SOLUTIONS

Mathematics

1. Since each compete two times with each other, hence boys Vs Boys total plays = $2 \,.\, m_{c_2}$

   Boys Vs Girls total plays $= 4m$

   As per given condition

   $2.m_{c_2} = 84 + 4m$

   $\Rightarrow m^2 - 5m - 84 = 0$

   $\Rightarrow m^2 - 12m + 7m - 84 = 0$

   $\Rightarrow (m - 12)(m + 7) = 0$

   $\Rightarrow m = 12, -7x$

   Hence (A) is the correct answer.

2. Since, ${}^nC_4$, ${}^nC_5$, ${}^nC_6$ are in $A.P.$

   $\therefore 2 \times {}^nC_5 = {}^nC_4 + {}^nC_6$

   $$\Rightarrow 2 \times \frac{n!}{5!\,(n-5)!} = \frac{n!}{4!\,(n-4)!} + \frac{n!}{6!\,(n-6)!}$$

   $$\Rightarrow \frac{2}{5!\,(n-5)!} = \frac{30 + (n-5)(n-4)}{6!\,(n-4)!}$$

   $\Rightarrow 6 \times 2\,(n-4) = 30 + n^2 - 9n + 20$

   $\Rightarrow n^2 - 21n + 98 = 0$

   $\Rightarrow n = 7$ or 14

3. As we know $\sim (P \to 2) = P \wedge \sim 2$,

   hence given expression

   $\sim (\sim P \to 2) = \sim P \wedge \sim 2$

4. The given integral can be written as

   $$I = \int \frac{3.x^{-3} + 2x^{-5}}{(2 + 3x^{-2} + x^{-4})^4} dx$$

   Let $2 + 3x^{-2} + x^{-4} = t$

   $\Rightarrow -6x^{-3} - 4x^{-5}dx = dt$

   $\Rightarrow -2\,(3x^{-3} + 2x^{-5})dx = dt$

$$I = -\frac{1}{2}\int \frac{dt}{t^4} = -\frac{1}{2}.\frac{t^{-4+1}}{-4+1} = \frac{1}{6}.\frac{1}{t^3} + C$$

$$= \frac{1}{6.(2+3x^{-2}+x^{-4})^3} + C = \frac{x^{12}}{6(2x^4+3x^2+1)^3} + C$$

5. Given series can be written as

$$\left(\frac{3}{4}\right)^3 + \left(\frac{6}{4}\right)^3 + \left(\frac{9}{4}\right)^3 + \left(\frac{12}{4}\right)^3 + \left(\frac{15}{4}\right)^3 + \cdots 15 \text{ terms}$$

$$= \frac{3^3}{4^3}(1^3 + 2^3 + 3^3 + \cdots + 15^3)$$

$$= \frac{3^3}{64}\left(\frac{15 \times 16}{2}\right)^2 = \frac{27}{64} \times \frac{225 \times 64}{1} = 27 \times 225$$

Since, given $225K = 27 \times 225$

$\Rightarrow K = 27$

6. Let $I_1 = \int_1^e \left(\frac{x}{e}\right)^{2x} \log_e^x \; dx$

Let $\left(\frac{x}{e}\right)^x = t$

$$\Rightarrow \ln x \, dx = \frac{1}{t} dt$$

$$I_1 = \int_{\frac{1}{e}}^{1} t^2 \frac{1}{t} dt$$

$$= \frac{t^2}{2} \Big|_{\frac{1}{e}}^{1}$$

$$= \frac{1}{2} - \frac{1}{2e^2}$$

and $I_2 = \int_1^e \left(\frac{e}{x}\right)^x \log_e^x dx$

Let $\left(\frac{e}{x}\right)^x = t$

$$\Rightarrow \ln x \, dx = -\frac{1}{t} dt$$

$$I_2 = \int_e^1 t . \left(\frac{-1}{t}\right) dt$$

$= e - 1$

Hence required integral is $I_1 - I_2 = \left(\frac{1}{2} - \frac{1}{2e^2}\right) - (e - 1)$

$$= \frac{3}{2} - e - \frac{1}{2e^2}$$

7. $\lim_{n\to\infty} \frac{n}{n^2+1^2} + \frac{n}{n^2+2^2} + \cdots + \frac{n}{n^2+(2n)^2}$

$$= \sum_{r=1}^{2n} \frac{n}{n^2+r^2} = \frac{1}{n}\sum_{r=1}^{2n} \frac{1}{1+\left(\frac{r}{n}\right)^2}$$

$$= \int_0^2 \frac{1}{1+x^2}dx = [\tan^{-1} x]_1^2$$

$$= \tan^{-1} 2$$

8. Given $h(x) = f\big(f(x)\big)$

$\Rightarrow h'(x) = f'\big(f(x)\big).f'(x)$

$\Rightarrow h'(x) = f\big(f(x)\big).f(x)$ (as $f'(x) = f(x)$ ....(i)

Now $f'(x) = f(x)$

$\Rightarrow \ln|f(x)| = x + c$

$\Rightarrow f(x) = k.e^x$

$\Rightarrow f(x) = \frac{2}{e}.e^x \quad as\ f(1) = 2$

From equation (i),

$$h'(x) = \frac{2}{e}e^{\left(\frac{2}{e}e^x\right)}.\left(\frac{2}{e}.e^x\right)$$

$$h'(1) = \frac{2}{e}.e^2.2 = 4e$$

Hence (A) is correct answer.

