My hearty congratulations to +2 Students!

If you want to get '200' out of '200' in Physics, you should be answered the compulsory problem as well as possible. The physics learners are advised to frame their own responses taking ideas from the help – points given for each problem.

Here, All the public examination questions (Up to Sep – 2015) particularly, Sixty Seven problems are dealt in a detailed and simple manner, just like your attempts. The students are thus prepared in an effective way to face the compulsory problem confidently and come out with flying colours.

With best wishes and regards,

Walk with educational service

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1. A Parallel Plate capacitor has plates of area 200 cm^2 and separation between the plates 1mm. Calculate (i) The potential difference between the plates if 1 nc charge is given to the capacitor (ii) with the same charge if the plate separation is increased to 2mm, what is the new potential difference and ((iii) electric field between the plates. [March: 2006]

$A = 200\ cm^2$
$= 200 \times 10^{-4} m^2$
$d = 1 \times 10^{-3}$ m

$1\ cm^2 = 10^{-4}\ m^2$

(i) $q = 1 \times 10^{-9}$ c The potential difference between the plates v =?

$$v = \frac{\sigma d}{\varepsilon_0} = \frac{q\ d}{A.\ \varepsilon_0}$$

$$= \frac{1 \times 10^{-9} \times 1 \times 10^{-3}}{2 \times 10^{-2} \times 8.854 \times 10^{-12}}$$

v=5.65 v

(ii) If d′= 2 m m v′=?

If the distance increase by two times the P.D also will increase two times

∴v′= **2** x 5.65 =11.3 V

(iii) Electric Field $E = v / d = 5.65 / 10^{-3}$
= 5650 v / m.

2. Three capacitors each of capacitance a 9 pF are connected in series (i) What is the total capacitance of the combination? (ii) What is the potential difference across each capacitor, if the combination is connected to 120V Supply?

[June - 2006, Sep 2006, June - 2011]

Given

C = 9 pF	v =120 v
n = 3	$v_1 = v_2 = v_3 = ?$
C_s = ?	$v_1 = v_2 = v_3 = v / n = 120 / 3$
C_S = c/n = 9/3	$v_1 = v_2 = v_3 = 40$ v
C_S = 3 pF	

3.Two Capacitances 0.5 μF and 0.75 μF are connected in parallel and the combination to a 110v battery. Calculate the charge from the source and charge on each capacitor?

Given: - [June - 2007]

c_1=0.5 μF ; c_2=0.75 μF

v = 110 v

q_1, q_2=? Total Charge q = ?

$q_1=c_1 v$

$= 0.5 \times 10^{-6} \times 110$

q_1= 55 μc

$q_2=c_2 v$

$=0.75 \times 10^{-6} \times 110$

q_2 =82.5 μc

$q = q_1+q_2 = 55+82.5$

q = 137.5 μc

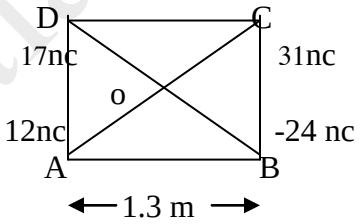
4. Calculate the electric potential at a point P, located at the centre of the square of point charges shown in the figure [June- 2007]

q_1=12 nc ; q_2=-24nc;

q_3=31 nc ; q_4=17 nc

if a=1.3 m

r=.OA=OB =OC=OD= a / √2



$$V = \frac{1}{4\pi\varepsilon_0 r}[q_1+q_2+q_3+q_4]$$

$$= \frac{9 \times 10^9 \times \sqrt{2}}{1.3}\left[12-24+31+17\right]$$

$$V = \frac{9 \times 1.414 \times 36 \times 10^{-9} \times 10^9}{1.3}$$

V = 352.4 V

5. Two positive charges of 12 μC and 8μC respectively are 10 cm apart. Find the work done in bringing them 4 cm Closer, so that, they are 6cm apart. [June 2008]

Given :- $q_1 = 12\ \mu c$; $q_2 = 8\mu c$

If $r_1 = 10$ cm

$$\text{Intial Energy } U_i = \frac{9 \times 10^9 \times q_1 q_2}{r_1}$$

$$= \frac{9 \times 10^9 \times 12 \times 10^{-6} \times 8 \times 10^{-6}}{10 \times 10^{-2}}$$

$= 8.64$ J

If $r_2 = 6$ cm ∴Final Energy

$$U_f = \frac{9 \times 10^9 \times 12 \times 10^{-6} \times 8 \times 10^{-6}}{6 \times 10^{-2}}$$

$U_f = 14.4$J

Work Done = W = Uf-Ui

$= 14.4 - 8.64$

W= 5.76 J

6. Two capacitors of unknown capacitances are connected in series and parallel if the net capacitances in the two combinations are 6 μ F and 25 μ F respectively find their capacitances

[Sep 2008]

Given :-

Cp=25 μ F

Cs = 6 μ F: c_1, c_2 =?

$C_p = c_1 + c_2$

$\therefore\ c_1 + c_2 = 25\ \mu F$

$C_2 = (25 - C_1)\mu F$

$C_s = C_1 C_2 / C_1 + C_2$

$$\frac{C_1 C_2}{C_1 + C_2} = 6$$

$$\frac{C_1 C_2}{25} = 6$$

$C_1 C_2 = 150$

$C_1 (25 - C_1) = 150$

$25C_1 - C_1^2 = 150$

$25C_1 - C_1^2 - 150 = 0$

$C_1^2 - 25C_1 + 150 = 0$

$(C_1 - 15)(C_1 - 10) = 0$

$C_1 = 15$ (0r) 10

$\therefore C_1 = 15\mu F$

$C_2 = 10\mu F$

7. The plates of parallel plate capacitor have an area of $90cm^2$ each and are separated by 2.5 mm. The capacitor is charged by connecting it is a 400V supply, how much electrostatic energy is stored by the capacitor? [June 2009, Sep 13]

$A=90\ cm^2 = 90 \times 10^{-4}\ m^2$
$d=2.5 \times 10^{-3}\ m$
$v=400\ v$
$E=?$
$E=cv^2/2$
$C=\varepsilon_0 A / d$

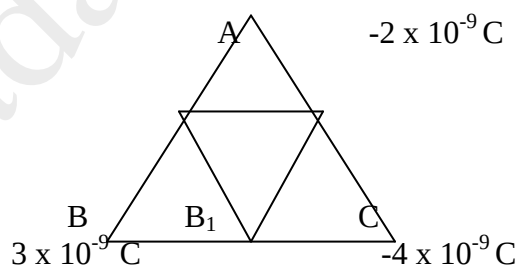
$$\therefore E = \frac{1}{2} \times \frac{\varepsilon_0 A}{d} \times v^2$$

$$E = \frac{1}{2} \times \frac{8.854 \times 10^{-12} \times 90 \times 10^{-4} \times 400 \times 400}{2.5 \times 10^{-3}}$$

$$= 2.55 \times 10^{-6}\ J$$

8. There Charges $-2\times10^{-9}C$, 3×10^{-9} C, -4×10^{-9} C are placed at the vertices of an equilateral triangle ABC of side 20 cm Calculate the work done in shifting the charges A, B and C to A_1, B_1, and C_1 respectively which are the mid points of the sides of the triangle. [June -2011]

