13}{R_5} = I$ $\quad I \cdot \frac{3}{0.5} =$ 64

$P = \frac{3}{R} V$

??



b. $I_T = \frac{3(4.5V) + 15\Omega}{3(0.02\Omega) + 0.1\Omega + 10\Omega}$

$I = 9.617A$

c. $P_L = (9.617)^2(10\Omega)$

$P_L = 3.18W$

d. $I_T = \frac{V_T}{R_T}$ $\quad 0.224 = \frac{3(4.5V) + 15\Omega}{3(0.02\Omega) + r + 10\Omega}$

$0.224 = \frac{67}{10.06 + r}$

$r = 18\Omega$

4. $\frac{1 \text{ km}}{72 \text{ seats}} \cdot \frac{2.013 \text{ a}}{1 \text{ seat}} \cdot \frac{60 \text{ s}}{1 \text{ km}} = 0.833 \frac{\text{s}}{\text{a}}$

$T = RC$

$0.833 = R(25 \cdot 10^{-9})$ $\quad R = 3.33 \cdot 10^7 \Omega$

5. $\frac{T}{R} = C = \frac{1 \cdot 10^{-4}}{1 \cdot 10^3} = C$ $\quad C = 1 \cdot 10^{-7} F$ < capacitance has to be less

6. No, the value is within acceptable values

Section 4

1 case	v direction	B	F
a	$-\hat{j}$ downward	$+\hat{k}$	$-\hat{i}$
b	$+\hat{j}$	$+\hat{i}$	$+\hat{k}$
c	$+i$	$+\hat{k}$	$+\hat{j}$
d			

No case d?

2. $\frac{F}{IvB} = \sin\theta$ $\frac{1.4 \cdot 10^{-16}}{(1.6 \cdot 10^{-19})(4 \cdot 10^{3})(1.25)} = \sin\theta$

$0.75 = \sin\theta$

$\theta = 10.1$

3. $q = \frac{(2.66 \cdot 10^{-26})(5 \cdot 10^{6})}{(9.231)(1.2)}$

$q = 4.8 \cdot 10^{-19} C$

b. $\frac{4.8 \cdot 10^{-19}}{1.6 \cdot 10^{-9}} = 3$

c. Can't have a piece of an electron. So it has to be a whole number

d. $\frac{16}{18} = \frac{2.66 \cdot 10^{-26}}{x}$

$x = 2.99 \cdot 10^{-26}$

$r_{18} = \frac{2.99 \cdot 10^{-26}(5 \cdot 10^{6})}{1.6 \cdot 10^{-19}(1.2)} = 0.779 m$

4. $F = 100(0.25)(2)\sin(90)$

$F = 50 N$

5. $T = NIAB\sin\theta$

$\frac{T}{NIA\sin\theta} = B = \frac{300}{200(25)(0.2^{2})\sin(90)} = B$

$B = 1.5 T$

6.

Case	B direction
a	+ $\vec{F}$ out of Page
b	+ $\vec{F}$ to the right
c	− $\vec{F}$ to the left

7. $B = \frac{\mu_0 I}{2\pi r}$ $\quad \frac{P}{J} = I \quad \frac{450 \cdot 10^6}{300,000} = 1,500A$

$B = \frac{4\pi \cdot 10^{-7}(1500)}{2\pi(20)} = \boxed{1.5 \cdot 10^{-5} T}$

8. $N = \frac{2\pi \cdot .5 \cdot 1}{4\pi \cdot 10^{-7} \cdot I}$

$N = \frac{10\pi \cdot 10^{-7}}{4\pi \cdot I}$

$N = \frac{2.5 \cdot 10^{6}}{I} \qquad I = 10^6$

$N = 2.5$ loops

9. $f = \frac{(1.6 \cdot 10^{-19})(1)}{2\pi(1.67 \cdot 10^{-27})}$

$f = \frac{1.6}{2\pi(1.67)} \cdot 10^8$

$\boxed{f = 15.23 \cdot 10^6 Hz}$