9. Given limit can be written as

$$L = \lim_{x\to1^-} \frac{\sqrt{\pi} - \sqrt{2\sin^{-1}x}}{\sqrt{1-x}} \times \frac{\sqrt{\pi} + \sqrt{2\sin^{-1}x}}{\sqrt{\pi} + \sqrt{2\sin^{-1}x}}$$

$$L = \lim_{x\to1^-} \frac{\pi - 2\sin^{-1}x}{\sqrt{1-x}\left(\sqrt{\pi} + \sqrt{2\sin^{-1}x}\right)} = \lim_{x\to1^-} \frac{\cos^{-1}x\ .2}{\sqrt{1-x}\left(\sqrt{\pi} + \sqrt{2\sin^{-1}x}\right)}$$

Let $K = \lim_{x\to1^-} \frac{\cos^{-1}x}{\sqrt{1-x}}$ put $x = \cos\theta$, we get

$$K = \lim_{\theta\to0} \frac{\frac{\theta}{2}.2}{\sqrt{2}.\sin\frac{\theta}{2}} = \sqrt{2}$$

$$L = \frac{\sqrt{2}.2}{2\sqrt{\pi}} = \sqrt{\frac{2}{\pi}}$$

Hence (A) is correct answer.

10. As we know, if the line $y = mx + c$ is a tangent to $x^2 = 8y$, then $c = -2m^2$,,
So equation of tangent with slope is
$y = mx - 2m^2$ ....(i)
Since tangent is inclined at as θ, with the positive x −axis, have $m = \tan\theta$.
Equation of tangent is $y = tan\theta . x - 2\tan^2\theta$
$\Rightarrow y\cot\theta = x - 2\,tan\theta$
Hence (A) is correct answer.

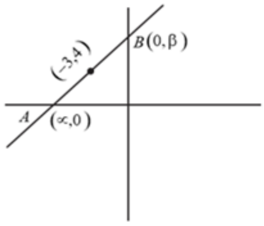
11. General term is $60\,C_r\left(7^{\frac{1}{5}}\right)^{60-r}\left(-3^{\frac{1}{10}}\right)^r$
We will get rational term when r is multiple of 10 and $60 - r$ is multiple of 5
$\therefore r = 0, 10, 20, 30, 40, 50, 60$
$\therefore$ Number of irrational term = Total term - Number of rotational term
$= 61 - 7$
$= 54$

12. Let rest two observations are x & y
$\therefore 3 + 4 + 4 + x + y = 20 \;\Rightarrow x + y = 9$ ....(i)
Variance, $5.2 = \frac{9+16+16+x^2+y^2}{5} - (4)^2$
$\Rightarrow x^2 + y^2 = 65$ ....(ii)
from (i) & (ii), $xy = 8$
$\therefore (x - y)^2 = x^2 + y^2 - 2xy = 65 - 16 = 49$
$\therefore |x - y| = 7$

13. Given $2^{(x+2)(x-2)(x-3)} = 1 \;\Rightarrow x = -2, 2, 3$
$\therefore n(A) = 3$
Again, $-3 < 2x - 1 < 9 \;\Rightarrow -1 < x < 5$
$\therefore x = 0, 1, 2, 3, 4 \;\; \therefore n(B) = 5$
$\therefore n\,(A \times B) = 3 \times 5 = 15$
$\therefore$ number of subset of $A \times B = 2^{15}$

14. $det(A) = 1(1 + \sin^2\theta) - \sin\theta(-\sin\theta + \sin\theta) + 1\,(\sin^2\theta + 1)$
$= 2 + 2\sin^2\theta$
$\because \theta \in \left[\frac{3\pi}{4}, \frac{5\pi}{4}\right] \;\; \therefore \sin^2\theta \in \left[0, \frac{1}{2}\right]$
$\therefore \det(A) \in [2, 3]$

15.



Let the line passing through $(-3, 4)$ intersect the coordinate axes at A & B.

Clearly $\frac{\alpha+0}{2} = -3$,

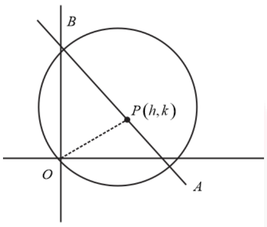
and $\frac{\beta+0}{2} = 4$

$\Rightarrow \alpha = -6$ and $\beta = 8$

Hence equation of line is $\frac{x}{-6} + \frac{y}{8} = 1$

$\Rightarrow$

16.



Since circle passing through origin intersect the coordinate axes at A & B, hence AB must be diameter and

$AB = 2r$.

Now, let foot of the perpendicular from origin upon AB be $p(h, k)$.

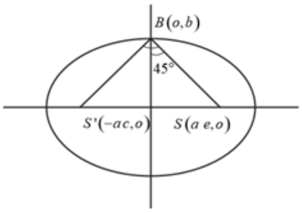
Equation AB is $y - k = \frac{-h}{k}(x - h) \Rightarrow A\left(\frac{h^2+k^2}{h}, 0\right)$ & $B\left(0, \frac{h^2+k^2}{k}\right)$

$$\Rightarrow \sqrt{\left(\frac{h^2+k^2}{h} - 0\right)^2 + \left(0 - \frac{h^2+k^2}{k}\right)^2} = 2r$$

$$\Rightarrow (h^2+k^2)^2\left(\frac{1}{h_2} + \frac{1}{k_2}\right) = 4r^2 \Rightarrow (h^2+k^2)^3 = 4r^2h^2k^2$$

Hence locus is $(x^2+y^2)^3 = 4r^2x^2y^2$ and (A) is correct option.

17.



