IIT – JEE: 2023 **AITS – 1 ADVANCED** **DATE: 19/03/23**

ANSWERS KEY

PAPER – I

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	D	A	B	C	C	D	AB	AC	ABCD	BC
Que.	11	12	13	14	15	16	17	18	**19**	20
Ans.	ABD	ABC	AB	BD	8	1	2	4	**2**	3
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	C	B	A	C	D	A	ABCD	CD	AC	AD
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	AD	AD	CD	BC	4	8	4	5	3	4
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	C	A	C	B	C	C	CD	ABCD	ABCD	BC
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	AD	AC	ABD	BD	4	5	2	9	9	7

PAPER – II

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	AC	AD	ABC	AB	ABC	AD	ABC	ACD	D	A
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	C	D	8	6	8	9	2	4	2	5
Que.	21	22	**23**	24	25	26	27	28	29	30
Ans.	AB	BC	**ABD**	BC	AD	CD	BCD	ABC	C	D
Que.	31	32	33	34	35	36	37	**38**	39	40
Ans.	B	B	6	4	2	2	3	**7**	3	2
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	ABCD	BCD	CD	ACD	AC	AB	ABC	AB	D	C
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	D	C	1	7	3	2	6	4	6	9

Note : **Detailed solution to this test is available on Tomorrow after 05.00 pm on our website.:www.iitianspace.com**

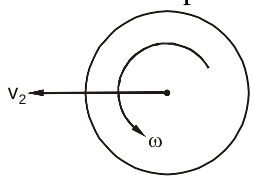
PHYSICS PAPER – I (SOLUTION)

1. **(D)**
Apply Snell's law and use geometry.

2. **(A)**
Use, v = $\nu\lambda$, and $v = \sqrt{\frac{\gamma RT}{m}}$.

3. **(B)**
As we know that
$\vec{F} = \oint I d\vec{\ell} \times \vec{B}$ and $\vec{T} = \vec{M} \times \vec{B}$.

4. **(C)**
The condition for no slipping here will be
$R\omega - v_2 = v_1$
$\therefore$ Point of contact remains at rest.
In terms of displacements.



$R\theta - S_2 = S_1$

$\therefore \quad \theta = \frac{S_1 + S_2}{R} = \frac{100 + 75}{150} = \frac{7}{6}$ rad.

5. **(C)**

6. **(D)**
Circuit is a balanced wheat stone bridge
$\therefore$ R of the whole circuit = 1 + 4 = 5 Ω
Induced cnf BLV = iR

$$v = \frac{iR}{BL} = \frac{.1 \times 5}{2 \times .1} = 2.5 \text{ m/s}$$

7. **(AB)**

8. **(AC)**
Using,
$V_A - L_1 \frac{di}{dt} + \varepsilon - L_2 \frac{di}{dt} = V_B$.

9. **(ABCD)**
Use the relation $\vec{v}_{\text{any particle}} = \vec{v}_a + \vec{\omega} \times \vec{r}$. For ground frame, while w.r.t. center mass frame body will only doing rotation.

10. **(BC)**
$\frac{1}{100 - x} = \frac{1}{-x} = \frac{1}{21}$
$\Rightarrow$ x, the distance of object from the lens = 30 cm, 70 cm

$m_1 = \frac{70}{-30}, \; m_2 = \frac{30}{-70}$

$\therefore \quad |m_1 - m_2| = \frac{40}{21}$.

11. **(ABD)**

12. **(ABC)**

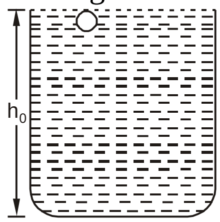
13. **(AB)**

14. **(BD)**

15. **(8)**

16. **(1)**

Let the net force on this particle is zero at height *h*. Then weight = upthrust [at *h*]

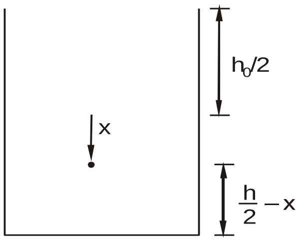


$\Rightarrow \quad \frac{4}{3}\pi r^3 .g. \frac{5}{2}\rho_0 = \frac{4}{3}\pi r^3 g \, \rho_0 \left[4 - \frac{3h}{h_0}\right]$.

