PHY 124 SOLUTIONS

FOR

PHARMACY STUDENTS

MADE EASY

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CHAPTER ONE EXERCISE

1. Q_1=+3μc, Q_2=+ 5μc, r=0.3m
   Calculate the net force
   $$f=\frac{KQ_1Q_2}{r^2}=\frac{9x10^9x3x5x10^{-12}}{0.3}\left[10^{-6}x10^{-6}=10^{-12}\right]$$
   F=1.5M (Like charges Repel, Hence the force is Repulsive.)
2. Same procedure Q_1= Q_2=+ 5μc, =5x10^{6}c
   r=0.05m,
   $$f=\frac{KQ_1Q_2}{r^2}=\frac{9x10^9x3x5x10^{-6}}{0.05}$$
   F=90N
3. force due to gravity (fg)Electrostatic force (i.e)
   $$fg=fe-----Mx(g)=\frac{KQ^2}{r^2}r^2=\frac{KQ^2}{M_exg}$$
   $$r=Q\sqrt{\frac{k}{m_{xg_e}}}=1.6x10-^{19}\sqrt{\frac{9x10^9}{9.1024x10x90}}$$
   r=5.03m.
4. r=0.3m, F-2.3 0x10-^{22}N
   using $f=\frac{KQ^2}{r^2},Q^2=\frac{fr^2}{K},Q=r\sqrt{\frac{f}{k}}$
   $$Q=0.3\sqrt{\frac{2.3x10^{-22}}{9x109}}=4.796x10^{-17}c$$

But $Q=ne,n=\frac{Q}{e}=\frac{4.796x10^{-17}}{1.6x10^{-19}}=2199.7...electrons$

n=300 electrons.

5. A) conventionally: /F_R/=/-F_x/
   -ve because of direction

$$f_x = \frac{KQ_1Q_2}{r^2} \frac{9x10^9 x2x3x10^{-12}}{(0.15)^2} = 2.4$$

$$fy = \frac{KQ_1Q_2}{r^2} = \frac{9x10^9 x2x4x10^{-12}}{(0.1)^2} = 7.2$$

But $/F_R/=/Fx/+/Fy/$ as stated above
$/F_R/= (-2.4)i +(7.2);N$
Magnitude of F_R i.e $F_R{}^2=fx^2+Ry^2$

$$F_R = \sqrt{(-2.4)^2 + (7.2)^2} = 7.59 = -7.6N$$

c. The angle that F_R makes with the +ve x – axis is 2

but 2= 180- θ (angle on a straight line)

$$\theta = \tan^{-1}\left\{\frac{fy}{fx}\right\} = \tan^{-1}\left[\frac{7.2}{2.4}\right], \theta = 71.57^0$$

$$2 = 180 - \theta = 180 - 71.57, 2 = 108$$

CHAPTER TWO EXERCISES

$$Q = 1.6X10^{-19} c, E = 120{,}000Vm^{-1} = 120{,}000N/C$$

$$r = 20mm = 0.02m, m = 9.1x10^{-3} kg$$

$$fe = fg$$

1. $fe = qE = 120{,}000x10^{-19} = 1.92x10^{-14} N$

$$f = Ma, a = \frac{f}{m} = \frac{1.92x10-14}{9.109x10^{-3}1} = 2.11x10^{16} ms^{-2}$$

$$S = ut + \frac{1}{2}gt^2$$

But u= 0(travels from rest)

$$S = \frac{1}{2}gt^2, t = \sqrt{\frac{2s}{g}} = \sqrt{\frac{2x0.02}{2x10^{16}}} t = 1.377x10^{-9} c$$

3a) $E = \frac{f}{Q} = \frac{KQ}{r^2} = \frac{9x10^9 x3x10^{10}}{0.02^2} E = 6750$

$6.8x10^3 N/C$

B) E=20% of original value E_0

$E = \frac{20}{100} xE_0 \frac{KQ}{r^2} = \frac{2}{10} E_0 = \frac{9x10^9 x3x10^{10}}{r^2}$