Given $\angle SBS' = \frac{\pi}{2}$

$\Rightarrow \angle OBS = \frac{\pi}{4}$

$\Rightarrow b = ae$ ....(i)

Also, $\Delta SBS' = 8$

$\Rightarrow \frac{1}{2}.2ae.b = 8$

$\Rightarrow aeb = 8$ ....(ii)

From (i) and (ii)

$b^2 = 8$ and $a^2 = 16$

$\Rightarrow b = 2\sqrt{2}$ and $a = 4$

Length of the latus rectum

$\frac{2b^2}{a} = \frac{2.8}{4} = 4$

Hence (C) is correct option.

18. Equation of line parallel to given line can be taken as $y = 2x + c$. Now this line touches the curve $y = x^2 - 5x + 5$, hence roots of the equation $x^2 - 5x + 5 = 2x + c$ must be equal

$\Rightarrow D = 0 \Rightarrow 4c = -29.$

Hence equation of tangent is $4y = 8x - 29$.

Clearly it passes through $\left(\frac{7}{2}, \frac{-1}{4}\right)$.

Hence (C) is the correct answer.

19. $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\vec{b}}{2} \Rightarrow (\vec{a}.\vec{c})\vec{b} - (\vec{a}.\vec{b})\vec{c} = \frac{\vec{b}}{2}$

$\vec{b}$ is not parallel to $\vec{c} \Rightarrow \vec{a}.\vec{c} = \frac{1}{2}$ and $\vec{a}.\vec{b} = 0$

$\Rightarrow \beta = \frac{\pi}{3}$ and $\alpha = \frac{\pi}{2} \Rightarrow \because \alpha - \beta = \frac{\pi}{6}$

20. $\cos(90-\theta) = \frac{\vec{n}_1.\vec{v}}{|n_1||\theta|}$

$$\sin\theta = \frac{(2\hat{\imath}-\hat{\jmath}-k\hat{k}).(\hat{\imath}+2\hat{\jmath}-2\hat{k})}{\sqrt{4+1+k^2}\sqrt{4+4+1}}$$

$$\frac{1}{3} = \frac{|2-2+2k|}{3\sqrt{5+k^2}}$$

$$|2k| = \sqrt{5+k^2} \Rightarrow k = \pm\sqrt{\frac{5}{3}}$$

21. $NCC - A, NSS - B$

$n(A) = 40, \quad n(B) = 30, n(A\cap B) = 20$

$\therefore n(A\cup B) = n(A) + n(B) - n(A\cap B)$

$= 40 + 30 - 20 = 50$

$\therefore P(A\cup B) = \frac{50}{60} = \frac{5}{6}$

$\therefore P(A\cup B)' = 1 - P(A\cup B)$

$= 1 - \frac{5}{6} = \frac{1}{6}$

22. At $x = 1, f'(x) = 0$

$\therefore f'(x) = 3x^2 - 6(a-2)x + 3a$

$\Rightarrow 3 - 6(a-2) + 3a = 0$

$\Rightarrow a = 5$

$\therefore \frac{f(x)-14}{(x-1)^2} = 0$

$\Rightarrow \frac{x^3-9x^2+15x-7}{(x-1)^2} = 0$

$\Rightarrow x - 7 = 0 \quad \Rightarrow x = 7$

23. $\frac{dy}{dx} + \frac{2}{x}y = x.$ It is in linear form

$I.F. = e^{\int\frac{2}{x}dx} = e^{2lnx} = x^2$

$\therefore y.x^2 = \int x.x^2\,dx = \frac{x^4}{4} + c$

$\because$ at $x = 1, y = -2$

$\therefore\ -2\times 1^2=\dfrac{(1)^4}{4}+c$

$\Rightarrow c=\ -2-\dfrac{1}{4}=\ -\dfrac{9}{4}$

$\therefore$ curve is $y.x^2=\frac{x^4}{4}-\frac{9}{4}$

$\therefore$ It passes through $(\sqrt{3},0)$.

24. $AM\ \geq\ GM$

$\dfrac{\sin^4\alpha+4\cos^4\beta+1+1}{4}\geq(4\sin^4\alpha\cos^4\beta)^{\frac{1}{4}}$

So $AM\ =\ GM\ \Rightarrow\ \sin^4\alpha\ =\ 4\cos^4\beta=1$

$\sin^4\alpha=1\ \Rightarrow\ \alpha=\dfrac{\pi}{2}$

$\cos\beta=\dfrac{1}{\sqrt{2}}\ \Rightarrow\ \beta=\dfrac{\pi}{4}$

Hence $-2\sin\alpha\,\sin\beta=-2\times 1\times\frac{1}{\sqrt{2}}=-\sqrt{2}$

25. $\because$ Quadratic expression is positive, hence $1+m>0$ and $D<0$

$\Rightarrow m>-1$ and $4(1+3m)^2-16\,(1+m)(1+2m)<0$

$\Rightarrow 9m^2+1+6m-4(2m^2+3m+1)<0$

$\Rightarrow m^2-6m-3=0$

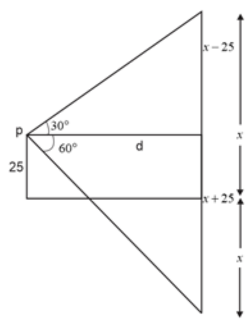
$\Rightarrow\left(m-3+2\sqrt{3}\right)\left(m-3-2\sqrt{3}\right)<0$

$m\in(3-2\sqrt{3},3+2\sqrt{3})$

$\therefore m=0,1,2,3,4,5,6$

$\therefore$ number of integral values $=7$

26.