$\Rightarrow \quad \frac{3h}{h_0} = 4 - \frac{5}{2} = \frac{3}{2}$

$\Rightarrow \quad h = \frac{h_0}{2} \quad \ldots(i)$

$\therefore$ At $h = \frac{h_0}{2}$ is the equilibrium position the particle has a speed in downward direction due to which it will move downward. Let at a further depth *x*-from $\frac{h_0}{2}$,



F_{net} = up thrust – weight $= \frac{4}{3}\pi r^3 g \rho_0 \left[4 - \frac{3\left(\frac{h_0}{2} - x\right)}{h_0}\right] - \frac{4}{3}\pi r^3 g \frac{5}{2}\rho_0$

$= \frac{4}{3}\pi r^3 \rho_0 g \left[4 - \frac{3}{2} + \frac{3x}{h_0} - \frac{5}{2}\right] = \frac{4\pi r^3 \rho_0 g}{h_0} \cdot x$

$\therefore \quad F = \frac{4\pi r^3 \rho_0 g}{h_0} \cdot x$

$\therefore$ Since the net force on the particle and displacement of ball from its mean position are oppositely directed so the particle executes SHM about its mean position *i.e.* $\left[h = \frac{h_0}{2}\right]$

$$\therefore \quad F = ma = -\frac{4\pi r^3 \rho_0 g}{h_0} x$$

$$\Rightarrow \quad \frac{4}{3}\pi r^3 \frac{5}{2}\rho_0 a = -\frac{4\pi r^3 \rho_0 g}{h_0} x$$

$$\Rightarrow \quad a = -\frac{6g}{5h_0}.x = -\left[\frac{12}{h_0}\right].x = -w^2 x$$

$$\left[\text{where } \omega = \sqrt{\frac{12}{h_0}} = \sqrt{\frac{12}{\frac{12}{\pi^2}}} = \pi\right]$$

$\therefore$ time taken by the particle to reach the bottom is

$$t = \frac{T}{2} = \frac{1}{2}\frac{2\pi}{\omega} = \frac{\pi}{\omega} = \frac{\pi}{\pi} = 1$$

17. **(2)**

18. **(4)**

Let q_1 and q_2 be charge on two capacitors after time t

$$\therefore \quad q_1 + q_2 = 2Q \quad \text{and} \quad \frac{q_1}{c_1} = \frac{q_2}{c_2}$$

Where $C_1 = \frac{\varepsilon_0 A}{(d_0 + vt)}$ and $C_2 = \frac{\varepsilon_0 A}{(d_0 - vt)}$

$$\therefore \frac{q_1}{q_2} = \frac{c_1}{c_2} = \frac{d_0 - vt}{d_0 + vt} \Rightarrow q_1 = Q\left[\frac{d_0 - vt}{d_0}\right] \text{ and } q_2 = Q\left[\frac{d_0 + vt}{d_0}\right]$$

The reduction in charge in the first capacitor is equal to the increase the charge on the second capacitor. The current is

$$I = -\frac{\Delta q_1}{\Delta t} = \frac{\Delta q_2}{\Delta t} = \frac{Q}{d_0} = \frac{6\times 10^{-3}}{1.5\times 10^{-3}} = 4A$$

19. **(3)**

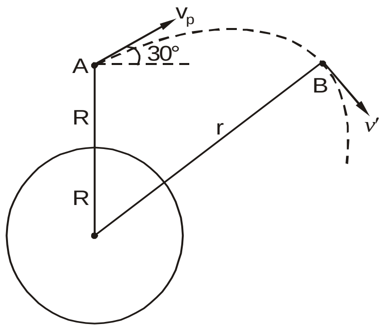
Let v_0 be the velocity required to send a particle to infinity from point A.

$$\frac{1}{2}mv_0^2 - \frac{GMm}{2R} = 0$$

$$\Rightarrow \quad v_0 = \sqrt{\frac{GM}{R}}$$

$\therefore$ velocity of projection at A

$$v_p = \frac{1}{\sqrt{2}} v_0 = \sqrt{\frac{GM}{2R}}$$



Let v' be the velocity at the highest point and r be its distance from the center of the planet. Using Conservation of angular momentum.