$AB=BC=AC=20 \times 10^{-2}\ m$
$q_1 = -2 \times 10^{-9}\ C$
$q_2 = 3 \times 10^{-9}\ C$
$q_3 = -4 \times 10^{-9}\ C$
$U=?$



Initial Potential Energy $U_i = 1 / 4\pi\varepsilon_0 d\ [q_1 q_2 + q_2 q_3 + q_3 q_1]$

$$U_i = \frac{9 \times 10^9}{20 \times 10^{-2}} [(-2 \times 10^{-9} \times 3 \times 10^{-9}) + (3 \times 10^{-9} \times -4 \times 10^{-9}) + (-4 \times 10^{-9} \times -2 \times 10^{-9})]$$

$$= \frac{9 \times 10^9}{20 \times 10^{-2}} [(-6 \times 10^{-18} - 12 \times 10^{-18} + 8 \times 10^{-18}]$$

$$U_i = \frac{-9 \times 10^9 \times 10 \times 10^{-18}}{20 \times 10^{-2}} = 4.5 \times 10^{-7}\ J$$

If the Charges on A′, B′, and C′ distance final potential energy r′= 10×10^{-2} m

$$Uf = \frac{9 \times 10^{9}}{10 \times 10^{-2}} [-10 \times 10^{-18}]$$

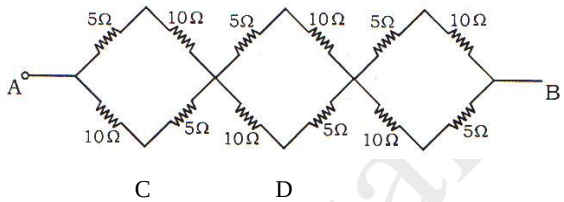
$= -9 \times 10^{-7}$ J

$\therefore U = Uf - Ui = -9 \times 10^{-7} - (-4.5 \times 10^{-7})$

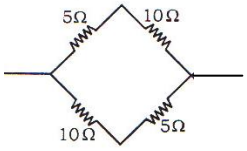
$= -(9+4.5) \times 10^{-7}$

$U = -4.5 \times 10^{-7}$ J

9. In the given network, calculate the effective resistance between points A and B. Find the effective resistance one unit [March: 2007]



∴The network has three identical units



R_1, R_2 are connected in series

$R_{s1} = R_1 + R_2$ $= 5+10 = 15\Omega$ $5+10 R_{1s}$

R_3, R_4 are connected in series

$R_{s2} = R_3 + R_4$

$R_{s2} = 5+10 = 15\Omega$

R_{s1}, R_{s2} are connected in Parallel $\therefore Rp_1 = R_s / n = 15 / 2 = 7.5\ \Omega$

Each unit has a resistance of 7.5 Ω

$R_s = nRp = 3 \times 7.5$

$R_s = 22.5\ \Omega$

10. The effective resistances are 10Ω , 2.4 Ω when two resistors are connected in series and parallel. What are the resistances of individual resistors

[March : 2007, March : 2010 October -2011, March : 2015]

$R_s = 10\Omega$; $R_P = 2.4\ \Omega$; $R_1, R_2 = ?$

$R_s = R_1 + R_2$

$R_1 + R_2 = 10\Omega$

$R_2 = (10 - R_1)\Omega$

$R_P = R_1 R_2 / (R_1 + R_2)$

$R_1 R_2 / (R_1 + R_2) = 2.4$

$R_1 R_2 / 10 = 2.4$

$R_1 R_2 = 24$

$R_1 (10 - R_1) = 24$

$10R_1 - R_1^2 - 24 = 0$

$R_1^2 - 10 R_1 + 24 = 0$

$(R_1 - 6)(R_1 - 4) = 0$

$R_1 = 6$ or 4

$\therefore R_1 = 6\ \Omega$; $R_2 = 4\ \Omega$

11. A copper wire of $10^{-6} m^2$ area of cross section carries a current of 2A, if the number of electrons per cubic metre is 8×10^{28}, calculate the current density and average drift velocity.($e=1.6 \times 10^{-19}$ c) [March : 2009]

$A=10^{-6} m^2$; $I=2A$; $n=8 \times 10^{28}$; $e=1.6 \times 10^{-19}$ c

$J=?$ $v_d=?$

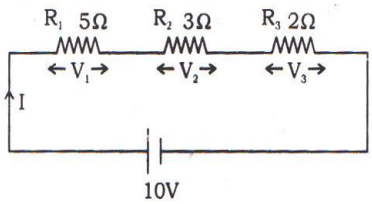
$J=I / A = 2 / 10^{-6} = 2 \times 10^6 A\ m^{-2}$

$$v_d = \frac{J}{n.e} = \frac{2 \times 10^6}{8 \times 10^{28} \times 1.6 \times 10^{-19}}$$

$= 0.156 \times 10^{-3}$

$v_d = 1.56 \times 10^{-4} ms^{-1}$

12. Three resistors are connected in series with 10V supply as shown in the figure. Find the voltage drop across each resistor [June - 2010 March: 2012]



Effective resistance of series combination $R_s = R_1+R_2+R_3$

$R_s = 5+3+2 = 10\ \Omega$

∴ Current in Circuit $I=v/ R_s=10/10 = 1$ A

Voltage drop across R_1 → $v_1 = I R_1 = 1 \times 5 = 5$ V

Voltage drop acrosR_2 → $v_2 = I R_2 = 1 \times 3 = 3$ V

Voltage drop acrosR_3 → $v_3 = I R_3 = 1 \times 2 = 2$ V.

13. What is the drift velocity of an electron in a copper conductor having area $10 \times 10^{-6} m^2$ carrying a current of 2A. Assume that there are 10×10^{28} electrons $/m^3$ [March : 2009]

$A = 10 \times 10^{-6} m^{-2}$; $I=2A$; $n=10 \times 10^{28}$ electrons / m^3

$v_d = ?$

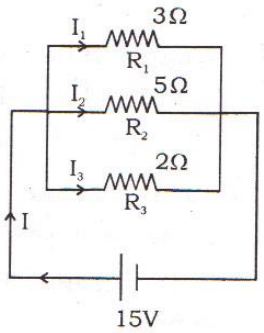
$I = n A e V_d$

$V_d = I / n A e$

$= 2 / [10 \times 10^{28} \times 10 \times 10^{-6} \times 1.6 \times 10^{-19}]$

$V_d = 1.25 \times 10^{-5} ms^{-1}$

14. Find the current flowing across the resistors 3 Ω, 5 Ω and 2 Ω connected in parallel to a 15 v supply, Also find the effective resistance and total current drawn from the supply [Oct-2010, March - 15]



$R_1 = 3\ \Omega$; $R_2 = 5\ \Omega$; $R_3 = 2\ \Omega$

V=15 v

$I_1, I_2, I_3 = ?$

Total Current I =?

Effective Resistance=?

Current Through R_1 $I_1 = V / R_1 = 15/3 = 5A$

Current Through R_2 $I_2 = V / R_2 = 15/5 = 3A$

Current Through R_3 $I_3 = V / R_3 = 15/2 = 7.5A$

∴ Total Current $I = I_1+I_2+I_3$

$= 5+3+7.5=15.5A$

Effective Resistance R = v / I =15 / 15.5

$= 0.967\ \Omega$

15. In a metre bridge, the balancing length for a 10 Ω resistance in left gap is 51.8 cm. Find the unknown resistance and specific resistance of a wire of length 108 cm and radius 0.2 mm.

