[CHEMISTRY]

Q-1. (1) 3° alcohol by $S_N{}^1$.

Hint: 3° carbocation is more stable hence 3° alcohol gives turbidity via $S_N{}^1$ pathway.

Q-2. (1) -5.1 eV.

Hint:: $Na \xrightarrow{+\Delta_i H = +5.1\,eV\ (given)} Na^+$

$\longleftarrow -\Delta H = -5.1\,eV$

The amount of energy required to remove an e^- from isolated, gaseous, neutral atom of Na is same as it is released during the gain of an e^- by $Na^{\oplus}$ ion

Q-3. (1) $Li_2^- < Li_2^+ < Li_2$

$Li_2\ (Z_2=6) = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2$

$B.O = \frac{1}{2}[4-2] = 1.$

$Li_2^+\ (Z_2=5) = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^1$

$B.O = \frac{1}{2}[3-2] = 0.5$

$Li_2^-\ (Z_2=7) = \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^1$

$B.O = \frac{1}{2}[4-3] = 0.5$

ABMO is vacant $(\sigma^* 2s)$ in case of Li_2^+.

If the Bond order is equal for two molecules or molecular ions then less involvement of ABMO decides stability.

Q-4. Sol^n: (4) 0.875 M.

$$M_1V_1 + M_2V_2 = MV$$

$$M = \frac{M_1V_1 + M_2V_2}{V} = \frac{0.5\times750 + 2\times250}{1000}$$

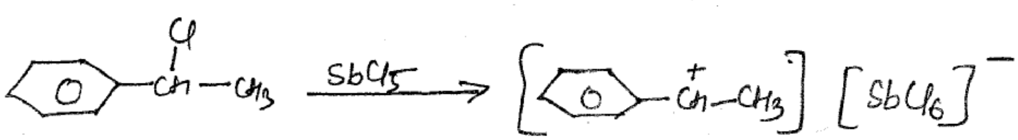
$$\therefore \quad M = 0.875$$

Q-5. All options are correct.

Q-6. Sol^n: (3) Co (Z=27)

$$E^0_{Co^{3+}|Co^{2+}} = 1.97\,V.$$

Q-7. Sol^n: (2) carbocation



2° benzyl carbocation.

The vacant unhybridized pure p-orbital of carbocation promotes racemisation.

Q-8. Solⁿ: (1) $Na^+ < Ba^{2+} < Al^{3+}$

Hint: As_2S_3 is a negative sol; According to "Hardy-Schulze rule" the coagulation will depend upon coagulating power of cation.

Hence, the coagulating power of cations are in the order of $Na^{\oplus} < Ba^{2+} < Al^{3+}$

Q-9. Solⁿ: (3.) 9.0 litres.

Hint: Initial pH = 1

means $[H^+] = 0.1\,M$.

new pH = 2

means $[H^+] = 0.01\,M$.

upon dilution: $M_1V_1 = M_2V_2$

$0.1 \times 1 = 0.01 \times V_2$

$\therefore V_2 = 10$ lit.

Initial volume (given) = 1 lit.

$\therefore$ Volume of water added = 10 − 1 = 9 litres.

Q-10. Solⁿ: Both N_2 & C_2 are diamagnetic.

$C_2\ (Z_2 = 12) = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 \pi 2p_y^2$

$N_2\ (Z_2 = 14) = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2$

All M.Os in both molecules are paired.

Q-11. Sol^n: ~~(2) & (4) both are correct answers.~~
(4.)

Hint: No. of odd e's in Fe^{2+} ion = 4

No. of odd e's in Mn^{2+} ion = 5.

Q-12. Sol^n: (1.) 4.08 %

Hint: let amount of $M^{3+} = x$

$\therefore M^{2+} = (.98 - x)$

$\therefore 3x + (.98 - x) \times 2 = 2$

$x = 0.04$

$\therefore$ % Fraction of $M^{3+} = \frac{0.04}{0.98} \times 100 = 4.08\%$.

Q-13. Sol^n: (1.) 5.

Hint:

$$\underset{(1^\circ \text{ amine})}{R-NH_2} + CH_3-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{-HCl} \underset{2^\circ \text{ amide}}{CH_3-\overset{O}{\overset{\|}{C}}-NH-R}$$

Each acetyl group addition increases the molecular mass by 42.

total increase in molecular mass = 390 − 180 = 210

$\therefore$ No. of $-NH_2$ Groups $= \frac{210}{42} = 5$.

Q-14. Solⁿ: (3) MnO_4^-

Q-15. Solⁿ: (2.) III > I > II > IV

Q-16. Solⁿ: (4.) 53.6 KJ mol^{-1}

Hint: Given, $K_1 = K$ at $T_1 = 300K$

$K_2 = 2K$ at $T_2 = 310K$.

Accdⁿ to Arrehenius eqⁿ:

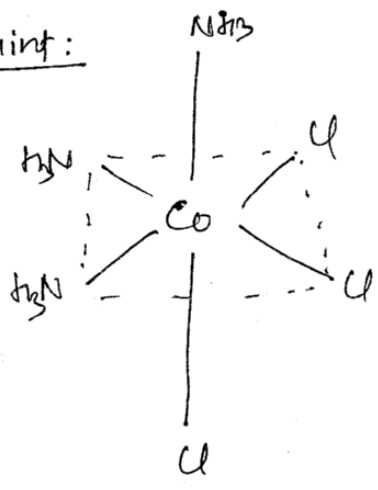
$$\log \frac{K_2}{K_1} = \frac{Ea}{2.303R}\left(\frac{T_2 - T_1}{T_1 \cdot T_2}\right)$$

Q-17. Solⁿ: (4) 18 molecules of ATP.