$\tan 30^o=\dfrac{x-25}{d}$

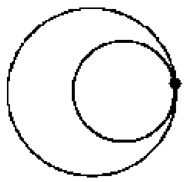
and $\tan 60^o = \frac{x+25}{d}$

$\Rightarrow \frac{\tan 30^o}{\tan 60^o} = \frac{x-25}{x+25} \Rightarrow \frac{1}{3} = \frac{x-25}{x+25}$

$\Rightarrow x + 25 = 3x - 75$

$\Rightarrow 2x = 100 \quad \Rightarrow x = 50m$

27.



$C_1 \equiv (0,0) \& C_2 \equiv (3,4)$

$r_1 = 9 \& r_2 = 4$

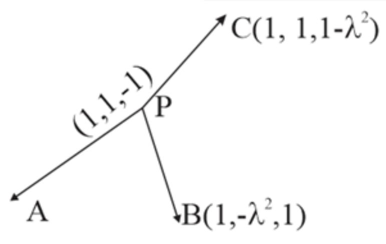
$\Rightarrow C_1C_2 = 5$ and $r_1 - r_2 = 5 \Rightarrow$ circles touch each other internally

$\Rightarrow |Z_1 - Z_2|_{min} = 0$ at the point of contact

28. P(success) $= p(5\ or\ 6) = \frac{1}{3}$

expectations equal to $\frac{100}{3} + \frac{100}{9} - \frac{400}{9} = 0$

29.



As we know, is four points P, A, B, C are ω planar, the vectors $\overrightarrow{PA}, \overrightarrow{PB}, \overrightarrow{PC}$ must be ω planar

$\Rightarrow \overrightarrow{PA},.(\overrightarrow{PB} \times \overrightarrow{PC}) = 0$

$$\Rightarrow \begin{vmatrix} -\lambda^2_{-1} & 2 & 2 \\ 0 & -\lambda^2+1 & 2 \\ 0 & 2 & -\lambda^2+1 \end{vmatrix} = 0$$

$\Rightarrow \lambda = \pm\sqrt{3}$

30. For non-trivial solution

$\Rightarrow \Delta = 0$

$$\Rightarrow \begin{vmatrix} 1-\lambda & -1 & -1 \\ 1 & 2-\mu & 1 \\ -1 & -1 & -\lambda \end{vmatrix} = 0$$

$\Rightarrow (1-\lambda)(-2\lambda + \lambda^2 + 1) + 1(-\lambda + 1) - 1\,(-1 + 2 - \lambda) = 0$

$\Rightarrow \lambda^2 - 3\lambda^2 + 3\lambda - 1 = 0$

$\Rightarrow (\lambda - 1)^3 = 0$

$\Rightarrow \lambda - 1^3$

Singleton set

Physics

1. $2 + mg\sin\theta = \mu\, mg\cos\theta \;\; mg\sin\theta + \;\mu\, mg\cos\theta = 10$

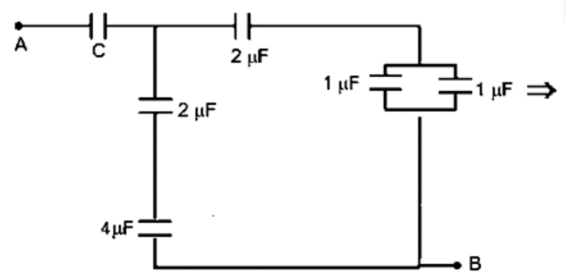
$$mg\;\sin\theta - \frac{mg\,(\sin\theta - \mu\cos\theta)}{mg\sin\theta + \;\mu\cos\theta} = \frac{-2}{10} = \frac{-1}{5}$$

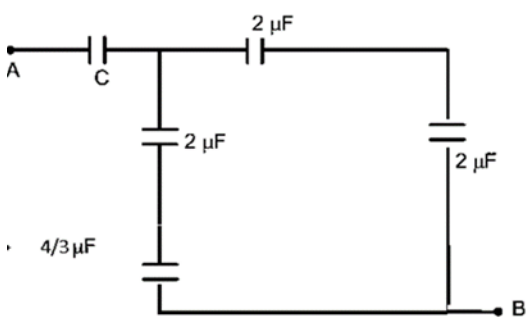
$(1 - \mu\sqrt{3})5 = -(1 + \mu\sqrt{3})$

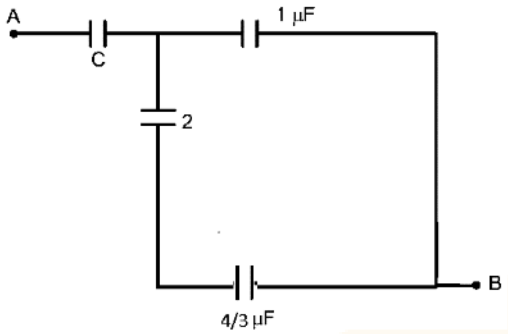
$6 = 4\sqrt{3}\,\mu$

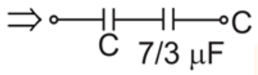
$$\mu = \sqrt{\frac{3}{2}}$$

2. Let us take the equivalent circuit one by one.









$\therefore C\ eq = \frac{C \times \frac{7}{3}}{C + \frac{7}{3}} = 0.5 \Rightarrow \frac{7}{3}C = \frac{C}{2} + \frac{7}{6}$

$\Rightarrow \frac{11}{6}C = \frac{7}{6} \Rightarrow C = \frac{7}{11}\mu F.$

3. $y = 5\sin 3\pi t + \sqrt{3}\cos 3\pi\, t$

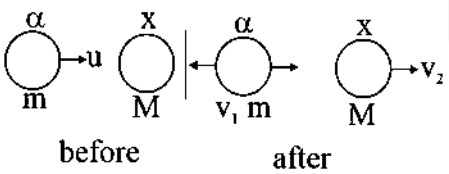
$= \sqrt{5^2 + (\sqrt{3})^2}\sin(3\pi t + Q)$

$= \sqrt{28}\sin\left(\frac{2\pi t}{\frac{2}{3}} + Q\right)$

Time period $= \frac{2}{3}s$

Amplitude $= \sqrt{28}\, m$

4.