$= \frac{2}{10} x6.8x10^3 r^2 = 1.985x10^{-3} = 0.044m = 4cm$

4) $Moment = 6.2x10^{-3} cm, \theta = 1.6x10^{-19} c$

$Ais\tan ce = \frac{moment}{charge} = \frac{6.2x10^{-3} cm}{1.6x10^{-19}} = 3.9x10^{-11} m$

b) Calculate the Forge (i)

i=moment x Electric field = 6.2x 10^{-3}cm x $1.6x10^{-19}$

i=$9.3x10^{-26}$NM

5) r= 0.5m, E=2.0N/C. calculate Q

$E \frac{KQ}{r^2} Q = \frac{Er^2}{K} = \frac{2x0.5^2}{9x10^9} = 5.56x10^{-10} c$

Note: iv= 1J/c = 1NM/C

1 v/m = 1N/C

CHAPTER THREE EXERCISES

1) Energy density μ = 2.5J, v=1.00m³

$$\frac{E}{V} = \frac{1}{2} E_0 E^2$$

$$U = \frac{2.5}{1} = 2.5J/m^3$$

$$E = \sqrt{\frac{2u}{E_0}} = \sqrt{\frac{2x2.5J/m^3}{8.85x10^{-12}}}$$

$$E = 7.52x10^5 \, V/m$$

$$\frac{u_1}{E^2{}_1} = \frac{u_2}{E^2{}_1}$$

$$u_2 = \frac{E_2^2 x u_1}{E_1^2}$$

$$E_2 = \frac{1}{4} E_1$$

$$= \frac{\left(\frac{1}{4} E_1\right)^2 x2.5}{E_1^2}$$

$$E_2 = 0.2 \, J/M^3$$

3). $Q_1 \overset{0.1m}{-\!-\!-\!-\!-\!-\!-\!-} Q_2 \overset{0.5m}{-\!-\!-\!-\!-\!-\!-\!-} Q_3$

Taking Q_3 as the test charge

$$\frac{KQ_1Q_2}{r_{13}} + \frac{KQ_2Q_3}{r_{13}} = KQ_3\left[\frac{Q_1}{r_{13}} + \frac{Q_2}{r_{23}}\right]$$

$$w.d = 9x10^9 x1.5x10^{-6}\left[\frac{3x10^{-6}}{1} + \frac{2x10^{-6}}{0.5}\right] = 9.5x10^{-2} J$$

4). The final kinetic Energy K.E

$$K.E = \frac{KQ_1Q_2}{r_{12}} + W.D = \frac{9.0x10^9 x3x2x10^{-12} + 9.5x10^{-2}}{0.5}$$

K.E =2.0 x 10^{-1}J

CHAPTER FOUR EXERCISES

Shortcut; $\theta = \theta/E_0 = E_0 = 8.85x10^{-12}\ NM^2/c$

1) $\theta = \frac{\theta}{E_0} = \frac{3x1.6x10^{-19}}{8.85x10^{-12}} = 5.43x10^{-8}\ NM^2/c$

2) Same procedure

$\theta = \frac{\theta}{E_0} = \frac{5x10^{-6}}{8.85x10^{-12}} = 5.6x10^5\ NM^2/c$

3) INFINITE LINE

$\lambda = 184c/cm = 18x10^{-6}x100 = 18x10^{-4}c/m$

4) $Q = \frac{Q}{E_0} = \frac{4.8x10^{-6}}{8.85x10^{-12}} = 5.42x10^5\ NM^2/c$

CHAPTER SIX EXERCISES

$A = 200cm^2 = 0.02m^2$, $d = 4 \times 10^{-3}m$, V=500v.