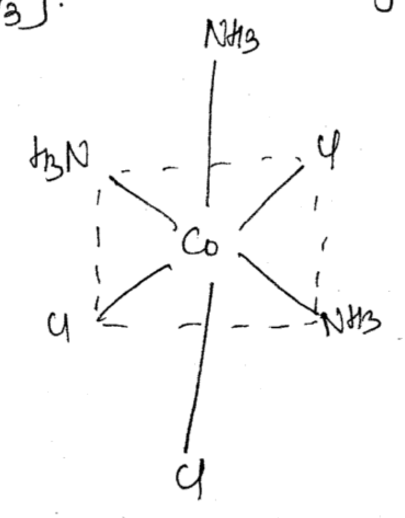
Q-18. ~~Solⁿ: (3) [Co en~~

Solⁿ: (2) $[Co(NH_3)_3Cl_3] \rightarrow$ Shows G.I only as achiral.

Hint:



(cis) fac.



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Q-19. Solⁿ: (4) $q = +208\,J$, $w = -208\,J$.

Hint: Process is isothermal reversible expansion,

hence, $\Delta U = 0$.

$\therefore\ q = -w$

as, $q = +208\,J$

$\therefore\ w = -208\,J$.

Q-20. Ans: (3) C_7H_8.

Hint: $C_xH_y + \left(\frac{4x+y}{4}\right)O_2 \longrightarrow x\,CO_2 + \frac{y}{2}H_2O$

	CO_2	H_2O
weight (given)	3.08 gm	0.72 gm
moles	0.07	0.04

$\therefore\ \dfrac{x}{y/2} = \dfrac{0.07}{0.04}$

$\dfrac{2x}{y} = \dfrac{0.07}{0.04}$

$\therefore\ \dfrac{x}{y} = \dfrac{7}{8}$

C_7H_8.

Q-21. Solⁿ: (3) $C_6H_5-\overset{\oplus}{C}H_2 > CH_2=CH-\overset{\oplus}{C}H_2 > CH_3-CH_2-\overset{\oplus}{C}H_2$

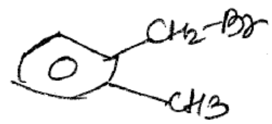
Q-22. Solⁿ: (2) $Ba < Ca < Se < S < Ar$.

Q-23. Sol^n: (2) $C^* : \bar{C} : C = 1 : 1.128 : 1.225$

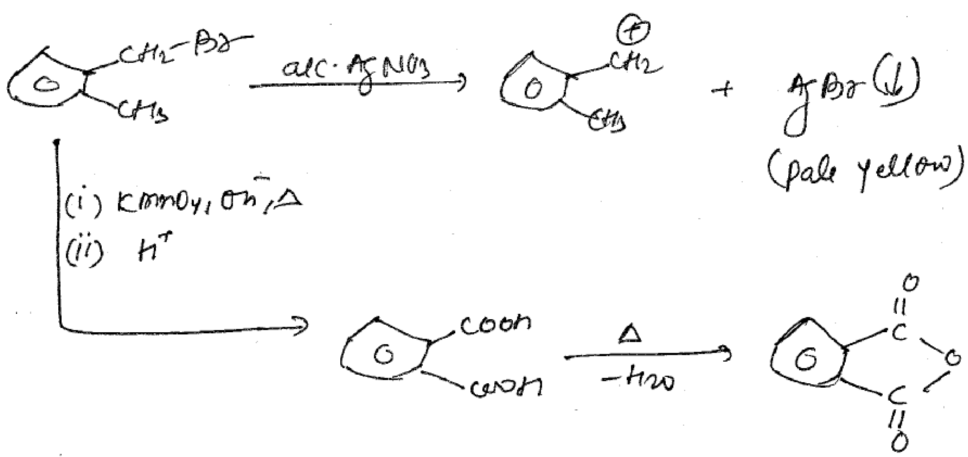
Q-24 Sol^n: (4) CH_3NCO

Q-25. Sol^n: (2) 2, 5 & 16.

Q-26. Sol^n: (1) silicon.

Q-27. Sol^n: (3) 

Hint: aq. or alc. $AgNO_3$ promotes ionization of the alkyl halide and the formation of S_N^1 products:



phthalic anhydride.

Q-28. Sol^n: (4) 1.214×10^{-7} m.

Hint: $E = \frac{hc}{\lambda} = R \cdot Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

Q- 29. Solⁿ: (3) CH_3-CH_2-COOH.