From momentum conservation $mu + 0 = -mv_1 + mv^2$........(1)

Using k energy conservation

$\frac{1}{2}mv^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$............(2)

Hence it retain 36%. Hence $v_1 = 0.6v$.

On solving we get $M = 4m$.

5. When electron pass through the Hg^{-} vapor it loses some of its energy. The loss in KE of electron = = $(5 - 6 - 0.7)eV = 4.9\ eV$.

$\therefore$ energy of radiation emitted = $4.9\ eV$.

$\therefore$ wavelength of radiation, $\lambda = \frac{1.24 \times 10^4}{4.9} A \approx 250\ nm$.

6. When we put our system in water, the focal length of lens is increased. Now the object is inside $2F$.

Hence image will be magnified

7. It is problem of kirchhof's current law.

ln R_1, current is $0.4\ A$.

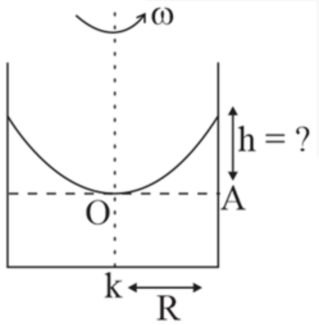
ln R_2, current is $0.8\ A - O.4A = 0.4A$

ln R_3, current is $(0.8 + 0.3)A = 1.1\ A$.

8. When cylinder is rotated, water will rise at the edge and will dip at the centre. The difference in pressure at A and O is $P_A - P_0 = \int gh$. Due to ω_0

Due to rotation, pressure difference $P_A - P_0 = \int .\ a_{cm}\ R$

$= \int .\left(\omega^2 . \frac{R}{2}\right) R$

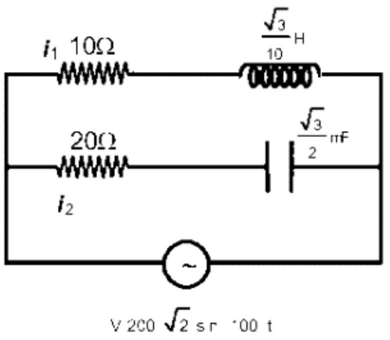


$$\therefore \int gh = \int \frac{\omega^2 R^2}{2} \Rightarrow h = \frac{\omega^2 - R^2}{2g} = (2\pi \times 2)^2 \times \frac{(0.05)^2}{2 \times 10}$$

$= 0.02\ m$

$= 2\ cm$

9.



Inductive reactance $x_L = \omega L = 100x\frac{\sqrt{3}}{10}\Omega$

$= 10\sqrt{3}\,\Omega$

Capacitive reactance

$$x_c = \frac{1}{\omega_c} = \frac{1}{100 \times \frac{\sqrt{3}}{2} \times 10^{-3}}\Omega = \frac{20}{v_3}\Omega$$

For i_1, phase difference between i_1& voltage, $\tan\phi_1 = \frac{x_L}{R} = \frac{10\sqrt{3}}{10} = \sqrt{3}$

$\Rightarrow\ \emptyset_1 = 60^o$, current lagging

For i_2, phase difference, $\tan\phi_2 = \frac{x_C}{R} = \frac{20/v_3}{20} = v_3$

$\Rightarrow\ \phi_1 = 60°$, current leading.

$\therefore$ difference in phase $= 90^o$.

10. $I_x = I_{cm} + mx^2$

$I_x = \frac{2}{5}mR^2 + mx^2$ $\Rightarrow$ Parabola opening upward

11. $\frac{dv}{dt} = k$

$\therefore v = kt$

$\therefore \frac{4}{3}\pi r^3 = kt$

$\therefore r = \left(\frac{3\,kt}{4\pi}\right)^{1/3}$

$$\therefore P_{\text{ex}}\frac{4T}{r} = \frac{4T}{\left(\frac{3KE}{4\pi}\right)^{1/3}} = \frac{4T\,(4\pi)^{1/3}}{(3\,k)^{1/3}}t^{-1/3} = ct^{-1/3}$$

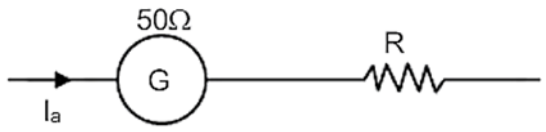
$\therefore \log P_{\text{ex}} = \log C - \frac{1}{3}\log t$

$\therefore y = c - mx$

12. $K = \frac{1}{2}mV^2 = \frac{1}{2}m\left(\sqrt{\frac{GM}{R}}\right)^2 = \frac{GMm}{2R} \propto \frac{m}{R}$

$\frac{K_A}{K_B} = \frac{m_A}{m_B} \times \frac{R_B}{R_A} = \frac{m}{2\,m} \times \frac{2\,R}{R} = 1$

13.