Find Q

$Q = cv = \frac{E.A}{d}xV = \frac{0.02x8.85x10^{-12}}{4x10^{-3}}x500 = 2.2x10^{-8}c.$

$Q = 22nc$

2). V= Vmax/2 from question Vmax = 2v

$Q = cv....V = \frac{Q}{c} = \frac{Qd}{AE_0}$

$V\max = \frac{2Qd}{AE_0}.....but..E = \frac{V\max}{d}\ E = \frac{2Qd}{AE_0xd} = \frac{2Q}{AE_0}$

$E = \frac{2x10x10^{-6}}{4.84x10^{-4}x6x8.85x10^{-12}} = 7.85x10^8\ v/m$

3). $K = \frac{c}{c_0} = \frac{0.482\mu f}{0.2\mu f} = 2.41$

4). A = 2000 cm^2 = $0.02m^2$ · E_0 = 8.85 mo-^{12} , d = $^{0.4cm}$ = 0.004m

$$C = \frac{c_0 A}{d} = \frac{8.85x10^{-12} x0.02}{0.004} = 4.45x10^{-11}, C = 44pf$$

5). K = E_r =2.6 V=500v d= 0.004m.

$Q_{1=}$cv= E_r {E_0A/d}x V.

From question (4) E_0A/d = 4.45x 10^{-11}

Q_1=2.6x4.45x10^{-11}x500

(presence of dielectric)--------------5.73x10^{-8}

But in (4) above, dielectric is absent

Q_0=CV=500x4.45x10^{-11}, Q_0=2.2x10^{-8}C

Q_3=Q_1 –Q_0= (5.72-2.2) x 10^{-8}

Q_3= 3.52x10^{-8} Q_3=35nc (change due to dielectric)

6). $E = \frac{1}{2} CV^2 = \frac{1}{2} x1.2x10^{-6} x(3000)^2 = 5.4 doules$

7). Width = 0.5m, L= ? d=0.2x10^{-4}m C= 4x10^{-6}. Er = 2.8

$$C = \frac{E_0 E.A}{d}$$ (find A to get L)

$$A = \frac{cd}{E_0 Er} = \frac{4x10^{-6} x0.2x10-6}{2.8x8.85x10-12}$$

A = $3.2284m^2$ But A= LxW = $L = \frac{A}{W} = \frac{3.2284m^2}{0.5m}$ = L= 6.456m

8). Note charging =q= $CE(I - e^{-t} / Rc)$

Discharging

Q_1 = Q_0 e-t/Rc Redischarges

$$I = \frac{dQ}{dt} = \frac{Q_0}{Rc} e^{-t/Rc}$$

In the question above

Remaining charge = I- decay charged

$$1 - \tfrac{2}{5} = \tfrac{3}{5} Q_0$$

Q_1= $\quad Q_1 = Q_0 e^{-t/Rc}$

$$\tfrac{3}{5} Q_0 = Q_0 e^{-1/600x10^{-6}x100000}$$

$$In\left(\tfrac{3}{5}\right) = \frac{-t}{600x10^{-6}x100000}$$

$$t = -In(3/5)x600x10^{-6}x100000$$
$$t = 30.65\,\text{sec}$$

9). Energy =1/2 Qv

Q=? V=12v

E=5.4 x 10^{-3}J

$$Q = 2E/v = \frac{2x5.4x10^{-3}}{12}$$
$$= 9x10^{-4}c$$

10). Refer to your textbook for diagram

$C_2 C_7$ = ¼ + 1/8 because C_2 and C_7 are in series

$$C_{2,7} = \frac{4x8}{4+8} = \frac{32}{12} = \tfrac{8}{3}$$

Also

C_1C_4, C_5, C_6 and $C_{2,7}$ are in parallel

$C_{145627}= C_1+C_4+C_5+C_6+C+_{2,7}$

$=4+4+6+2+ 8/3$

$=56/3$ µf

5µf and the combining equivalent of $C_1C_{41}C_5C_{nd}$ $C_{2.7}$ are in parallel

$$\frac{1}{Cequ}=\frac{1}{C_3}+\frac{1}{C145627}$$

$$\frac{1}{Cequ}=\frac{1}{5}+\frac{1}{56/3}=\frac{1}{5}+\frac{3}{56}$$

$$Cequ=\frac{56x5}{15+56}=3.943\mu f.$$

11). C_1=2µf

Q=Cv note different charge is stored in as much they have different capacitor of capacitance but the same voltage across them

$Q_1=C_1V$

$=2x10^{-6}x500$

$=1x10^{-3}c$

12). The above question is the definition of electric potential which is the workdone in taken a charge from one place to another.