Hint: $\underset{(A)}{CH_3-CH_2-COOH} \xrightarrow{NH_3} CH_3-CH_2-COO^{\ominus}\overset{\oplus}{N}H_4$

$\xrightarrow{\Delta} CH_3-CH_2-CONH_2$

$\xrightarrow{Br_2,\ KOH} CH_3-CH_2-NH_2$

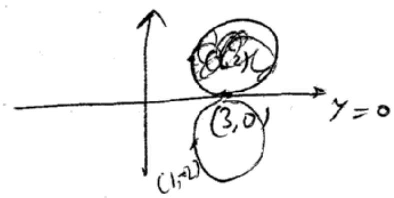
Q- 30. Solⁿ: (2) H_2^{2+}, He_2

Hint: H_2^{2+} $(Z_2=0)$ $B.O=0$

He_2 $(Z_2=4)$ $\sigma 1s^2 \sigma^* 1s^2$

$B.O = 0$.

[MATHEMATICS]



Q31 Eqn of circle can be taken as

$(x-3)^2 + y^2 + dy = 0$

(1,2) should satisfy

$\Rightarrow 4 + 4 + d\times 2 = 0 \Rightarrow d = 4$

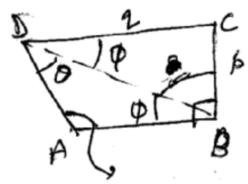
so Eqn of circle is $(x-3)^2 + y^2 + 4y = 0$

$x^2 + y^2 - 6x + 4y + 9 = 0$

Now check from alternatives circle passes through (5,-2)

so (2) is correct.

Q32 let $\angle BDC = \phi = \angle ABD$



$180 - (\theta + \phi)$

From right triangle BCD

$BD = \sqrt{p^2+q^2}$

$\cos\phi = \frac{q}{\sqrt{p^2+q^2}}$

$\sin\phi = \frac{p}{\sqrt{p^2+q^2}}$

Appling Sine rule in ΔDAB

$$\Rightarrow \frac{BD}{\sin[180-(\theta+\phi)]} = \frac{AB}{\sin\theta}$$

$$\Rightarrow AB = \frac{\sqrt{p^2+q^2}\,\sin\theta}{\sin(\theta+\phi)}$$

$$= \frac{\sqrt{p^2+q^2}\,\sin\theta}{\sin\theta\cos\phi + \cos\theta\sin\phi}$$

$$= \frac{\sqrt{p^2+q^2}\,\sin\theta}{(\sin\theta)\times\frac{q}{\sqrt{p^2+q^2}} + (\cos\theta)\cdot\frac{p}{\sqrt{p^2+q^2}}}$$

$$= \frac{(p^2+q^2)\,\sin\theta}{q\sin\theta + p\cos\theta}$$

so Ans (4)

Q33 let common tangent Equation on parabola can be taken

$$ty = x + \sqrt{5}t^2$$

or $y = \frac{1}{t}x + \sqrt{5}t$ or in terms of slope is

$$y = mx + \sqrt{5}/m$$

Now line is also tangent to circle $x^2+y^2 = \left(\sqrt{5/2}\right)^2$

so $p = r$

$$\Rightarrow \frac{|0+0+\sqrt{5}/m|}{\sqrt{1+m^2}} = \sqrt{5/2}$$

on squaring $\Rightarrow \frac{5}{m^2(1+m^2)} = \frac{5}{2} \Rightarrow m^4+m^2 = 2$

$$\Rightarrow m^4+m^2-2=0$$

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

$$\Rightarrow m = \pm 1$$

Taking + sign gives desired tangent

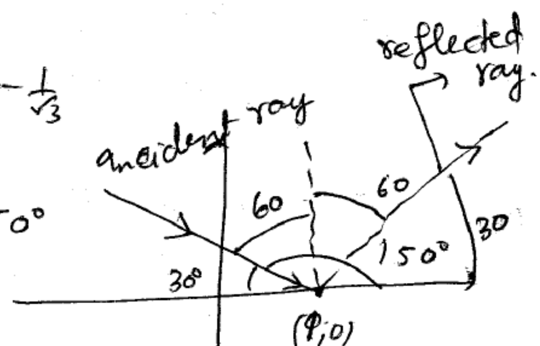
so (i) is true & second is false.

Ans (2)

Q34 $y = -\frac{1}{\sqrt{3}}x + 1 \Rightarrow$ slope $= -\frac{1}{\sqrt{3}}$

$$= \tan\theta = -\frac{1}{\sqrt{3}}$$

$$\Rightarrow \theta = 150^\circ$$



From figure reflected ray passes through (1,0) & makes an angle 30° with x axis

so Eq. $y-0 = (\tan 30)(x-1)$

$$\Rightarrow \sqrt{3}y = x-1$$

So Ans (3)

(35) Variance. (Because variance does no change due to change of origin)

(36) $2\tan^{-1}y = \tan^{-1}x + \tan^{-1}z$

$\Rightarrow \tan^{-1}\frac{2y}{1-y^2} = \tan^{-1}\frac{x+y}{1-xy}$

$\Rightarrow \frac{2y}{1-y^2} = \frac{x+y}{1-xy}$ since x, y, z are in AP

$\Rightarrow 2y = x+z$

$\Rightarrow \frac{2y}{1-y^2} = \frac{2y}{1-xz}$

$\Rightarrow y^2 = xz$ so x, y, z are in G.P

Since x, y, z are in A.P. as well as G.P.

so $x = y = z$.