[Oct-2010, June - 2010]

$P = 10\ \Omega$
$l_1 = 51.8cm$
$l_2 = 48.2cm$
$Q = ?$
$Q / P = l_2 / l_1$
$Q = P.\ l_2 / l_1 = 10 \times 48.2 / 51.8$
$Q=9.3\ \Omega$
$L = 108\ cm = 1.08m$
$r = 0.2 \times 10^{-3}\ m = 2 \times 10^{-4}\ m.$
$\rho=?$
$\rho= Q.A / L \Rightarrow Q.\pi r^2 / L$

$$= \frac{9.3 \times 3.14 \times (2 \times 10^{-4})^2}{1.08}$$

$\rho = 108.2 \times 10^{-8} = 1.082 \times 10^{-6}\ \Omega m$

16. An iron box of 400 W power is used daily for 30 minutes. If the cost per unit is 75 paise, find the weekly expense on using the iron box

[June - 2012]

P=400 W; t=1/2 Hour.
Rate /Unit = 75 Paise
Cost /Week = ?
Energy consumed in one day = P x t
= 400 x 1 / 2
=200 w h
W =0.2 k wh
W =0.2 Unit
Energy consumed in one week =7 x 0.2
=1.4 Unit

Cost / Week = Total units consumed x (rate / unit) = 1.4x0.75 = Rs.1.05

17. The resistance of a field coil measures 50 Ω at 20°C and 65 Ω at 70°C. Find the temperature coefficient of resistance.

$t_1= 20^o C$; $R_1= 50\ \Omega$, $t_2 = 70^o C$ $R_2= 65\ \Omega$ $\alpha =?$ [June 2013]

$$\alpha = \frac{R_2-R_1}{R_1t_2-R_2 t_1}$$

$$= \frac{65-50}{(50x70) – (65x20)} = \frac{15}{3500-1300}$$

$$= \frac{15}{2200} = 0.0068 / ^o C$$

18. A circular coil of radius 20cm has 100 turns wire and it carries a current of 5A. Find the magnetic induction at a point along its axis at a distance of 20cm from the centre of the coil. [March 2006, Oct -2006, March 2009,June-2015]

n =100 turns
$a = 20 \times 10^{-2}$ m
I = 5 A
$x = 20 \times 10^{-2}$ m
B =?

$a^2 = 4 \times 10^{-2}$

$x^2 = 4 \times 10^{-2}$

$$B = \frac{n\mu_0 I a^2}{2(a^2 + x^2)^{3/2}}$$

$$= \frac{10^2 \times 4 \times 3.14 \times 5 \times 4 \times 10^{-2} \times 10^{-7}}{2(4 \times 10^{-2} + 4 \times 10^{-2})^{3/2}}$$

$$= \frac{4 \times 3.14 \times 10^{-6}}{(8 \times 10^{-2})^{3/2}} = \frac{4 \times 3.14 \times 10^{-6}}{16\sqrt{2} \times 10^{-3}}$$

$= 0.555 \times 10^{-3}$
$B = 5.55 \times 10^{-4}$ T

19. A rectangular coil of 500 turns and area 6×10^{-4} m^2 is suspended inside a radial magnetic field of induction 10^{-4}T by a suspension wire of torsional constant 5×10^{-10} Nm/degree. Calculate the current required to produce a deflection of 10^0
[June 2006, Oct -09, March -13, Sep - 15]

N = 500; A=6×10^{-4} ;B=10^{-4} T
C = 5×10^{-10} Nm / degree $\theta = 10^\circ$, I=?
I = C θ / NBA

$$= \frac{5 \times 10^{-10} \times 10}{5 \times 10^2 \times 6 \times 10^{-4} \times 10^{-4}} = \frac{10^{-3}}{6}$$

I = 0.166 mA

20. A moving coil galvanometer of resistance 20 Ω produces full scale deflection for a current of 50mA. How you will convert the galvanometer into (i) an ammeter of range 20A and (ii) a voltmeter of range 120V.
[March : 2007,March : 2009, June -13, March -=15]

G = 20 Ω ; Ig = 50 mA;
(i) 20 A an ammeter range 20 A.
I = 20 A = 20000 mA

$$S = \left[\frac{Ig}{I-Ig}\right] G$$

$$= \left[\frac{50}{20000-50}\right] 20$$

$$= \frac{50}{19950} \times 20$$

S = 0.05 Ω

∴ A shunt of 0.05 Ω should be connected in parallel

(ii) 120 v a voltmeter range v=120 R=?

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

$$= \left[\frac{120}{50 \times 10^{-3}}\right] - 20$$

= (120000 / 50) -20

=2380 Ω

∴ A resistance of 2380 Ω should be connected in series with the galvanometer

21. A long straight wire carrying current produces a magnetic induction of 4×10^{-6} T at a point, 15 cm from the wire. Calculate the current through the wire [Oct -2007]

$a=15 \times 10^{-6}$ m; $B=4 \times 10^{-6}$ T; I=?

$B=2 \times 10^{-7} \times I / a$

∴ $I= B \times a / 2 \times 10^{-7}$

$=4 \times 10^{-6} \times 15 \times 10^{-2} / 2 \times 10^{-7}$

I=3A

22. In a hydrogen atom electron moves in an orbit of radius 0.5 A° making 10^{16} revolutions per second. Determine the magnetic moment associated with orbital motion of the electron. [June- 2008]

radius $r= 0.5 \times 10^{-6}$m

$n=10^{16}$ revolution / Second.

$e=1.6 \times 10^{-19}$ c

μ_l=?

$\mu_l = I \times A$

$I=e/T =e.n$

$A=\pi r^2$

$\therefore \mu_l = en \times \pi r^2$

$=1.6 \times 10^{-19} \times 10^{16} \times 3.14 \times (0.5 \times 10^{-10})^2$

$\mu_l = 1.256 \times 10^{-23} Am^{-2}$

23. Two parallel wires each of length 5cm are placed at a distance of 10cm apart in air. They carry equal currents along the same direction and experience a mutually attractive force of 3.6×10^{-4} N Find the current through the conductors.

[Oct 2009; June 2010, March 2013]

$a = 10 \times 10^{-2}$m; l=5m; $F=3.6 \times 10^{-4}$ N

$I_1 = I_2 = I = ?$

$$F = \frac{2 \times 10^{-7} \times I_1 I_2}{a} \times l$$

$$F = \frac{2 \times 10^{-7} \times I^2 \times l}{a}$$

$$\therefore I^2 = \frac{F \times a}{2 \times 10^{-7} \times l}$$

$$= \frac{3.6 \times 10^{-4} \times 10 \times 10^{-2}}{2 \times 10^{-7} \times 5}$$

$I^2 = 36$

$I = 6A$

24. A galvanometer has a resistance of 40 Ω It shows full scale deflection for a current of 2mA. How you will convert the galvanometer into a voltmeter of range o to 20v?