V= kq/r = r= 6cm = 0.06m

$Q= 1.2x\ 10^{-6}c$

$$\frac{9x10^9\ x1.2x10^{-6}}{0.06}=180kv$$

13). $Q= 1.0x10^{-6}c$

$C_1=0.001x10^{-6}f$, C_2=?

$d_1=d$ $\quad d_2= 1/2d$

Ar=A $\qquad$ A_2=3A

$$C=\frac{E_0A}{d}.....\frac{cd}{A}=K$$

$$\frac{C_1d_1}{A_1}=\frac{C_2d_2}{A_2}$$

$$C_2=\frac{C_1d_1A_2}{A_1d_2}=\frac{1.0x10^{-6}xdx3A}{Ax\frac{1}{2}d}$$

$$C_2=6C_1=6x0.001x10^{-6}f$$
$$=6nf$$

$$Q=CV$$
$$V=\frac{Q}{c}=\frac{1x10^{-6}}{x10^{-6}c}$$

Potidiff V= 1000v

14). Power =75w=p

t= 15minutes = 15x 60 = 900sec

v= 150 v

work = power x time = ½ CV^2

$$C=\frac{powerxtime}{\frac{1}{2}v^2}=\frac{75x900}{\frac{1}{2}(150)^2}$$

$$C=6f$$

15). V=500v, A = $0.1m^2$,d= 0.001m

E_0= 8.85 x 10^{-12} f/m. Q= ?

Note --------- Q= $\frac{VAE_0}{d} = 5000x0.1x3.85x10^{18}$

$Q = 4.425x10^{-6}c - - - - Q = 7.44C$

CHAPTER 9 (SUPPLIMENTARY PROBLEMS)

1) $H^{2+} = 2e$
   F=? v= $2x10^5$ ms^{-1}
   B=0.75T
   q=2e = $2x1.6x10^{-19}$c
   f= qvB = $2x1.6x10^{-19}x2x0.75$
   force F=$4.8x10^{-14}$N
2) Mproton = 1.67×10^{-27}
   B= 0.60T q=$1.6x10^{-19}$
   Charge of proton.
   Note ½ Mv^2 = Energy = ½ m^2v^2/m
   $m^2v^2 = q^2B^2r^2 (ifMV = qBv)$
   $\frac{1}{2}mv^2 = \frac{\frac{1}{2}q^2B^2r^2}{m} = \frac{1}{2}\frac{m^2v^2}{m}.$

   $\frac{1}{2}x\frac{(1.6x10^{-19}x0.60x0.012)}{1.67x10^{-27}}$
   = $3.9733x10^{-16}$J in electron volt
   Lev.--------- 1.6×10^{-19}J
   Work Wer ---------- $\left(\frac{3.9733x10^{-16}Jxlev}{1.6x10^{-19}}\right)$

   = 2483ev = 2480ev.

9.3 B = 0.1 + 0.3J -0.2k (in tesla)
F = qv B$\sin\theta$

$$I(0) - \begin{vmatrix} I & J & K \\ 3.2x10.5 & 0 & 0 \\ 0.1 & 0.3 & -0.2 \end{vmatrix} j(-64000) + k(96000)$$

Vx B

= 64000L + 96000k

$(vxB) = \sqrt{64000^2 + (9600)^2}$

= 115,377.64

$F = q\,(V \times B) = 1.6 \times 10^{-19} \times 115{,}377.64$

$F = 1.8 \times 10^{-14}$N

9.4 $\quad f = Ma - qvB = \frac{MV^2}{r}$

$r = \frac{MV^2}{QVB} = r = \frac{V_{RM}}{QB}$

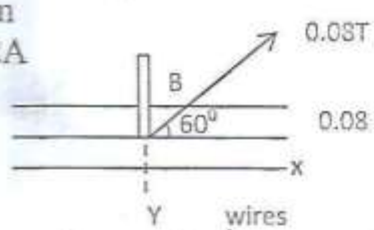
$$\frac{1}{2}MV^2 = ev_0, V = \frac{\sqrt{2evo}}{m} = \frac{\sqrt{2x\,1.6 \times 600 \times 10^{-19}}}{1.16 \times 10^{-26}}$$