Ans (4)

Q37 $\int x^5 f(x^3)\,dx$ let $x^3 = t$

$\Rightarrow 3x^2 dx = dt$

$\Rightarrow \int t\,\frac{f(t)}{3}\,dt = \frac{1}{3}\int t f(t)\,dt$

Now integrating by parts

$\Rightarrow \frac{1}{3}\int t f(t)\,dt = \frac{1}{3}t\int f(t)\,dt - \frac{1}{3}\int\left[\boxed{\left(\frac{dt}{dt}\right)}\int f(t)\,dt\right]dt$

$= \frac{1}{3}t\,\phi(t) - \frac{1}{3}\int \phi(t)\,dt$

$= \frac{1}{3}x^3\phi(x^3) - \frac{1}{3}\int \phi(x^3)\,d(x^3)$

$= \frac{1}{3}x^3\phi(x^3) - \frac{1}{3}\int \phi(x^3) \times 3x^2 dx$

$= \frac{1}{3}x^3\phi(x^3) - \int x^2\phi(x^3)\,dx + C$

so Ans is (2)

(38) $9 = 16(1-e^2) \Rightarrow e = \sqrt{7}/4$

so focus $= (\pm 4 \times \sqrt{7}/4, 0) = (\pm\sqrt{7}, 0)$

center of circle $=$ ~~(0,3)~~ $(0,3)$

$\Rightarrow$ radius $= \sqrt{(\pm\sqrt{7})^2 + 3^2} = 4$

so eqn of ~~circ~~ circle $x^2 + (y-3)^2 = 4^2$

$\Rightarrow x^2 + y^2 - 6y - 7 = 0$

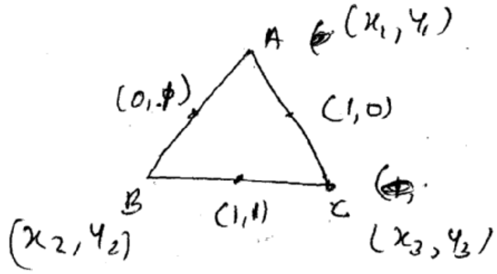
Ans (d)

Q39

$\frac{x_1 + x_2}{2} = 0$ — (1)

$\frac{x_2 + x_3}{2} = 1$ — (2)

$\frac{x_3 + x_1}{2} = 1$ — (3)



(1) + (2) + (3) $\Rightarrow x_1 + x_2 + x_3 = 2$

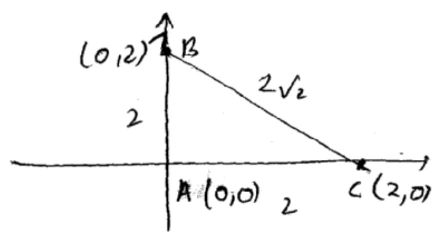
$\Rightarrow$ ~~$x_3 = 0, = x$~~ $x_3 = 2, \quad x_1 = x_2 = 0$

$\frac{y_1 + y_2}{2} = 1$ — (4), $\frac{y_2 + y_3}{2} = 1$ — (5), $\frac{y_1 + y_3}{2} = 0$ — (6)

$\Rightarrow y_1 + y_2 + y_3 = 2$

so $\Rightarrow y_3 = 0, \; y_1 = 0, \; y_2 = 2$

So triangle is plotted as



$x_i = \frac{2 \times 2 + 2 \times 0 + 2\sqrt{2} \times 0}{2 + 2 + 2\sqrt{2}}$

$= \frac{4}{4 + 2\sqrt{2}} = \frac{2}{2 + \sqrt{2}} = \frac{2(2-\sqrt{2})}{4-2} = 2 - \sqrt{2}$

(40) $m_{Tangent} = 2$

$\frac{dy}{dx} = \frac{d}{dx}\int_0^x |t|\,dt = |x|$

$\Rightarrow |x| = 2 \Rightarrow x = \pm 2$

when $x = 2$

$\Rightarrow y = \int_0^x |t|\,dt = \int_0^2 |t|\,dt = 2$

when $x = -2$

$\Rightarrow y = \int_0^{-2} |t| dt = \int_0^{-2} -t\, dt = -\frac{t^2}{2}\Big|_0^{-2} = -2$

so pt. on the curve are $(2,2)$ & $(-2,-2)$ having slope 2

so Eqn of tangent $y-2 = 2(x-2)$ & $y+2 = 2(x+2)$

clearly $x_{int.} = \pm 1$

so Ans (4)

(41) $0.7 + 0.77 + 0.777 - \text{——}$ up to 20 term.

$= \frac{7}{9}\left[0.9 + 0.99 + 0.999 + \text{——}\right]$

$= \frac{7}{9}\left[1-(0.1) + 1 - 0.01 + 1 - 0.001 + \text{—}\right]$

$= \frac{7}{9}\left[20 - \left\{\frac{1}{10} + \frac{1}{10^2} + \frac{1}{10^3} + \text{— up to 20 terms}\right\}\right]$

$= \frac{7}{9}\left[20 - \frac{\frac{1}{10}\left\{1 - \left(\frac{1}{10}\right)^{20}\right\}}{1-\frac{1}{10}}\right]$

$= \frac{7}{9}\left[20 - \frac{\{1 - 10^{-20}\}}{9}\right] = \frac{7}{81}\left[179 + 10^{-20}\right]$

so Ans is (2)

(42) S_1

p	q	$p \wedge \sim q$	$(\sim p) \wedge q$	$(p \wedge \sim q) \wedge (\sim p \wedge q)$
T	T	F	F	F
T	F	T	F	F
F	T	F	T	F
F	F	F	F	F