$2.5\,V = (50 + R) \times 4 \times 10^{-4}$

$\Rightarrow \frac{2.5}{4} \times 10^4 = 50 + R$

$\Rightarrow 250 \times 25 = 50 + R$

$\Rightarrow R = 6250 - 50 = 6200\ \Omega$

14. $hv = W + \frac{V_0}{2}e$

$\frac{hv}{2} = W + V_0 e$

on solving we get, $W = \frac{3}{2}h\,v$

$\Rightarrow hv_0 = \frac{3}{2}h\,v$

$\Rightarrow v_0 = \frac{3}{2}v$

15. Range $= \sqrt{2\,hR}$

To double the range h have to be made 4 times.

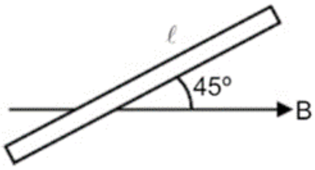
16. $\frac{1}{f_1} = (\mu_1 - 1)\left(\frac{1}{-R} - \frac{1}{\omega}\right)\ \frac{1}{f_2} = (\mu_2 - 1)\left(\frac{1}{R} - \frac{1}{\omega}\right)$

When joined together

$\frac{1}{f_{\text{eq}}} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{\mu_2 - 1}{-R} + \frac{\mu_2 - 1}{R} = \frac{\mu_2 - \mu_1}{R}$

$= f_{\text{eq}} = \frac{R}{\mu_2 - \mu_1}$

17.



$\varepsilon \text{ind} = Bvl \sin 45^0$

$= 0.3 \times 10^{-4} \times 5 \times 10 \times \frac{1}{\sqrt{2}}$

$= 1.060 \times 10^{-3} V$

18. When switched on,

$V_{CE} = 0$

$V_{CC} - R_C\, i_C = 0$

$i_c = \frac{V_{CC}}{R_C} = \frac{5}{1 \times 10^3} = 5 \times 10^{-3} A$

$i_c = \beta i_B$

$i_B = \frac{i_C}{\beta} = \frac{5 \times 10^{-3}}{200} = 2.5 \times 10^{-6} A \; = 2.5\, \mu A$

using KVL at input side,

$V_{BB} - i_B\, R_B - V_{BE} = 0$

$V_{BB} = V_{BE} + i_B R_B$

$= 1 + 100 \times 10^3 \times 25 \times 10^{-6}$

$= 1 + 2.5$

$= 3.5\, V$

19. $\frac{\lambda_1}{4} = 11\, cm. + e \Rightarrow \frac{v}{512 \times 4} = 11\, cm \; + e \quad \ldots$(i)

$\frac{\lambda_2}{4} = 27\, cm. + e \Rightarrow \frac{v}{256 \times 4} = 27\, cm \; + e \quad \ldots$(ii)

Equation (ii)-(i)

$\frac{v}{256 \times 4} \times \frac{1}{2} = 0.16$

$v = 0.16 \times 2 \times 4 \times 256$

$= 327.68\ m/s$

$= 328\ m/s.$

20. Since $\left.\frac{dq}{dt}\right|_{t=4s} = 0$

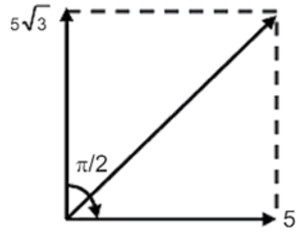
Therefore current = 0

21. $\left[\frac{L}{CVR}\right] = \left[\frac{L}{R}\frac{R}{CRV}\right] = \left[\frac{L}{R}\right]\left[\frac{1}{RC}\right]\left[\frac{R}{V}\right]$

$= [T]\left[\frac{1}{T}\right]\left[\frac{R}{V}\right]$

$= \left[\frac{R}{V}\right] = \left[\frac{1}{1}\right] = A^{-1}$

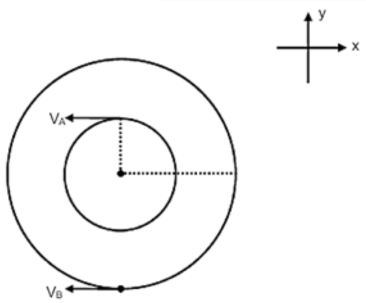
22. $y = 5\,\&\,m(3\pi t) + 5\sqrt{3}\cos 3\pi t$



$\omega = 3\pi$

$T = \frac{2\pi}{\omega} = \frac{2}{3}\text{sec}$

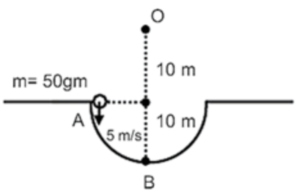
23. $t = \frac{\pi}{2\omega}$



$\vec{V}_A = \omega R_1(-\hat{\imath})$

$\vec{V}_B = \omega R_2(-\hat{\imath})$

24. Applying conservation of energy



$mgR = \frac{1}{2}mV_2^2 - \frac{1}{2}mV_1^2$

$V_2 = \sqrt{2gr + V_1^2}$

$= \sqrt{2 \times 10 \times 10 + 25}$

$V_2 = 15\ m/s$

$L_0 = mV_Br$

$= 20 \times 10^{-3} \times 20 \times 15$

$L_0 = 6\ kgm^2/s$

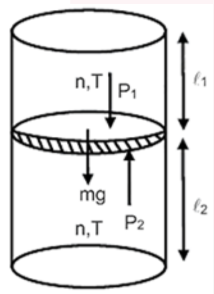
25. $E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{A\varepsilon_0} = 100\ V/m$

$Q = 100 \times A\ \varepsilon_0$

$\Rightarrow Q = 100 \times 1 \times 8.85 \times 10^{-12} C$

$= 8.85 \times 10^{-10} C$

26.