V = 128653.5042m/s

$$1 = \frac{VM}{QB} = \frac{128653.5042 \times 1.16 \times 10^{-26}}{1.6 \times 10^{-19} \times 0.6} = 0.0155M$$

= r = 0.016m

9.5 $\quad$ I = 2A



L x B				
I (0) –	I	J	K	J (0) + k (1.5 x 0.0069)
L x b				= 0.1035k
	1.5	0	0	
But f				= L x B = I LB $\sin\theta$
= 2 x	0.04	0.069	0	0.1035k = 0.2In

In the z direction or (k direction)

9.6 b = 0.12T, N = 60turn, r = 0.013m,

$A = \pi r^2 = 5.3 \times 10^{-4} M^2$

$I = 1.5A, \theta = 90^0$

Y = BINA $\sin\theta$

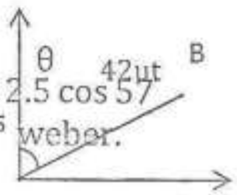
$= 0.12 \times 1.5 \times 60 \times 5.3 \times 10^{-4} \sin 90$

Torque $T = 5.72 \times 10^{-3}$

$F_1 = \frac{2 \text{ x Torgue}}{\text{radius}} = 0.88N$

9.7) $B = 42 \times 10^{-6+}T, \theta = 57^0, A = 2.5m^2$

$\theta = BA\cos\theta$



$\theta\ 42 \times 10^{-6} \times 2.5 \cos 57$

$\theta = 5.7 \times 10^{-5}$ weber.

CHAPTER 11

1) From ground state the n = excited state

$E_{11} = \frac{-13.6ev}{4^2} = \frac{-13.6ev}{16} = -00.85ev$

$E_1 = \frac{-13.6ev}{12} = \frac{-13.6ev}{12} = -13.6ev$

$\Delta E = E_4 - E_1 = (-0.85+13.6)ev$

$\Delta E = 12.75ev$

2) Speed of an e^- in the 2^{nd} orbit

$V = \frac{nl}{2\bar{\lambda}mr} = \frac{2\times6.6\times10^{-34}}{2\bar{\lambda}\times9.11\times10^{-31}\times0.0529\times4}$

Note: $r = 0.0529n^2$ and $M_e = 9.11\times10^{-31}kg$

$v = 1.095 \times 10^{-3} Mls$

3) Calculate freq from n = 2 to n = 5

$E_2 = \frac{-13.6}{2^2} = \frac{-13.6}{4} = -3.4$

$E_5 = \frac{-13.6}{5^2} = \frac{-13.6}{25} = -0.544$

$\Delta E = E_5 - E_2 = 0.544 + 3.4 = 2.856ev$

$E = hf, \quad f = E/h$

$F = \frac{2.856\times1.6\times10^{-19}}{6.651\times10^{-34}} = 6.68 \times 10^{14} hz$

4) From D_2 to n_{0-1}

$E_2 = \frac{-13.6}{2^2} = -3.4$

$E_{0.1} = \frac{-13.6}{0} = 0$

$\Delta E = 0 - (-3.4) = 3.4ev$

$E = hf, \quad f = E/h$

$F = \frac{3.4\times1.6\times10^{-19}}{6.639\times10^{-34}} = 8.2 \times 10^{14} H_z$

5) $F = 98.9MHz = 98.9\times10^6 H_z$

$P = 750 \times 10^3 W$

Calculate the no of photons for seconds

$E = pt = 750 \times 10^3 \times 1 = 75.0 \times 10^3 J$

$E = nhf, \; n = \frac{E}{hf} = \frac{750\times10^3}{6.654\times10^{-34}\times98.9\times10^6}$