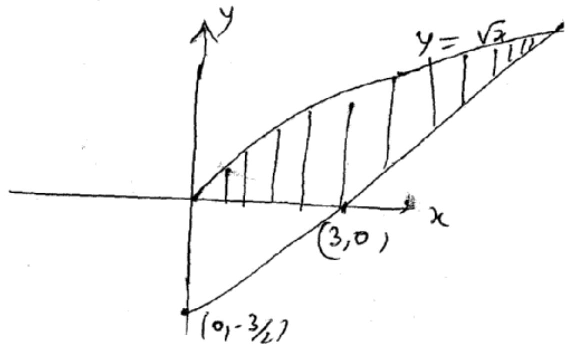
$\Rightarrow$ Fallacy.

S_2

p	q	$p \Rightarrow q$	$\sim q \Rightarrow \sim p$	$(p \Rightarrow q) \Leftrightarrow (\sim q) \Rightarrow \sim p$
T	T	T	T	T
T	F	F	F	T
F	T	T	T	T
F	F	T	T	T

(43) For intersection of $y = \sqrt{x}$ or $y^2 = x$ &

$2y - x + 3 = 0$



$2y - y^2 + 3 = 0$

$y^2 - 2y - 3 = 0$

$(y-3)(y+1) = 0$

$\Rightarrow y = 3$ &

when $y = 3 \Rightarrow x = 9$

Required area $= \int_0^3 (x_{st.} - x_c)\,dy$

$= \int_0^3 (2y + 3 - y^2)\,dy = y^2 + 3y - \frac{y^3}{3}\Big|_0^3$

$= 9 + 9 - 9 = 9$

so Ans (4)

(44) $\frac{\tan A}{1-\cot A} + \frac{\cot A}{1-\tan A} = \frac{\sin A/\cos A}{1 - \frac{\cos A}{\sin A}} + \frac{\cos A/\sin A}{1 - \sin A/\cos A}$

$= \frac{\sin^2 A}{\cos A(\sin A - \cos A)} + \frac{\cos^2 A}{\sin A(\cos A - \sin A)}$

$= \frac{\sin^3 A - \cos^3 A}{(\sin A - \cos A)\sin A \cos A}$

$= \frac{\cancel{(\sin A - \cos A)}(\sin^2 A + \cos^2 A + \sin A \cos A)}{\cancel{(\sin A - \cos A)}\sin A \cos A}$

$= \operatorname{cosec} A \sec A + 1$

so Ans is (1)

(45) let $f(x) = 2x^3 + 3x + k$

$f'(x) = 6x^2 + 3 > 0$ so $f(x)$ is an increasing function of $x \Rightarrow f(x)$ can not cut x axis at two points so there does not exist any k.

Ans is (3)

(46) $\lim_{x\to 0} \dfrac{(1-\cos 2x)(3+\cos x)}{x \tan 4x}$

$\lim_{x\to 0} \dfrac{(2\sin^2 x)(3+\cos 4x)\cdot \cancel{x}}{x x \cdot \frac{\tan 4x}{4x} \cdot 4\cancel{x}}$

$\dfrac{\sin^2 x}{x x} = 1$, $\dfrac{\tan 4x}{4x} = 1$

$= \dfrac{2 \times (3+1)}{4} = 2$

so Ans (3)

~~Q47 $T_n = {}^nC_2 - n = \frac{n(n-1)}{2} - n$~~

~~$= \frac{n(n-3)}{2}$~~

~~$T_{n+1} - T_n = 10$~~

~~$\Rightarrow \frac{(n+1)(n-2)}{2} - \frac{n(n-3)}{2} = 10$~~

~~$\Rightarrow n^2 - n - 2 - (n^2 - 3n) = 20$~~

~~$\Rightarrow$~~

Q47 No. of triangles equal to n of ways of selecting three vertices $= {}^nC_3$

Now $\;{}^{n+1}C_3 - {}^nC_3 = 10$

${}^nC_{3-1} = 10 \Rightarrow \frac{n(n-1)}{2} = 10$

$n^2 - n = 20$

$\Rightarrow n^2 - n - 20 = 0$

$n = 5, -4$

so Ans (1)

Q48 $\frac{dP}{dx} + 12\sqrt{x} = 100$

$\frac{dP}{dx} = 100 - 12\sqrt{x}$

$\int dP = \int (100 - 12\sqrt{x})dx$

$\Rightarrow P = 100x - 8x^{3/2} + c$

when $x = 0 \Rightarrow$ no additional worker $\Rightarrow P = 2000$

so $c = 2000$

$P = 100x - 8x^{3/2} + 2000$

when $x = 25$

$\Rightarrow P = 100 \times 25 - 8 \times (25)^{3/2} + 2000 = 2500 - 1000 + 2000$

$= 3500$ item

Ans 2

(49) $I = \int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}}$ — (1)

$I = \int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan(\pi/3+\pi/6-x)}}$

$= \int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\cot x}}$

$= \int_{\pi/6}^{\pi/3} \frac{\sqrt{\tan x}}{\sqrt{\tan x}+1} dx$ — (2)

(1) + (2) $\Rightarrow 2I = \int_{\pi/6}^{\pi/3} 1 \cdot dx = x \Big|_{\pi/6}^{\pi/3}$

$= \pi/6$

$\Rightarrow I = \pi/12$

so (a) is wrong & b is correct.