[Oct – 2010]

$G = 40\ \Omega$; $Ig = 2 \times 10^{-3}$A; $V = 20$V

$R = ?$

$$R = \left[\frac{V}{Ig}\right] - G$$

$$= \left[\frac{20}{2 \times 10^{-3}}\right] - 40$$

$$= \frac{20000}{2} - 40$$

$= 10000-40$

$R = 9960\ \Omega$

∴ A resistance of 9960 Ω should be connected in series

25. Two straight infinitely long parallel wires carrying equal currents and placed at a distance of 20cm apart in air experience a mutually attractive force of 4.9×10^{-5} N per unit length of wire, calculate the current [Oct-2011]

$F = 4.9 \times 10^{-5}$ N; $a = 20 \times 10^{-2}$ m; $l = 1$m

$I_1 = I_2 = I = ?$

$$F = 2 \times 10^{-7} \times \frac{I_1 I_2}{a} \times l$$

$$F = 2 \times 10^{-7} \times \frac{I^2}{a} \times l$$

$$l^2 = \frac{F \times a}{2 \times 10^{-7} \times l}$$

$$= \frac{4.9 \times 10^{-5} \times 20 \times 10^{-2}}{2 \times 10^{-7} \times 1}$$

$l^2 = 49$

$I = 7A$

26. The deflection in a galvanometer falls from 50 divisions to 10 divisions when 12 Ω resistance is connected across the galvanometer. Calculate the galvanometer resistance

[Sep 2012]

$S = 12\ \Omega$; $\theta = 50$ divisions

$\theta g = 10$ divisions $G = ?$ $G = \left[\frac{I - I_g}{I_g}\right] s$ $I \alpha \theta$

$$\therefore G = \left[\frac{\theta - \theta g}{\theta g}\right] s$$

$$= \left[\frac{50 - 10}{10}\right] \times 12$$

$$= \frac{40}{10} \times 12$$

$G = 48\ \Omega$

27. A Current of 4A flows through 5 turn coil of a trangent galvanometer having a diameter of 30cm. if the horizontal component of Earth's Magnetic induction is 4×10^{-5}T, find the deflection produced [March – 14]

$2a = 30 \times 10^{-2}$ m; $n = 5$; $I = 4A$;

$Bh = 4 \times 10^{-5}$ T; $\theta = ?$

$$I = \frac{Bh \times 2a}{n.\mu 0} \times \tan\theta$$

$\tan\theta = \frac{I \times n \times \mu 0}{Bh.2a}$

$= \frac{4x5x4\pi x10^{-7}}{4x10^{-5}x30x10^{-2}}$

$= \frac{2x3.14}{3} = \frac{6.28}{3}$

$\tan\theta = 2.093$

$\theta = tan^{-1}\ 2.093$

$\theta = 64^o 28'$

28. A rectangular coil of area 20cm X 10 cm with turns of wire is suspended in a radial magnetic field of induction $5x10^{-3}$T If the galvanometer shows an angular deflection of 15° for a current of 1mA. Find the torisional constant of the suspension wire. [June - 14]

A = 20 cm X 10 cm = $20x10x10^{-4}$ m
B = $5x10^{-3}$ T
I = 1mA $\theta = 15^o$

C = ?
I = $\frac{C.\theta}{nBA}$

C = $\frac{InBA}{\theta}$

$= \frac{1x10^3x100x5x10^{-3}x20x10x10^{-4}}{15}$

= $0.66x10^{-6}$
C = $6.6x10^{-7}$ Nm/degree
(Or) $381.7x10^{-7}$ = $3.81x10^{-5}$ Nm/radian

29. In an Tangent galvanometer, a current of 1A produces a deflection of 30°, Find the current required to produce a deflection of 60°. [Sep – 14]

$I_1 = 1A$; $\theta_1 = 30^o$

$I_2 = ?$; $\theta_2 = 60^o$

$I \alpha \tan\theta$

$\frac{I_1}{I_1} = \frac{\tan\theta_2}{\tan\theta_1}$

$I_2 = \frac{\tan\theta_2}{\tan\theta_1} x I_1$

$I_2 = \frac{\tan 60^o}{\tan 30^1} x 1$

$I_2 = \frac{\sqrt{3}}{\left(1/\sqrt{3}\right)} x 1$

$I_2 = 3A$

30. A Uniform magnetic field of induction 0.5T acts perpendicular to the plane of the dees of a cyctotorn. Calculate this frequency of the oscillator to accelerate protons $m_p = 1.67x10^{-27}$ kg) (Sep – 15)

B = 0.5 T; $m_p = 1.67x10^{-27}$ kg $q = 1.6 \times 10^{-19}$ c

Frequency $\gamma = ?$

$$\gamma = \frac{Bq}{2\pi m} = \frac{0.5x1.6x10^{-19}}{2x3.14x1.67x10^{-27}}$$

$$\gamma = 0.073x10^8$$

$$\gamma = 7.63\, MH_z$$

31. An A.C generator consists of a coil 10,000 turns and of area $100cm^2$ The coil rotates at an angular speed of 140 rpm in a uniform magnetic field of 3.6×10^{-2} T. Find the maximum value of the emf induced. [June 2009]

$N = 10^4$ turns; $A = 100 \times 10^{-4} m^2$

$B = 3.6 \times 10^{-2}$ T;

$E_0 = ?$

$\gamma = 140$ rpm
$= 140 / 60$ rps

$E_0 = N A B \omega = N A B 2\pi \gamma$

$E_0 = 10^4 \times 100 \times 10^{-4} \times 3.6 \times 10^{-2} \times 2 \times 3.14 \times 140/60$

$E_0 = 52.752$ V

32. .A Soap film of retractive index 1.33, is illuminated by white light incident at an angle 30^0. The reflected light is examined by spectroscope in which dark band corresponding to the wave length 6000 Å is found. Calculate the smallest thickness of the film. [Oct-2007, Sep -2013]

μ=1.33; i=30°; n=1 (smallest thickness)

λ=6000 Å, t=?

If dark band $2\mu t \cos r = n\lambda$

$t = n\lambda / 2\mu\cos r$

$\mu = \sin i / \sin r$

$$\sin r = \frac{\sin i}{\mu} = \frac{\sin 30°}{1.33} = 0.373 \quad \therefore \left[r = \sin^{-1} 0.3759 \quad r = 22°04' \right]$$

$$t = \frac{1 \times 6000 \times 10^{-10}}{2 \times 1.33 \times \cos 22°04'}$$

$$t = \frac{6000 \times 10^{-10}}{2 \times 1.34 \times 0.9267}$$

$t = 2.434 \times 10^{-7}$ m

33. In young's experiment of a light of frequency 6×10^{14} Hz is used distance between the centres of adjacent fringes is 0.75 mm. Calculate this distance between the slits, if the screen is 1.5m away.

[Oct-2007 – Sep 14, June - 15]

$\gamma = 6 \times 10^{14}$ Hz; $\beta = 0.75 \times 10^{-3}$m

D = 1.5 m d = ?

$\beta = \lambda D / d$ [$\lambda = c / \gamma$]

$\beta = C D / \gamma . d$

$\therefore d = C D / \gamma . \beta$

$$= \frac{3 \times 10^8 \times 1.5}{6 \times 10^{14} \times 0.75 \times 10^{-3}}$$

$d = 1 \times 10^{-3} = 1$m m

34. A parallel beam of monochromatric light is allowed to incident normally on a plane transmission grating having 5000 lines per centimetre. A second order spectral line is found to be diffracted at an angle 30^0 Find the wave length of the light.