$m\, v_p \quad 2\,\text{R}\cos30° = m\, v' r$

$$\Rightarrow \quad v' = \frac{\sqrt{3}\text{R}}{\text{r}}\sqrt{\frac{\text{GM}}{\text{R}}} = \sqrt{\frac{3\text{GMR}}{2\text{r}^2}} \quad \ldots(1)$$

From conservation on the mechanical energy at A and B

$$-\frac{\text{GMm}}{2\text{R}} + \frac{1}{2}\text{m}.\frac{\text{GM}}{2\text{R}} = -\frac{\text{GMm}}{\text{r}} + \frac{1}{2}mv'^2$$

replacing the value of v' from (1) in the above eq^n.

$$-\frac{\text{GM}}{4\text{R}} = -\frac{\text{GM}}{\text{r}} + \frac{1}{2}\times\frac{3}{2}\frac{\text{GMR}}{\text{r}^2} \quad \Rightarrow \quad r^2 - 4\text{R}r + 3\text{R}^2 = 0$$

$$\Rightarrow \quad (r - 3\text{R})(r - \text{R}) = 0 \quad \Rightarrow \quad r = \text{R},\ r = 3\text{R}$$

20. (3)

$$\text{I}_0 = 4\text{I}_0\cos^2\frac{\phi}{2}$$

$$\Rightarrow \quad \cos\frac{\phi}{2} = \frac{1}{2}$$

$$\Rightarrow \quad \phi = \frac{\pi}{3}$$

$\therefore$ Path difference of the two beams producing intensity I_0 on the screen is $\frac{\lambda}{3}$.

Optical path difference between two beams meeting on the screen

$$= \left\{\left(\text{S}_2\text{P} - \text{t} + \frac{4}{3}\text{t}\right) - \left(\text{S}_1\text{P} - \text{t} + \frac{3}{2}\text{t}\right)\right\}$$

$$= (\text{S}_2\text{P} - \text{S}_1\text{P}) + t\left(\frac{4}{3} - \frac{3}{2}\right) \quad = d\sin\theta - \frac{\text{t}}{6}.$$

$$\therefore \quad \frac{\text{dY}}{\text{D}} - \frac{\text{t}}{6} = \frac{\lambda}{3}$$

$$\Rightarrow \quad \frac{\text{dY}}{\text{D}} = \frac{\lambda}{3} + \frac{\text{t}}{6}$$

$$\Rightarrow \quad \text{Y} = \frac{\text{D}}{\text{d}}\left[\frac{\lambda}{3} + \frac{\text{t}}{6}\right]$$

$$= \frac{1}{10^{-4}}\left(\frac{6000\times10^{-10}}{3} + \frac{.6\times10^{-6}}{6}\right)$$

$$= \frac{1}{10^{-4}} \times 3\times10^{-7} = 3\times10^{-3}\ \text{m}$$

$$\therefore \quad \text{Y} = 3\ \text{mm}$$

CHEMISTRY PAPER – I (SOLUTION)

21. **(C)**
In (B) Nitrogen can undergo resonance in the ring.
In (A) Nitrogen lone pairs is some what delocalized towards the adjacent >C = O and (C) & (D) have electron withdrawing groups attached.

22. **(B)**
$H_2O(l) \longleftrightarrow H_2O(g)$
On adding inert at constant P, V increases, so equilibrium shifts in the direction where no. of gases moles are more

23. **(A)**
Background count from dead CO_2 = $\frac{9000}{900} = 10 \text{ count / min}$.
Count from contemporary wood $\frac{22000}{200} = 110 \text{ counts / min}$.
$\therefore$ Actual count = (110 –10) = 100
Count from test sample 24000 ÷ 400 = 60 count per min.
$\therefore$ Actual counting rate = (60 – 10) = 50 count/min.

$$t = \frac{2.303}{\lambda} \log \frac{\text{activity of contemporary wood}}{\text{activity of test sample}}$$