Ans (3)

(Q 50) $\det(P) = 1(12-12) - \alpha(4-6) + 3(4-6)$

$= 2\alpha - 6$

$\det(P) = (\det A)^{3-1} = 4^2 = 16$

so $2\alpha - 6 = 16 \Rightarrow \alpha = 11$

Ans → (1)

(51) No Solution $\Rightarrow \dfrac{k+1}{k} = \dfrac{8}{k+3} \neq \dfrac{4k}{3k-1}$

$\Rightarrow (k+1)(k+3) = 8k \Rightarrow k^2 - 4k + 3 = 0 \Rightarrow k = 3, 1$ — (1)

& $\dfrac{8}{k+3} \neq \dfrac{4k}{3k-1} \Rightarrow 4k(k+3) \neq 8(3k-1)$

$\Rightarrow k^2 + 3k \neq 6k - 2$

$\Rightarrow k^2 - 3k + 2 \neq 0 \Rightarrow k \neq 1, 2$ — (2)

(1) & (2) $\Rightarrow k = 3$ so no. of values of k is 1

Ans (1)

(52) $y = \sec(\tan^{-1}x)$

$\dfrac{dy}{dx} = \sec(\tan^{-1}x) \cdot \tan(\tan^{-1}x) \cdot \dfrac{1}{1+x^2}$

$\left.\dfrac{dy}{dx}\right|_{x=1} = \sec\frac{\pi}{4} \cdot \tan\frac{\pi}{4} \cdot \dfrac{1}{1+1} = \dfrac{\sqrt{2}}{2} = \dfrac{1}{\sqrt{2}}$

Ans (4)

(53) First line passes through $a = (2, 3, 4)$ & || to $\vec{b} = \hat{i} + \hat{j} - k\hat{k}$

Second " " " $c = (1, 4, 5)$ & || to $\vec{d} = k\hat{i} + 2\hat{j} + \hat{k}$

lines to be co-planar $\Rightarrow \begin{vmatrix} a_1 - c_1 & a_2 - c_2 & a_3 - c_3 \\ b_1 & b_2 & b_3 \\ d_1 & d_2 & d_3 \end{vmatrix} = 0$

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

applying $C_2 \to C_2 + C_1$ & $C_3 \to C_3 + C_1$

$\Rightarrow \begin{vmatrix} 1 & 0 & 0 \\ 1 & 2 & 1-k \\ k & k+2 & k+1 \end{vmatrix} = 0 \Rightarrow 2(k+1) - (k+2)(1-k) = 0$

$\Rightarrow 2k + 2 - [-k^2 - k + 2] = 0$

$\Rightarrow k^2 + 3k = 0 \Rightarrow k = 0, -3$

so Ans (2)

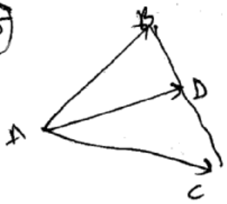
(54) Total no. of elements in $A \times B = 8$

No. of subsets of three or more elements $= {}^8C_3 + {}^8C_4 + {}^8C_5 + \dots + {}^8C_8$

$= 2^8 - {}^8C_0 - {}^8C_1 - {}^8C_2$

$= 256 - 1 - 8 - 28 = 219$

(Q55)



median $\vec{AD} = \dfrac{\vec{AB} + \vec{AC}}{2}$

$= 4\hat{i} - \hat{j} + 4\hat{k}$

length $= \sqrt{16+1+16} = \sqrt{33}$

Q56 Total no. of ways student can answer the ~~questi~~ questions $= 3^5$

No. of ways of getting 4 correct answes $= \underbrace{{}^5C_4}_{\text{selecting for quest. for correct answes.}} \times 1 \times \underbrace{2}_{\text{no. of ways for wrong ans.}}$

Getting all the correct $= 1$ ways

so Favorable no of ways $= {}^5C_4 \times 2 + 1 = 11$

Prob. $= \dfrac{11}{3^5}$

so (2) is correct.

Q57 let $z = \cos\theta + i\sin\theta$

$\dfrac{1+z}{1+\bar{z}} = \dfrac{1+\cos\theta + i\sin\theta}{1+\cos\theta - i\sin\theta} = \dfrac{2\cos^2\theta/2 + 2i\sin\theta/2\cos\theta/2}{2\cos^2\theta/2 - 2i\sin\theta/2\cos\theta/2}$

$= \dfrac{(\cos\theta/2 + i\sin\theta/2)}{(\cos\theta/2 - i\sin\theta/2)} \times \dfrac{(\cos\theta/2 + i\sin\theta/2)}{(\cos\theta/2 + i\sin\theta/2)}$

$= \dfrac{\cos 2(\theta/2) + i\sin 2(\theta/2)}{\cos^2\theta/2 + \sin^2\theta/2}$

$= \cos\theta + i\sin\theta$

so argument $= \theta$

Ans 2

(58) Roots of Eq. $x^2+2x+3=0$ are imaginary ($D = 4-4\times3 < 0$)
so both roots are complex hence $ax^2+bx+c=0$ also have complex roots in pair with it's conjugate so Eqn. have both roots common.