[March 2008, March 2010, June -12]

$N = 5000$ lines / cm

$= 5 \times 10^5$ lines / m

$m = 2$

$\theta = 30°$

$\lambda = ?$

$\sin\theta = Nm\lambda$

$\lambda = \sin\theta / Nm$

$= \sin 30° / (5 \times 10^5 \times 2)$

$= \frac{1}{2 \times 5 \times 10^5 \times 2}$

$= 0.5 \times 10^{-6}$

$= 5000 \times 10^{-10}$ m

$\lambda = 5000$ A°

35. A monochromatic light of wavelength 5893 A° is incident on a water surface having refractive index 1.33 Find the velocity frequency and wavelength of light in water . [Oct – 2008, March -11]

$\mu = 4 / 3$ $\lambda = 5893$ A°

Velocity of $C_w = ?$ $\lambda_w = ?$ $\gamma = ?$

$C_w = C / \mu$

$= \frac{3 \times 10^8}{4/3}$

$C_w = \frac{9}{4} \times 10^8$

$= 2.25 \times 10^8$ ms^{-1}

$\lambda_w = \lambda / \mu$

$= \frac{5893 \times 10^{-10}}{4/3}$

$= \frac{5893 \times 10^{-10} \times 3}{4}$

$= 4419.75 \times 10^{-10}$m

$\gamma = C / \lambda$

$= \frac{3 \times 10^8}{5893 \times 10^{-10}}$ [frequency in water = frequency in air]

$\gamma = 5.09 \times 10^{14}$ H_Z

36.In a Newton's rings experiment the diameter of the 20th dark ring was found to be 5.82 mm and that of the 10th ring 3.36mm. If the radius of the plano convex lens is 1 m. Calculate the wavelength of light used.

[March : 2010, March – 14, Sep - 15]

$d_{20} = 5.82 \times 10^{-3}$m ; $d_{10} = 3.36 \times 10^{-3}$m

n + m = 20; n = 10; m = 10 ; R = 1 m

λ = ?

$$\lambda = \frac{d^2_{n+m} - d^2_n}{4mR} = \frac{d^2_{20} - d^2_{10}}{4mR}$$

$$= \frac{(5.82 \times 10^{-3})^2 - (3.36 \times 10^{-3})^2}{4 \times 10 \times 1}$$

$$= \frac{(5.82 + 3.36)\ (5.82 - 3.36) \times 10^{-6}}{40}$$

$\lambda = 9.18 \times 2.46 \times 10^{-6}/40$

$\lambda = 0.56457 \times 10^{-6} = 5.645 \times 10^{-10}$ m

λ = 5645 A°

37. A plano – convex lens of radius 3m is placed on an optically flat glass plate and is illuminated by monochromatic light. The radius of the 8th dark ring is 3.6mm. Calculate the wave length of light used.

[March : 2011]

R= 3 m; $r_8 = 3.6 \times 10^{-3}$m ; n=8;

λ = ?

$\lambda = r^2_n / nR$

$$= \frac{3.6 \times 3.6 \times 10^{-6}}{8 \times 3}$$

$= 0.54 \times 10^{-6} = 5400 \times 10^{-10}$ m

λ = 5400 A°

38. A Plane transmission grating has 5000 lines / cm. Calculate the angular separation in second order spectrum of red line 7070Å and blue line 5000Å [June -2013, June - 15]

N = 5000 lines / cm (or) $N = 5 \times 10^5$ lines per meter

m = 2, $\lambda_R = 7070$ Å; $\lambda_V = 5000$ Å

$\theta_R - \theta_V = ?$

$\sin\theta = Nm\lambda$

$\sin\theta_R = 5 \times 10^5 \times 2 \times 7070 \times 10^{-10}$

Sin $\theta_R = 0.707 = \frac{1}{\sqrt{2}}$

$\theta_R = 45^0$

Sin $\theta_v = 5x10^5 x2x5000x10^{-10}$

Sin $\theta_v = 0.5 = \frac{1}{2}$

$\theta_v = 30^o$

$\theta_R - \theta v = 45^o - 30^o$

$\theta_R - \theta v = 15^0$

39. A 300 mm long tube containing 60 cc of sugar solution produces a rotation of 9° when placed in a polarimeter. If the specific rotation is 60°, calculate the quantity of sugar contained in the solution

l=300 mm = 3dm [June -2013]

v=60 CC, $\theta = 9^o$, S=60°, m =?

$$s = \frac{\theta}{lc} = \frac{\theta}{\left(\frac{m}{v}\right)l}$$

$$s = \frac{\theta v}{ml}$$

$$m = \frac{\theta v}{sl} = \frac{9x60}{60x3} = 3g$$

40. In a Young's double slit experiment two concurrent sources of intensity ratio of 64:1 produce interference f rings. Calculate the ratio of maximum and minimum intensities. [Sep - 14]

if $\frac{I_1}{I_2} = 64:1$

$\frac{I_{max}}{I_{min}} = ?$

$I \alpha a^2$

$$\therefore \frac{I_1}{I_2} = \frac{a_1^2}{a_2^2}$$

$$\frac{a_1}{a_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{64}{1}} = \frac{8}{1}$$

$a_1 = 8a_2$

$$\frac{I_{max}}{I_{min}} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2}$$

$$= \frac{(8a_1+a_2)^2}{(8a_1-a_2)^2} = \frac{(9a_2)^2}{(7a_2)^2}$$

$$\frac{I_{max}}{I_{min}} = 81:49$$

41. In Newton's ring experiment the diameter of certain order of dark ring is measured to be double that of second ring, what is the order of the ring? [June - 14]

$d_n = 2d_2$

n = ?

$$r_n^2 \alpha n$$

$$dn^2 \alpha n$$

$$\frac{dn^2}{d_2^2} = \frac{n}{2}$$

$$\frac{(2dn)^2}{d_2^2} = \frac{n}{2}$$

$$\frac{4d_2^2}{d_2^2} = \frac{n}{2}$$

n = 8

42. Wave length of Balmer second line is 4861 A°. Calculate the wave length of first line. [March : 2007]

$\lambda_2 = 4861$ A°

$\lambda_1 = ?$

For Balmer II Line $n_1 = 2$; $n_2 = 4$

$$\bar{\gamma}_2 = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$1/\lambda_2 = R\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

$$= \left[\frac{4-1}{16}\right]R$$

$$1/\lambda_2 = 3R/16 \longrightarrow (1)$$

For Balmer I line $n_1 = 2$; $n_2 = 3$

$$\bar{\gamma}_2 = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \qquad = R\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= \left[\frac{9 - 4R}{36}\right]$$

$1/\lambda_1 = 5 / 36\,R \longrightarrow (2)$

$(1) / (2) \quad \lambda_1/\lambda_2 = \frac{3R}{16} X \frac{36}{5R}$

$\lambda_1/\lambda_2 = 27/20 \qquad \lambda_1 = \frac{27}{20} x\, \lambda_2$

$\lambda_1 = \frac{27}{20} x\, 4861$

$\lambda_1 = 6562$ A°

43. In Bragg's Spectrometer the glancing angle for first order spectrum was observed to be 8°. Calculate the wave length of x-ray. If d =2.82 x 10^{-10}m. At what angle will the second maximum occur?