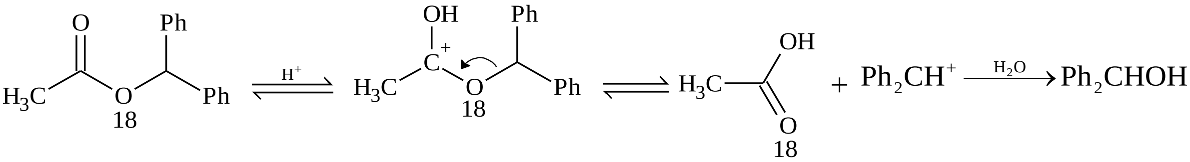
$$t = \frac{2.303}{.693} \times 5570 \log \frac{100}{50} = \frac{2.303}{.693} \times 5570 \times .3010$$

t = 5570 years

24. **(C)**
The order of ligand strength in the spectrochemical series $F^- < H_2O < NH_3 < NO_2^-$. A strong ligand causes a larger degree of splitting resulting in high value of E (energy). Therefore corresponding low value of λ $\left[E = \frac{hc}{\lambda}\right]$

25. **(D)**
Protonation occurs on the OH which can produce more stable carbocation and while rearrangement phenyl has higher migratory aptitude over o-substituted phenyl.

26. **(A)**
Esters $R - \overset{\overset{\displaystyle O}{\|}}{C} - O - R'$ where R′ can form a stable carbocation undergoes alkyl-oxygen cleavage.



27. **(ABCD)**

28. **(CD)**

29. **(AC)**

$\underset{\text{HO}}{R-\underset{|}{CH}-CH_3}$, $R-\underset{O}{\underset{||}{C}}-CH_3$

30. **(AD)**

31. **(AD)**

$\underset{sp^3}{S_2O_8^{2-}}$, $\underset{sp^3}{SO_4^{2-}}$ $\underset{sp^3}{S_2O_3^{2-}}$, $\underset{sp^2}{NO_3^-}$

$\underset{sp^3}{I_3^+}$, $\underset{sp^3d^2}{BrF_5}$ $\underset{sp^3d^2}{XeF_4}$, $\underset{sp^3d^2}{SF_6}$

32. **(AD)**

Rate of chemisorption increases with increases in temperature and heat of physisorption is less than heat of chemisorption

33. **(CD)**

$$Mg_3N_2 + H_2O \longrightarrow Mg(OH)_2 + \underset{(A)}{NH_3}$$

$$NH_3 + CuO \longrightarrow Cu + \underset{(C)}{N_2} + H_2O$$

Ammonium salts containing anions which are oxidizing in nature then on heating ammonium salts $N_{2(g)}$ is liberated instead of NH_3 ∴ (b)

34. **(BC)**

35. **(4)**

$2H_2$ + $O_2 \longrightarrow 2H_2O_{(l)}$
12 mL 6 mL
$2CO$ + $O_2 \longrightarrow 2CO_{2(g)}$
12 mL 6 mL

Total oxygen available = $80 \times \frac{20}{100} = 16$ mL

O_2 used in above reactions = 6 + 6 = 12 mL

∴ Unused oxygen = 16 – 12 = 4 mL.

36. **(8)**

$\frac{E_{500}}{R \times 500} = \frac{E_{400}}{R \times 400}$ from corresponding Arrhenius equations.

∴ $E_{500} = E_{400} \times \frac{5}{4}$

Given $E_{500} = E_{400} + 2$

∴ $E_{400} + 2 = E_{400} \times 1.25$

∴ $E_{400} = 8$ KJ mol^{-1}.