$$\Rightarrow \frac{1}{a} = \frac{2}{b} = \frac{3}{c} \Rightarrow a:b:c = 1:2:3$$

Ans (4)

(59) First plane can be written as $4x+2y+4z-16=0$
& second is $4x+2y+4z+5=0$

$$d = \frac{|-16-5|}{\sqrt{4^2+2^2+4^2}} = \frac{21}{6} = 7/2$$

Ans (2)

(60)
$$\left[\frac{(x^{1/3})^3+1}{x^{2/3}-x^{1/3}+1} - \frac{(x^{1/2}-1)(x^{1/2}+1)}{x(x^{1/2}-1)}\right]^{10}$$

$$\left[\frac{(x^{1/3}+1)\cancel{(x^{2/3}-x^{1/3}+1)}}{\cancel{x^{2/3}-x^{1/3}+1}} - \frac{(x^{1/2}+1)}{x}\right]^{10}$$

$$\left[x^{1/3}+1-x^{-1/2}-1\right]^{10} = \left(x^{1/3}+x^{-1/2}\right)^{10}$$

$$T_{r+1} = {}^{10}C_r \left(x^{1/3}\right)^{10-r}\left(-x^{-1/2}\right)^r$$

$$= (-1)^r\,{}^{10}C_r\, x^{\frac{10-r}{3}-\frac{r}{2}} \quad — (1)$$

For term independent of $x \Rightarrow \frac{10-r}{3} - \frac{r}{2} = 0$

$$\Rightarrow 20-2r-3r = 0$$
$$\Rightarrow r = 4$$

Putting $r=4$ in (1) $\Rightarrow T_5 = {}^{10}C_4 = \frac{10\times9\times8\times7}{24}$

$$= 210$$

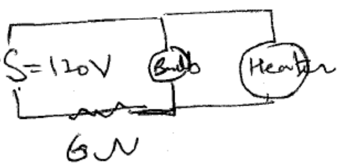
So Ans (2)

[PHYSICS]

61. (2) $q = q_0(1 - e^{-t/RC})$, $q_0 = CV$ & $t = 2\tau$, $\tau = RC$

62. (3) $F_c = \frac{1}{2\pi RC}$ & $F_m = F_c \frac{\sqrt{1-m^2}}{m}$ m → modulation index

63. (3)



$R_{Bulb} = 240\,\Omega$

$R_{Heater} = 60\,\Omega$.

Initial voltage across 6Ω $V_1 = \frac{120}{246} \times 6$ volts

equivalent resistance of the bulb & heater 48Ω

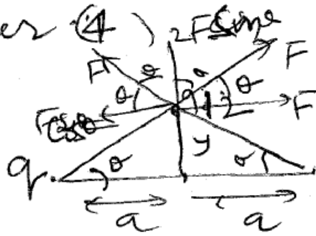
So final voltage across the 6Ω $V_2 = \frac{120}{(48+6)} \times 6$

Difference in the voltage across the 6Ω = the decrease in the voltage across the bulb $= V_2 - V_1 = 10.04$ volts

64. Answer (2)

In equilibrium $Mg = kx_0 + A\frac{L}{2}\rho g$

65. Answer (4)



$F' = 2F\sin\theta$

$F' = 2 \times K\frac{qq}{2(a^2+y^2)} \times \frac{y}{\sqrt{a^2+y^2}}$

as $y << a$ $F' = 2K\frac{qqy}{2a^3}$

66. Answer (2)

when unpolarised light passes through A

$I_1 = \frac{I_0}{2}$ then Apply $I_2 = I_1\cos^2\theta$ so $I_2 = \frac{I_0}{4}$

67. (3) Initially current is max, then when $\frac{hc}{\lambda}$ becomes less than work function current will become zero.

68. Answer (3)

The path difference for the pts lying on the circle, whose center is the center of the screen will be same, hence fringes will be circular.

69. (3) $\mathcal{E} = B\omega \int_{2l}^{3l} x \, dx = \frac{5}{2} B\omega l^2$

70. Answer (3) $h\nu = 13.6 \times \left(\frac{1}{(n-1)^2} - \frac{1}{n^2}\right)$

$$\nu \propto \frac{(n-1)^2 n^2}{(2n-1)} \propto \frac{n^4 \left(1-\frac{1}{n}\right)}{n\left(2-\frac{1}{n}\right)} \propto n^3$$

71. Answer (3) $4\pi R^2 T = \frac{4}{3}\pi R^3 \rho L$

$$4\pi \times 2R\Delta R T = \frac{4\pi \, 3R^2 \Delta R}{3} \times \rho L$$

hence $R = 2T/\rho L$

72. (2)

73. Answer (1)

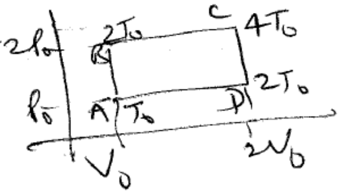
74. Answer (1) Heat extracted from the source

$= \Sigma$ positive ΔQ_s

ΔQ is positive for $A \to B$ & for $B \to C$

$\Delta Q_{AB} = \frac{3}{2} P_0 V_0$ $\quad \Delta Q_{BC} = 5 P_0 V_0$

So $\Delta Q_{AB} + \Delta Q_{BC} = \frac{13}{2} P_0 V_0$



75. (1) $\nu = \frac{1}{2l}\sqrt{\frac{T}{\mu}} = \frac{1}{2l}\sqrt{\frac{Y \Delta l A}{l \times A \times 1 \times \rho}}$ $Y = \frac{T/A}{\Delta l/l}$ $\mu = A \times 1 \times \rho$

$= \frac{1}{2 \times 1.5}\sqrt{\frac{2.2 \times 10^{11} \times \frac{1}{100}}{7.7 \times 10^3}}$

$= 178.2 Hz$

76. Answer (3)

Range $i = \frac{i_G \times l_G}{S}$ More the value of S more is the resistance of ammeter

So Range $\alpha \frac{1}{\text{resistance of the ammeter}}$.