[June - 2007]

$\theta_1 = 8°$; d= 2.82 x 10^{-10}m; n=1

$\lambda = ?$

$2d \sin\theta = n\lambda$

$$\lambda = \frac{2d \sin\theta}{n}$$

$$= \frac{2 \times 2.82 \times 10^{-10} \times \sin 8°}{1}$$

$= 2 \times 2.82 \times 10^{-10} \times 0.139$

$\lambda = 0.7849 \times 10^{-10}$ m

n = 2 when $\theta_2 = ?$

$2d \sin\theta_2 = n\lambda$

$\sin\theta_2 = n\lambda / 2d$

$$= \frac{2 \times 0.7849 \times 10^{-10}}{2 \times 2.82 \times 10^{-10}}$$

$\sin\theta_2 = 0.2783$

$\theta_2 = \sin^{-1} 0.2783$

$\theta_2 = 16° 9'$

44. An α- particle is projected with an energy on 4 MeV directly towards a gold nucleus, Calculate this distance of its closest approach (Given atomic number of gold 79 and atomic number of a α particle =2) [March : 2008]

(Atomic number of Gold = 79, Atomic number of α particle = 2)

K.E = $4 \times 10^{-6} \times 1.6 \times 10^{-19}$ J Z=79 r_0 =?

$$r_0 = \frac{18 \times 10^9 \times Ze^2}{K.E}$$

$$= \frac{18 \times 10^9 \times 79 \times 1.6 \times 10^{-19} \times 1.6 \times 10^{-19}}{4 \times 10^6 \times 1.6 \times 10^{-19}}$$

$$= 568.8 \times 10^{-16}$$

$$r_0 = 5.688 \times 10^{-14} \text{ m}$$

45. An electron beam passes through a transverse magnetic field of 2×10^{-3} T and an electric field E of 3.4×10^4 V / m, acting simultaneously. If the path of the electrons remain undeviated calculate the speed of electrons. If the electric field is removed what will be the radius of the electron path..? [Oct-2011]

E = 3.4×10^4 v / m ; B = 2×10^{-3} T

v = ? r = ?

$$v = E / B$$

$$= \frac{3.4 \times 10^4}{2 \times 10^{-3}}$$

$$v = 1.7\ 10^{+7} \text{ ms}^{-1}$$

$$Bev = mv^2 / r$$

$$Be = mv / r \qquad \therefore \quad r = mv / Be$$

$$= \frac{9.11 \times 10^{-31} \times 1.7 \times 10^7}{2 \times 10^{-3} \times 1.6 \times 10^{-19}}$$

$$r = 4.839 \times 10^{-2} \text{ m}$$

46. How fast would a rocket have to go relative to an observer for its length to be corrected to 99% of its length at rest [Oct -2007, Oct -11, March -12, Jun - 14]

when $l = \frac{99}{100} l_o$; v = ?

$$l = l_o\sqrt{1-v^2 / c^2}$$

$$\frac{99}{100} l_o = l_o \sqrt{1-v^2 / c^2}$$

$$0.99 = \sqrt{1-v^2 / c^2}$$

$(0.99)^2 = 1-(v^2 / c^2)$

$(c^2-v^2) / c^2 = 0.99^2$

$c^2-v^2 = (0.99c)^2$

$v^2 = c^2 -0.9801\ c^2$

$= c^2 (1-0.9801)$

$v^2 = 0.0199\ c^2$

$v = 0.141\ c$

$= 0.141 \times 3 \times 10^8$

$v = 0.423 \times 10^8\ ms^{-1}$

47. At what speed is a particle moving if the mass is equal to three times its rest mass? [Oct-2008, Sep – 14, June - 15]

$m = 3\ m_0$

$v = ?$

$$m = \frac{m_0}{\sqrt{1 -v^2 / c^2}}$$

$$3\ m_0 = \frac{m_0}{\sqrt{1 -v^2 / c^2}}$$

$3 \sqrt{1 -v^2 / c^2} = 1$

$9(1 -v^2 / c^2) = 1$

$9 (c^2-v^2) /c^2 = 1$

$9c^2 - 9v^2 = c^2$

$9v^2 = 9c^2 - c^2$

$9v^2 = 8c^2$

$v^2 = 8 c^2 / 9$

$v = 2\sqrt{2}\ c / 3$

$= 2\sqrt{2} \times 3 \times 10^8 / 3$

$v = 2\sqrt{2} \times 10^8\ ms^{-1}$

$v = 2.828\ ms^{-1}$

48. The time interval measured by an observer at rest is 2.5×10^{-8} s What is the time interval as measured by an observer moving with velocity v=0.73c [June - 2009]

$t_o = 2.5 \times 10^{-8}$ s

$v = 0.73c$ $t = ?$

$t = t_o / \sqrt{1 -v^2 / c^2}$

$v^2 / c^2 = 0.5329\ c^2 / c^2$

$1 –(v^2 / c^2)= 1 - 0.5329 = 0.4671$

$\sqrt{1 -v^2 / c^2} = \sqrt{0.4671} = 0.6834$

$t = t_0 / 0.6834$

$= 2.5 \times 10^{-8} / 0.6834 = 3.658 \times 10^{-8}$ s

49. Work function of Iron is 4.7eV Calculate the cut off frequency and the corresponding cut off wavelength for this metal

[June 09, March 2012]

$w = 4.7$ e V

$w = 4.7 \times 1.6 \times 10^{-19}$ J

$\gamma_o = ?$ $\lambda_o = ?$

$w = h\gamma_o$

$\gamma_o = w / h$

$$= \frac{4.7 \times 1.6 \times 10^{-19}}{6.626 \times 10^{-34}}$$

$\gamma_o = 1.134 \times 10^{15}$

$\lambda_o = c / \gamma_o$

$$= \frac{3 \times 10^{8}}{1.134 \times 10^{15}}$$

$= 2.645 \times 10^{-7}$

$\lambda_o = 2645$ A°

50. A metallic surface when illuminated with light of wavelength 3333 A° emits electrons with energies up to 0.6ev. Calculate the work function of the metal

[Oct 2009, June 2012, March 2013]

$\lambda = 3333$A° K.E $= 0.6$ e v $w = ?$

$h\gamma = w + k.E$

$\therefore w = h\gamma - k.E$

$w = h.c / \lambda - k.E$

$$= \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{3333 \times 10^{-10} \times 1.6 \times 10^{-19}} - 0.6$$

$w = 3.727 - 0.6$

$w = 3.127$ eV

51. A proton is moving at a speed of 0.900 times the velocity of light Find the kinetic energy in joules and Mev. [March: 2011]

$v = 0.9$ c; $m_o = 1.67 \times 10^{-27}$ kg

$(m - m_o)c^2 = ?$

$m = m_o / \sqrt{1 - v^2 / c^2}$

$$= \frac{1.67 \times 10^{-27}}{\sqrt{1 - 0.81\, c^2 / c^2}}$$

$$= \frac{1.67 \times 10^{-27}}{} = \frac{1.67 \times 10^{-27}}{}$$

$\sqrt{1-0.81}$ $\sqrt{0.19}$

$m_o = 3.831 \times 10^{-27}$ kg

$m - m_o = (3.831 \times 10^{-27} - 1.67 \times 10^{-27})$

$= 2.161 \times 10^{-27}$

$(m - m_o)\, c^2 = 2.161 \times 10^{-27} \times 9 \times 10^{16}$

$(m - m_o)\, c^2 = 19.449 \times 10^{-11}$ J

$$E = \frac{19.449 \times 10^{-11}}{1.6 \times 10^{-19}}$$

$= 12.155 \times 10^{-11} \times 10^{-19}$ ev

$= 12.155 \times 10^{8}$

E = 1215 Mev

52. What is the de Braglie wave length of an electron of Kinetic energy 120ev? [Oct-2012]

If. k.E = 120 ev

v = 120 v λ = ?