$P_1 + \frac{mg}{A} = P_2$

$\Rightarrow \frac{nRT}{l_a A} + \frac{mg}{A} = \frac{nRT}{l_2 A}$

$\Rightarrow m = \frac{nRT}{g}\left(\frac{1}{l_2} - \frac{1}{l_1}\right)$

$= \frac{nRT}{g}\left(\frac{l_1 - l_2}{l_1 l_2}\right)$

27. Change in $Z = (6 \times 2) - 4 = 8$

Change in $A = 6 \times 4 = 24$

${}^{232}_{90}TH \underset{4\beta}{\overset{6\alpha}{\rightarrow}} {}^{208}_{82}P_B$

28. $I = \frac{B_0^2}{2\mu_0} \times C$

$B_0 = \sqrt{\frac{2\mu_0 I}{C}}$

$B_{\text{rms}} = \sqrt{\frac{\mu_0 1}{C}} = \sqrt{\frac{4\pi\times10^{-7}\times10^{8}}{3\times10^{8}}}$

$\approx 10^{-4}T$

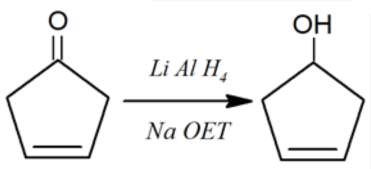
29. $\delta = \frac{\rho_0 vg\times L}{Ay}$

$\delta' = \frac{(\rho_0-\rho_L)vg\times L}{Ay} \Rightarrow \frac{\delta^{\wedge\prime}}{\delta} = \frac{\rho_0-\rho_L}{\rho_0} = \frac{8-2}{8}$

$\delta' = 3\ mm$

Chemistry

1. $Li\ Al\ H_4$ is a strong reducing agent as it can reduce carboxylic acids, aldehydes, ketones and alcohols. But it cannot reduce double bonds. Also $Na\ OET$ acts as a solvent in the above reaction and does not take part chemically. Hence, the reaction will be



2. $H_2O_2 \rightarrow H_2O + \begin{matrix} 1 & 0 \\ 3 & 2 \end{matrix}$

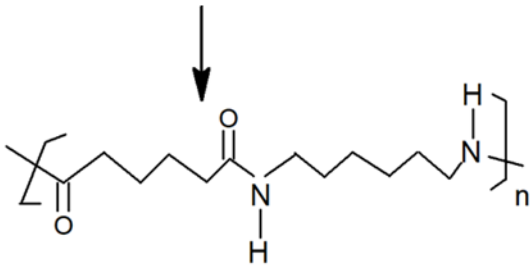
Volume strength $= 11.35 \times M$

$= 11.35 \times 1$

$= 11.35$

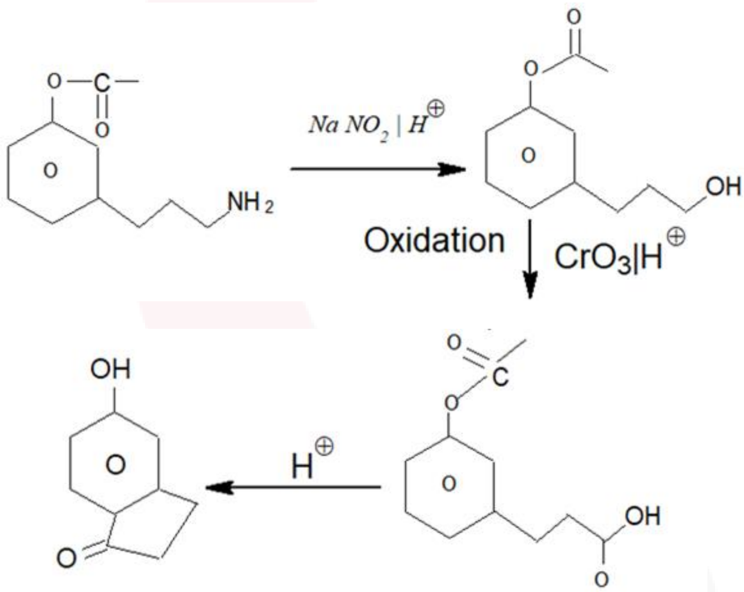
3. Nylon−66 is made up by hexamethylene diamine $(H_2N-(CH_2)_6NH_2)$ and Adipic acid $(HCOO-(CH_2)_4-COOH)$.

$NH_2(CH_2)_6NH_2 + HCOO(CH_2)_4COOH$



4. C –atom has the tendency to link with one another through covalent bonds to form chavis and rings (catenation) this is because $C-C$ bonds are very strong. Down the group the size increases tendency to show catenation decreases. This is because of bond enthalpy. The order of catenation is $C > Si > Ge \cdot Pb$ does not show catenation.

5.