37. **(4)**

$V = (5 \times 10^{-8})^3 = 1.25 \times 10^{-23}$ ce

$m = dV = 4 \times 1.25 \times 10^{-22} = 5 \times 10^{-22}$ g

Mass of one molecule of FeO = $\frac{72 \text{ g} - mol^{-1}}{6.022 \times 10^{23} \text{ mol}^{-1}} = 1.195 \times 10^{-22}$ g

$\therefore$ Number of FeO per unit cell = $\frac{5\times10^{-22}}{1.195\times10^{-22}} \approx 4.$

38. (5)

$N_2O_4 \rightleftharpoons 2NO_2$

1 0

$1-\alpha$ 2α

$\therefore$ Total moles at equilibrium = $1 + \alpha$

Now $\frac{1+\alpha}{1} = \frac{M_{N_2O_4}}{M_{mix}}$

where $M_{mix} = \frac{\rho RT}{P} = \frac{1.84\times0.082\times348}{1} = 52.50$

$\therefore$ $1+\alpha = \frac{92}{52.50} = 0.75$

$\therefore$ $K_P = \frac{4\alpha^2}{1-\alpha^2}\times P = \frac{4\times(0.75)^2}{1-(0.75)^2} \approx 5.$

39. (3)

$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2.$

Chromium changes from +3 to +6 oxidation state. So change in oxidation state is of 3.

40. (4)

$P_A = 2\rho_B$ $2m_A = m_B$ $\therefore \frac{P_A}{P_B} = ?$

$P_A = \frac{\rho_A RT}{M_A}$

$P_B = \frac{\rho_B RT}{m_B}$

$\therefore$ $\frac{p_A}{p_B} = \frac{\rho_A m_B}{\rho_B m_A} = \frac{2\rho_B\times2m_A}{\rho_B m_A} = 4.$

MATHS PAPER – I (SOLUTION)

41. **(C)**

$|z|^2 = 4 \Rightarrow z.\bar{z} = 4 \Rightarrow \frac{\bar{z}}{4} = \frac{1}{z}$, let complex number $\omega = z + \frac{1}{z} \Rightarrow \omega = z + \frac{\bar{z}}{4}$

$4\omega = 4z + \bar{z} \Rightarrow 4(u + iv) = 4(x + iy) + (x - iy)$

$\Rightarrow \quad 4u + 4v\,i = 5x + 3iy \Rightarrow \frac{u^2}{25} + \frac{v^2}{9} = 1$

42. **(A)**

Positive difference of any two of them is at least 3

$\Rightarrow$ there will be at least 2 numbers between any two of them

Let C_1, C_2, C_3, C_4, C_5 be the chosen numbers.

Put two zeroes in between each pair as shown

$\uparrow C_1 00 \; \uparrow C_2 00 \; \uparrow C_3 00 \; \uparrow C_4 00 \; \uparrow C_5 \; \uparrow$

$x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5 \quad x_6$

Let there be $x_1, x_2, x_3, x_4, x_5, x_6$ numbers in the vacant spaces as shown.

Then, $x_1 + x_2 + x_3 + x_4 + x_5 + x_6 = 7$ with $x_i \geq 0$

No. of ways = ${}^{7+6-1}C_{6-1} = {}^{12}C_5$

43. **(C)**

$f(1) = 1$, $f(2) = \left(1 + \frac{1}{2}\right)$, $f(3) = \left(1 + \frac{1}{2} + \frac{1}{3}\right), ..., f(n) = 1 + \frac{1}{2} + \frac{1}{3} + ... + \frac{1}{n}$

$$\sum_{i=1}^{n} f(i) = \left\{n + \frac{n-1}{2} + \frac{n-2}{3} + ... + \frac{1}{n}\right\}$$

$$\Rightarrow \quad \sum_{i=1}^{n} f(i) = \left\{n\left(1 + \frac{1}{2} + \frac{1}{3} + ... + \frac{1}{n}\right) - \left(\frac{1}{2} + \frac{2}{3} + \frac{3}{4} ... \frac{n-1}{n}\right)\right\}$$

$$\sum_{i=1}^{n} f(i) = \left\{nf(n) - \left(1 - \frac{1}{2} + 1 - \frac{1}{3} ...... + 1 - \frac{1}{n}\right)\right\}$$

$$\Rightarrow \quad \sum_{i=1}^{n} f(i) = n\left(f(n) - 1\right) + f(n)$$

44. **(B)**

$$\lim_{n\to\infty} \sum_{k=0}^{n} \frac{{}^nC_k}{n^k} . \int_0^1 x^{n+2} dx = \lim_{n\to\infty} \int_0^1 \frac{{}^nC_k}{n^k} x^n . x^2 dx$$