$\lambda = (12.27 / \sqrt{v})$ Å

$= (12.27 / \sqrt{120})$

$= (12.27 / 10.95)$

$\lambda = 1.121$ A°

53.The rest mass of an electron 9.1×10^{-31} Kg What will be it's mass if it moves with $4/5^{th}$ of the speed of light [June - 14]

$m = 9.1 \times 10^{-31}$

$\vartheta = \frac{4}{5} c$

m = ?

$$m = \frac{m_0}{\sqrt{1-\frac{\vartheta^2}{c^2}}}$$

$$= \frac{9.1 \times 10^{-31}}{\sqrt{1-\frac{16c^2}{25c^2}}}$$

$$= \frac{9.1 \times 10^{-31}}{\sqrt{\frac{25-16}{25}}}$$

$$= \frac{9.1 \times 10^{-31}}{\sqrt{\frac{9}{25}}}$$

$$= \frac{9.1 \times 10^{-31}}{\frac{3}{5}}$$

$= \frac{5x9.1x10^{-31}}{3}$

$= \frac{45.5}{3} x10^{-31}$

m = $15.16x10^{-31}$ Kg.

54. Calculate the Debroglie wavelength of an electorn if the speed 10^5 ms^{-1}
(given m = $9.1x10^{-31}$ kg; h = $6.626x10^{-34}$ JS) (Sep – 15)

m = $9.1x10^{-31}$ Kg

h = 6.626x10-34 Js

$v = 10^5$ ms^{-1}

λ =?

$\lambda = \frac{h}{mv} = \frac{6.626x10^{-34}}{9.1x10^{-31}x10^5}$

= $0.7281x10^{-8}$

λ = 72.81 A^O

55. A piece of bone from an archaeological site is found to give a count rate of 15 counts per minutes A similar sample of fresh bone gives a count rate of 19 counts per minute. Calculate the age of the specimen (Given $T1_{/2}$= 5570 Years)
[Oct - 2011, March- 2006, Sep -2013, March – 2014]

N = 15 counts / minute $T_{1/2}$=0.693 / λ

N_0 = 19 counts minute

t = ?

$N = N_0 e^{-\lambda t}$

$N / N_0 = e^{-\lambda t}$

$N_0 / N = e^{\lambda t}$

$log_e(N_0 / N) = \lambda t$

$t = \frac{1}{\lambda} \log_e\left(\frac{N_0}{N}\right) = \frac{1}{\lambda}$ x2.303x $\log_e\left(\frac{19}{15}\right)$

$t = \left(\frac{T_{1/2}}{0.693}\right)$ x 2.303 x log 1.266

$t = \frac{5570}{0.693}$ x 2.303 x .1026

t = 1899 Years

56. Calculate the energy released when 1Kg of $_{92}U^{235}$ undergoes nuclear fission. Assume, energy fission is 200 Mev. Avagadro Number =6.023 x 10^{23} Express your answer in Kilowatt hour also [March : 2006, Sep -2011, Sep 2013]

Energy produced fission = 200 Mev

$= 200 \times 10^{6} \times 1.6 \times 10^{-19}$ J $= 3.2 \times 10^{-11}$

Avagadro Number N $= 6.023 \times 10^{23}$

1 kg $_{92}U^{235}$ Energy released f 1kg $_{92}U^{235}$ = ?

235 g $_{92}U^{235}$ Number of atoms in 235 g of uranium $= 6.023 \times 10^{23}$

Number of atoms in 1Kg (or) 1000 g of uranium $_{92}U^{235}$ –

$$= \frac{6.023 \times 10^{23}}{235} \times 1000$$

$= 2.562 \times 10^{24}$

∴ Energy produced by 1 kg of uranium during fission

$= 2.562 \times 10^{24} \times 3.2 \times 10^{-11}$

E $= 8.2016 \times 10^{13}$ J

1 k w h $= 3.6 \times 10^{6}$ J

$$\therefore E = \frac{8.2016 \times 10^{13}}{3.6 \times 10^{6}} = 2.2782 \times 10^{7} \text{ k w h}$$

57. Find the energy released when two $_1H^2$ nuclei fuse together to form a single $_2He^4$ nucleus. Given the binding energy per nucleon of $_1H^2$ a single $_2He^4$ nucleus, Given the binding energy per nucleon of $_1H^2$ and $_2He^4$ are 1.1 Mev and 7.0 Mev respectively,

[June 2006, October 2012]

$_1H^2$-BE/A of = 1.1 Mev

$_2He^4$ - BE/A of = 7 Mev

$2\,_1H^2 \longrightarrow {}_2He^4 + Q$

Energy released Q = ?

BE/A of $_1H^2$- = 1.1 Mev

BE of $_1H^2$- = 2 x 1.1 Mev = 2.2 Mev

BE/A of $_2He^4$ = 7 Mev

BE of $_2He^4$ = 4 x 7=28 Mev

$2\,_1H^2 \longrightarrow {}_2He^4 + Q$

$2 \times 2.2 \longrightarrow 28 + Q$

$4.4 \longrightarrow 28 + Q$

∴Q = 28 – 4.4 = 23.6 Mev

58. A reactor is developing energy at the rate of 32 MW. Calculate the required number of fissions per second of $_{92}U^{235}$ Assume that energy per fission is 200 Mev.

[June - 2006,2008,2011, March – 14]

Energy / fission = 200 MeV = $200 \times 10^{6} \times 1.6 \times 10^{-19}$

Total Energy = 32 MW

No of fission of $_{92}U^{23}$ = $\frac{\text{Total Energy}}{\text{Energy/Fission}}$

$$N = \frac{32 \times 10^{6}}{200 \times 10^{6} \times 1.6 \times 10^{-19}}$$

N = 10^{18} fission / Second

59. Show that the mass of radium ($_{88}Ra^{226}$) with an activity of 1 curie is almost a gram [June - 2006,March :2008, March :2012]

[$T_{½}$ - 1600 Years ;
1 curie = 3.7×10^{10} disintegration / second]

$T_{½}$ =1600 Years
=1600 x 365.25 x 24 x 60 x 60

$dN / dt = 3.7 \times 10^{10}$ disintegration / Second

m = ? $T_{½} = 0.6931 / \lambda$

$dN / dt = \lambda N$

$$N = \frac{1}{\lambda} \frac{dN}{dt}$$

$$= \frac{T_{½}}{0.6931} \times \frac{dN}{dt}$$

$$N = \frac{1600 \times 365.25 \times 24 \times 60 \times 60}{0.6931} \times 3.7 \times 10^{10}$$

$= 2.695 \times 10^{21}$

According to Avagadro's Principle, 6.023×10^{23} atoms = 226 g of Radium, 2.695×10^{21} atoms

$$m = \frac{226}{6.023 \times 10^{23}} \times 2.695 \times 10^{21}$$

= 1.011 g

m ≈1g

60.Calculate the mass of coal required to produce the same energy as that produced by the fission of 1 Kg of $_{92}U^{235}$

[October-2006]

Energy fission = 200 Mev = $200 \times 1.6 \times 10^{-19} \times 10^{6}$
Avagadro Number =6.023×10^{23}
Heat of combustion of Coal = 33.6×10^{6} J / kg
Mass of Coal= ?