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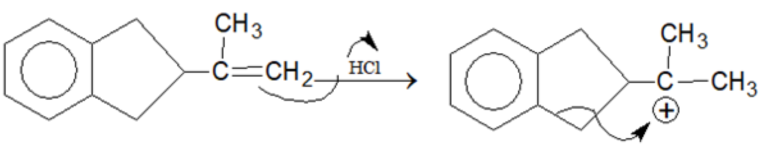
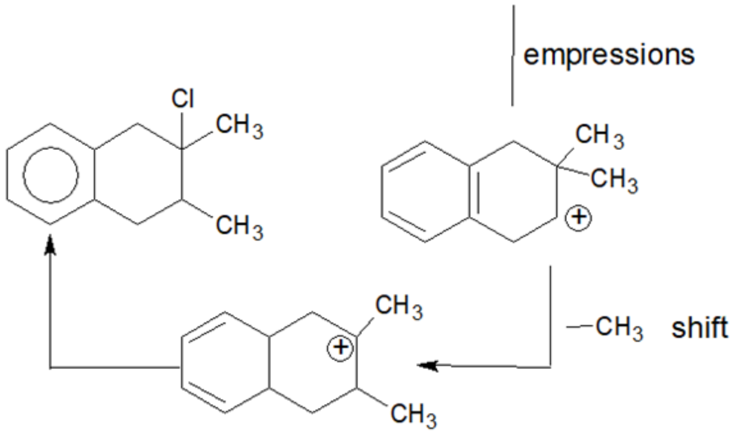
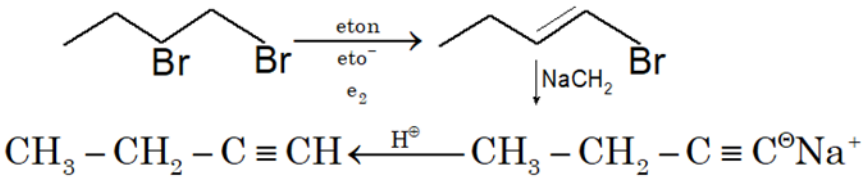
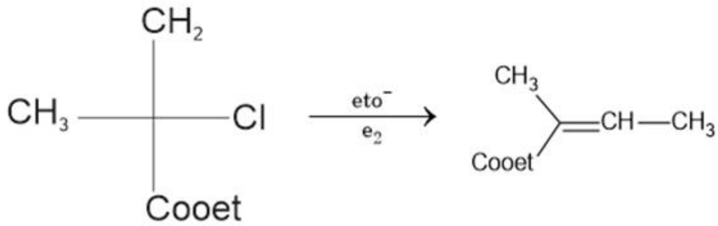




7.



8. In Fischer projechai formula



→ $\beta - H$ present at leaving roup.

→ sayzeff product will from. (more stable alkene)

9. In the mentioned, H^- will get added to the carbon having slight positive charge. Presence of Cl increases the positive charge whereas an electron donating group like NH_2 decreases the tendency.

Hence, the correct order will be:

D > C > B > A

10. Photochemical smog, often refused to as summer smog consists of nitrogen oxides, volatile organic compounds, tropospheric ozone, etc., It is formed when there components react in the presence of sunlight.

CF_2Cl_2, a chlorofluorocarbon, is not present in photochemical smog, but is a major cause of ozone-layer depletion.

11. $C + O_2 \rightarrow CO_2 \qquad \Delta H = x$

We get above equation add n of 2 and 3

$C + \frac{1}{2}O_2 \rightarrow CO \qquad \Delta x = y$

$+CO + \frac{1}{2}O_2 \rightarrow CO_2 \quad \Delta x = z$

$\overline{C + O_2 \rightarrow CO_2}\ 3^{rd}\ \Delta H = x$

$x = y + z$

12. Mn^{2+} will have configuration $= 3d^5 4s^0$

$\mu = 5.93 = \sqrt{n(n+2)}$

or, $\quad n = 5$ as $\sqrt{35} = 5.93$

If has 5 unpaired electron which are not getting paired up. This implies that the ligand paired up. This implies that the ligand is a weak field ligand. Among the given options, weak ligand is en (Ethylenediamine)

13.

$$3Cl_2 + \underset{(HotandConcentrated\ )}{6NaOH} \downarrow 5NaCl + NaClO_3 + 3H_2O$$

Ions will be Cl^-, CO_3^-

14. $\Delta y = ky \times m \times i \quad \ldots(i)$

$\because n = 2$ because benzoic acid is deamarised $\beta = 80\% = 0.8$ mwy of $C_6H_5COOH = 112$

here $i = \left(\frac{1}{n} - 1\right)\beta + 1$

$i = \left(\frac{1}{2} - 1\right) 0.8 + 1$

$= 0.6$

Put the value in equation (i)

$2 = 0.6 \times \frac{\frac{wt\,of\ \text{benzoic acid}}{112}}{\frac{30}{1000}} \times 5$

wt of benzoic acid $= 24.4gm$

15. $2\pi r = n\lambda$

$$2\pi a_0 \frac{n^2}{Z} = n\lambda$$

$$2\pi a_0 \frac{n^2}{Z} = n1.5\pi a_0$$

$$\frac{n}{Z} = \frac{1.5}{2} = \frac{3}{4}$$

16. $n_1 = \frac{8}{40} = 0.2$

$n_2 = \frac{18}{18} = 1$

Mole fraction of $NaOH = \frac{0.2}{1.2} = 0.167$

Molarity $= \frac{8}{40} \times \frac{1000}{18} = 11.11$

17. $8 \times 10^{-12} = (2S' + 0.1)^2 S'$

Or $S' = 8 \times 10^{-10} M$

18. C Form most stable $p\pi - p\pi$ bonds

19. $n_1 T_1 = n_2 T_2$

$\Rightarrow n \times 300 = \left(n - \frac{2n}{5}\right) T_2$

$\Rightarrow 300 = \frac{3}{5} T_2$

$\Rightarrow T_2 = 500K$

21. Calcination is required for hydroxide carbonate and hydrated oxide ores

23. Theory based

25. Fact

26. P and S will do acid base reaction with Grignard reagent rates.