$$= \lim_{n\to\infty} \int_0^1 x^2 \left\{\sum_{k=0}^{n} {}^nC_k \left(\frac{x}{n}\right)^k\right\} dx$$

$$\Rightarrow \quad \lim_{n\to\infty} \int_0^1 x^2 . e^x dx$$

$\Rightarrow$ apply by part $\Rightarrow$ $e - 2$

45. **(C)**

$$\int \frac{2\sqrt{1+\frac{1}{4}\left(\sqrt{\frac{1}{x}}-\sqrt{x}\right)^2}}{\sqrt{1+\frac{1}{4}\left(\sqrt{\frac{1}{x}}-\sqrt{x}\right)^2}-\frac{1}{2}\left(\sqrt{\frac{1}{x}}-\sqrt{x}\right)}dx = \int \frac{2\frac{\sqrt{(1+x)^2}}{2\sqrt{x}}}{\frac{\sqrt{(1+x)^2}}{2\sqrt{x}}-\frac{1}{2}\left(\frac{1-x}{\sqrt{x}}\right)}dx = \int \frac{2(1+x)}{1+x-1+x}dx$$

$$\int dx + \int \frac{dx}{x}$$

$\Rightarrow$ $x + \log x$

46. **(C)**

If $x \in I$ then [x] = x and {x + r} = 0 for any $r \in I$. Thus f (x) = x. If $x \in R \sim I$ then [x] = integral part of x and {x + r} = {x} for any r = 1, 2,…. 1000. Thus f(x) = [x] + {x} = x

47. **(CD)**

$$x^2\left(\int_0^{\pi/2}(2\sin t + 3\cos t)dt\right) = 2$$

$\Rightarrow$ $5x^2 = 2 \Rightarrow x = \pm\sqrt{\frac{2}{5}}$

48. **(ABCD)**

$P(A \cap B) = P(A)P(B)$

$\Rightarrow$ $\frac{1}{2}.\frac{1}{5} = \frac{1}{10}$

and P(A/B) = P(A) = $\frac{1}{2}$

Now $P(A \cup B) = P(A) + P(B) - P(A \cup B)$

$P(A \cup B) = \frac{1}{2}+\frac{1}{5}-\frac{1}{10} = \frac{3}{5}$ and $P(A/A\cup B) = \frac{P(A\cap(A\cup B))}{P(A\cup B)} = \frac{P(A)}{P(A\cup B)}$

$\frac{1/2}{3/5} = \frac{5}{6}$ and $P(A\cap B/\bar{A}\cup\bar{B}) = 0$

49. **(ABCD)**

$$I = \int_{-\alpha}^{a} e^x dx + \int_{-\alpha}^{\alpha} \cos x \ln\left(x+\sqrt{1+x^2}\right)dx$$

$$= e^{\alpha} - e^{-\alpha} > \frac{3}{2}$$

50. **(BC)**

51. **(AD)**

52. **(AC)**

53. **(ABD)**

54. **(BD)**

$f(t) = t^3 - t^2 + t + 1$

$f'(t) > 0$

$\therefore \max.\{f(t) : 0 \le t \le x\} = f(x)$

55. **(4)**

56. **(5)**

57. **(2)**

58. **(9)**

Let n be a non-negative integer such that

$\left[\frac{x}{44}\right] = \left[\frac{x}{45}\right] = n$

Then $\left[\frac{x}{44}\right] = n \Leftrightarrow 44n \le x < 44(n+1)$ *and*

$\left[\frac{x}{45}\right] = n \Leftrightarrow 45n \le x < 45(n+1)$

So, $\left[\frac{x}{44}\right] = \left[\frac{x}{45}\right] = n$

$\Leftrightarrow 45n \le x < 44(n+1)$

$\Leftrightarrow 44n + n \le x < 44n + 44$

This the case if and only if $n < 44$ and then x can assume exactly $44 - n$ different values.