Number of Atoms in 235 g U^{235} –= 6.023×10^{23}

Number of Atoms in 1000 g (or) 1 kg U^{235}

$$N = \frac{6.023 \times 10^{23}}{235} \times 10^{3} = 2.562 \times 10^{24}$$

1 Energy/fission =3.6×10^{11} J

Energy produced by the fission of 1Kg of U^{235} = $2.562 \times 10^{24} \times 3.6 \times 10^{-11}$

E = 8.2016×10^{13} J

Let M be the mass of the coal required to produced equivalent to energy produced by 1Kg of U^{235}

M x Heat of combustion of Coal = 8.2016×10^{13}

$M \times 33.6 \times 10^{6} = 8.2016 \times 10^{13}$

$$M = \frac{8.2016 \times 10^{13}}{33.6 \times 10^{6}} = 2.441 \times 10^{6} \text{ kg} = 2441 \times 10^{3} \text{ Kg}$$

M = 2441 ton.

61. Mass defect of $_6C^{12}$ is 0.098 amu. Calculate the B.E /A of $_6C^{12}$ nucleus. [June - 2007]

Δ m of $-_6C^{12}$ = 0.098 amu; A=12

BE / A = ?

Δ m of $-_6C^{12}$ = 0.098 amu

BE of $-_6C^{12}$ = Δ m x 931 Mev

= 0.098 x 931 MeV

= 91.238 MeV

BE/A Of $-_6C^{12}$ = 91.238 /12 = 7.603MeV

62. Calculate the time required for 60% of a sample of radon to undergo decay. Given $T_{1/2}$ redon =3.8 days [March : 2007]

Half life of Rṅ = 3.8 days

Original Amount N_0 = 100% ; Amount of Sample disintegrated ($N_0 - N$)= 60%

Amount of Sample present N = 40% time required t=?

$$T_{1/2} = \frac{0.6931}{\lambda}$$

$$\lambda = \frac{0.6931}{T_{1/2}}$$

$$N = N_0 e^{-\lambda t}$$

$$N / N_0 = e^{\lambda t}$$

$$N_0 / N = e^{\lambda t}$$

$$\log (N_0 / N) = \lambda t$$

$$t = \frac{1}{\lambda} \log_e \left(\frac{N_0}{N}\right) = \frac{1}{\lambda} \times 2.303 \times \log_e \left(\frac{100}{40}\right)$$

$$t = \left(\frac{T_{1/2}}{0.693}\right) \times 2.303 \times \log 2.5$$

$$t = \frac{3.8}{0.6931} 2.303 \times \log_{10} 2.5$$

$$t = \frac{3.8}{0.6931} 2.303 \times 0.3979$$

t = 5.022 days

63. The binding energy per nucleon for $_6C^{12}$ nucleus is 7.68 MeV and that for $_6C^{13}$ is 7.47 MeV. Calculate the energy required to remove a neutron from $_6C^{13}$ nucleus

[March: 2009, March - 15]

BE/A of - $_6C^{12}$ = 7.68 Mev

BE/A of - $_6C^{13}$ = 7.47 Mev

BE/A of Q = ?

$_6C^{13} \longrightarrow C^{12} + {}_0n^1 + Q.$

BE/A of - $_6C^{13}$ = 7.47 Mev

Total BE of C^{13}= 13 x 7.47 MeV

= 97.11 MeV

$_6C^{12}$ - BE/A = 7.68 Mev

Total BE of $_6C^{12}$

= 12 x 7.68 Mev

= 92.16 Mev

Binding Energy of a neutron = = BE of $_6C^{13}$ --BE of $_6C^{12}$

= 97.11 – 92.16 = 4.95 MeV

64.. Calculate the energy released in the following reaction

$_3Li^6 + {}_0n^1 \longrightarrow {}_2He^4 + {}_1H^3$

Given Mass of $_3Li^6$ –= 6.015126 amu

Mass of $_0n^1$= 1.008665 amu

Mass of $_2He^4$ = 4.002604 amu

Mass of $_1H^3$ = 3.016049 amu

∴ Mass of the reactants =?

Mass of $_3Li^6$ = 6.015126 amu

Mass of $_0n^1$= 1.008665 amu +

7.023791 amu

Mass of $_2He^4$ = 4.002604 amu

Mass of $_1H^3$–= 3.016049 amu

7.018653

Mass Defect Δm = Mass of the reactants - Mass of the products

Δm = 7.023791 - 7.018653

Δm = 0.005138 amu

Energy released in the reaction = Δm x 931 MeV

= 0.005138 x 931 MeV

E= 4.783 MeV

65. Calculate the energy released in the reaction $_{13}AI^{27} + _1H^2 \longrightarrow _{12}Mg^{25} + _2He^4$

Mass of $_{13}AI^{27}$ –= 26.981535 amu

Mass of $_{12}Mg^{25}$ = 24.98584amu

Mass of $_1H^2$ = 2.014102 amu

Mass of $_2He^4$= 4.002604 amu

Energy related in the reaction = ?

Mass of reactants $_{13}AI^{27}$ –+ $_1H^2$ = 26.981535 +2.014102

= 28.995637 amu

Mass of products $_{12}Mg^{25}$ + $_2He^4$– = 24.98584 + 4.002604

= 28.988444 amu

Mass of defect = Mass of reactions - Mass of Products

Δm = 0.007193

Energy released in the reaction E = Δm x 931 MeV

= 0.007193 X 931 MeV

E = 6.696 Mev

66. A transistor is connected in CE configuration. The voltage drop across the load resistance (Rc) 3 k Ω is 6V. Find the basic current. The current gain α of the transistor is 0.97 [June - 2010]

α = 0.97 Rc = 3K Ω

V_{CE}= 6V I_B =?

$I_c = V_{CE} / Rc$

$= 6 / 3 \times 10^3$

$= 2\times 10^{-3}$ A

$\beta = \alpha / (1 - \alpha)$

$= 0.97 / (1 - 0.97)$

$= 0.97 / 0.03$

$\beta = 32.33$

$\beta = I_c / I_B$

$I_B = I_c / \beta$

$= 2 \times 10^{-3} / 32.33$

$= 0.0618 \times 10^{-3}$

$I_B = 61.8 \times 10^{-6}$A

$I_B = 61.8\ \mu$A

67. A 10 MH_z Sinusoidal carrier wave of amplitude 10 mv is modulated by 5 Kz sinusoidal audio signal wave of amplitude 6 mV. Find this frequency components of the resultant modulated wave and their amplitude [March: 2011]

Frequency of the carrier (f_c) = 10MH_z

Frequency of signal (f_s) = 5 KH_z= 0.005 MH_z

Amplitude of the signal = 6 mV

Amplitude of the carrier Signal = 10 mV

Frequency components of Modulated Wave = ?

Amplitude of the components in the modulated wave = ?

Upper side band frequency $f_c + f_s$ = 10+0.005

= 10.005MH_z

Lower side band frequency = $f_c - f_c$ = 10 - 0.005

= 9.955MH_z

The Modulation Factor m = E_s / E_c

= 6 / 10

= 0.6

Amplitude of USB = Amplitude of LSB = $mE_c / 2$ = (0.6 x 10) / 2 = 3 mV

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