$n = 1.14 \times 10^{31}$ photons

CHAPTER 13

1) Half life of iodine $t½ = 8$ days at a certain time, $N = 4 \times 10^4$ nuclei

a) Calculate the activity

As stated earlier, Activity A = AN

$$\lambda = \frac{0.693}{t\frac{1}{2}}$$

converting t½ to seconds

$t½ = 8 \times 86400 = 691200s$

$$\lambda = \frac{0.693}{691200} = 1.00 \times 10^{-6}\ s^{-1}$$

$A = 1.00 \times 10^{-6} \times 4 \times 10^{14} = 4.0 \times 10^{8}$ dee

b) Using $\frac{N}{No} = 2^{-n}$ $n = \frac{t}{t\frac{1}{2}} = \frac{1 \times 864}{8 \times 864} = \frac{1}{8}$

note (How many iodine remained after 1day)

(hence t = 1day = 1 x 86400)

$N = No\ (2^{-n})$

$N = 4 \times 10^{14}\ (2^{-1/8}) = 3.7 \times 10^{17}$ nuclei

2) No = 200 N = 25

Midday means 12 0 clock between 12 O clock and 3 O clock T = 3 hours.

Using equation (1)

$$N = No\ (½)^{t/t_{½}}$$

$$\left(\frac{N}{No}\right) = \left(\frac{1}{2}\right)^{t/t_{½}}$$

$$\left(\frac{25}{200}\right) = \left(\frac{1}{2}\right)^{T/t½}$$

$$\left(\frac{1}{8}\right) = \left(\frac{1}{2}\right)^{3/T½}$$

$$\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{3/T½}$$

$$3 = \frac{3}{T_{½}} \qquad T_{½} = \frac{3}{3}$$

Half life $T_{½} = 1$ hour

3) t = 2 hours

$No = 8000$ $N_{died} = 1000$

Remaining bacteria

N = No – Ndied

$$8000 - 1000 = 7000$$

$$\left(\frac{N}{No}\right) = \left(\frac{1}{2}\right) {}^{t}/_{t_{1/2}}$$

$$\frac{7000}{8000} = \left(\frac{1}{2}\right)^{2/T_{1/2}}$$

$$\frac{7}{8} = \left(\frac{1}{2}\right)^{2/T_{1/2}}$$

$$\frac{2}{t^{1}/_{2}} = \frac{\log\left(\frac{7}{8}\right)}{log\left(\frac{1}{2}\right)}$$

$$t_{1/2} = \frac{2}{\left[\frac{\log\frac{7}{8}}{\log\frac{1}{2}}\right]} = \frac{2}{0.19}$$

t ½ = 10.38 hour

N = 5000 – population

$$\frac{5000}{8000} = \left[\frac{1}{2}\right]^{T/10.38}$$

$$\left(\frac{5}{8}\right) = \left[\frac{1}{2}\right]^{T/10.38}$$

Take log of both side we have

$$\text{Log}\left(\frac{5}{8}\right) = \frac{T}{T_{1/2}} \log\left(\frac{1}{2}\right)$$

$$T = 10.4 \log \frac{\left(5/8\right)}{\log\left(1/2\right)}$$

$$= 7\text{hours}$$

4) $N_1 = N_0$

Ndied = 2/3 N_o

Remaining = N_o = 2/3 N_o

$N = 1/3\ N_o$

$N = N_o\ (½)\ {}^{T}/_{T_{1/2}}$

$$\text{Log}\left(\frac{1}{3}\right) = \log\left(\frac{1}{2}\right)^{T/T_{1/2}}$$

$$\text{Log}\left(\frac{1}{3}\right) = {}^{T}/_{T_{1/2}} \log\left(\frac{1}{2}\right)$$

$$T = T½ \log \frac{\left(\frac{1}{3}\right)}{\log\left(\frac{1}{2}\right)}$$

$= 16.48 = 16.5$ hours

Check out this parameters:

λ = decay constant (5^{1})

note n = no of disintegrations

No = initial activity

N = after decay the remaining activity

T½ = half life of a substance

Undergoing radioactive decay in see