(i) False, when shunt will be connected across the shunt, the resistance of the ammeter will decrease hence range will increase

(ii) True

77. Answer (4) Total Energy at altitude 2R − PE on surface = Energy required

$-\frac{GMm}{3R} \times \frac{1}{2} - \left\{-\frac{GMm}{R}\right\}$

78. Answer (1) $x = 1 \times t$

$y = 2t - \frac{1}{2} \times 10\, t^2$

So $y = 2x - 5x^2$

79. Answer (1)

The charge of one must cancel the charge on other so $120 C_1 = 200 C_2$

80. Answer (2)

Applying law of conservation of angular momentum about P

$$mr^2\omega_0 = mvr + mr^2 \times \frac{v}{r}$$

$$v = \frac{\omega_0 r}{2}$$

81. Answer (2) $PV^\gamma = C$

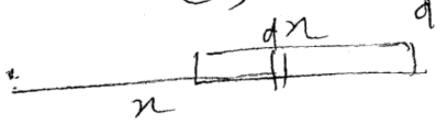
$$dP\,V^\gamma + \gamma V^{\gamma-1}dV\,P = 0$$

$$\Rightarrow dP = -\frac{\gamma P\,dV}{V} = -\frac{\gamma P A x}{V}$$

$$\frac{F}{A} = -\frac{\gamma P A x}{V}$$

$$\Rightarrow F = -\frac{\gamma P A^2}{V}x = ma$$

82. Answer (3)



$$dV = \frac{1}{4\pi\varepsilon_0} \times \int_L^{2L} \frac{(Q/L)\,dx}{x}$$

83 Answer (4)

$$\phi_{smaller} = \frac{\mu_0}{2} \times \frac{i_b R^2}{(R^2+x^2)^{3/2}} \times \pi r^2$$

$$= M \times i_b$$

also $\phi_{bigger} = M \times i_s$

$$\phi_{bigger} = \frac{\mu_0}{2} \times \frac{R^2}{(R^2+x^2)^{3/2}} \times \pi r^2 \times i_s$$

Q.84. Answer (2) $\frac{d\theta}{dt} \propto (\theta - \theta_0)$

hence θ ~~is an~~ exponentially decreases with time.

Q.85 - (4) forward biased p-n junction

Q.86. Answer (3)

$mv = (M+m)V$

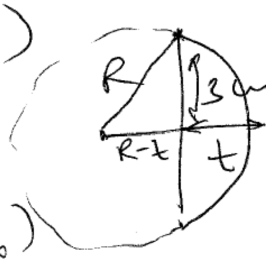
Loss of energy $= \frac{1}{2}mv^2 - \frac{1}{2}(M+m)\left(\frac{mv_0}{M+m}\right)^2$

$= \frac{1}{2}mv^2 \times \frac{M}{(M+m)}$

Q.87. Answer (2)

Amplitude decreases exponentially in every 5 sec, ~~so~~ it will become .9 times of it's previous value so it will fall to .9 × .9 × .9 times

Q.88- Answer (2)



$R^2 = (R-.3)^2 + 3^2$

$\Rightarrow R = \frac{9.09}{.6}$

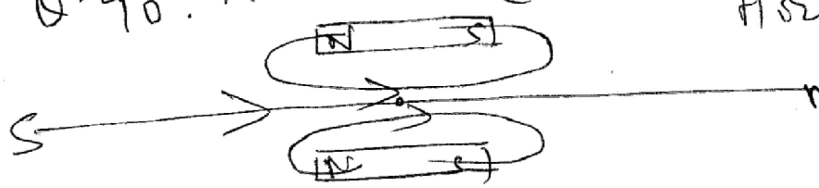
$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$

$\frac{1}{f} = \left(\frac{3}{2} - 1\right) \times \frac{.6}{9.09}$ $\Rightarrow f = \underline{30.3\text{ cm}}$

Q.89. Answer (1)

$\frac{E}{B} = c$ so $E = Bc$

Q.90. Answer (1)



Horizontal component of the earth is directed from S to N

So Net $B = B_1 + B_2 + B_H$

$= \frac{\mu_0}{4\pi} \times \frac{M_1}{r^3} + \frac{\mu_0}{4\pi} \times \frac{M_2}{r^3} + .36 \times 10^{-4}$

$= \frac{\mu_0}{4\pi r^3} [M_1 + M_2)$

$= (2.2 \times 10^{-4} + .36 \times 10^{-4})$ Wb/m²

$= 2.56 \times 10^{-4}$ Wb/m²

Typed Solutions will be available after 24 hours