Therefore the number of non-negative integer values of x is

$(44-0) + (44-1) + ... + (44-43)$

$= 44 + 43 + ... + 1 = \frac{1}{2}(44 \times 45) = 990$

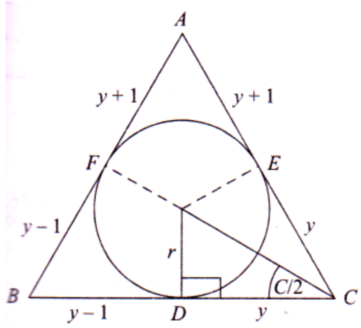
59. **(9)**

60. **(7)**

Let BD, CE and AF be of lengths y – 1, y and y + 1 respectively. Since the lengths of the tangent, from an external point to the circle are equal we get BF = BD = y – 1, CD = CE = y and AE = AF = y + 1

$\Rightarrow$ BC = 2y – 1, CA = 2y + 1 and AB = 2y,

$\Rightarrow$ s = 3y



Now $\tan\frac{C}{2} = \frac{r}{y}$ and $\tan\frac{B}{2} = \frac{r}{y-1}$

So that $\tan\left(\frac{B}{2} + \frac{C}{2}\right) = \frac{\frac{r}{y-1} + \frac{r}{y}}{1 - \frac{r^2}{y(y-1)}}$

$\Rightarrow \quad \cot\frac{A}{2} = \frac{2xy - r}{y^2 - y - r^2} \quad \Rightarrow \quad \frac{y+1}{r} = \frac{2ry - r}{y^2 - y - r^2}$

$\Rightarrow \quad y^3 - 3r^2 y - y = 0$

$\Rightarrow \quad y^3 - 48y - y = 0$ [as r = 4 (given)]

$\Rightarrow \quad y = 0$ or $y^2 = 49 \quad \Rightarrow \quad y = 7$

PHYSICS PAPER – II (SOLUTION)

1. **(AC)**

The equation of standing wave given as,

$y = 2A\sin kx\cos\omega t$

$$dK = \frac{1}{2}dm\left(\frac{dy}{dt}\right)^2$$

$$= \frac{1}{2}\mu\, dx\ (4A^2\omega^2\sin^2 kx\sin^2\omega t)$$

Integrate it from $x = 0$ to $x = \frac{\lambda}{2}$

$K = \pi kA^2T\sin^2\omega t$

$K_{\max}$ at $\sin^2\omega t = 1$, $K_{max} = \pi kA^2T$

Similarly Average value of kinetic energy ($K_{average}$) = $\frac{\int_0^T K\,dt}{\int_0^T dt} = \frac{\pi kA^2T}{2}$

2. **(AD)**

Angular frequency $\omega = \frac{1}{\sqrt{LC}}$

Since product of L and C is same for all the three circuits. Therefore ω is same for all the three circuits.

Hence, choice (A) is correct.

From conservation of mechanical energy

$\frac{1}{2}Li_0^2 = \frac{1}{2}CV^2$ or $i_0^2 = \frac{C}{L}V^2$

or $i_0 = \sqrt{\frac{C}{L}}.V$ or $i_0 \propto \sqrt{\frac{C}{L}}$

$\frac{C}{L}$ is maximum for the third circuit.

Hence, maximum current is greatest for third circuit. So, choice (D) is correct.

3. **(ABC)**

δ will be maximum when $i_1 = 90°$

$\delta = i_1 + i_2 - A$

$\Rightarrow \delta = 90^o + i_2 - A$

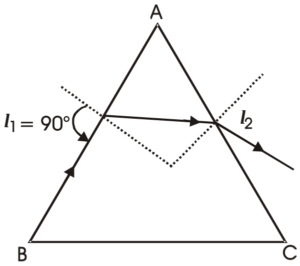
$\Rightarrow \frac{\sin i_2}{\sin r_2} = \mu$

$$\boxed{\Rightarrow \sin i_2 = \mu\sin(A - r_1)}$$

if $i_1 = 90^o$, then $r_1 = \theta_C$

$\Rightarrow i_2 = \sin^{-1}\left[\mu\sin(A - \theta_c)\right]$

and $i_1 \neq i_2$



$i_2 = \mu[\sin A \cos r_1 - \cos A \sin r_1]$

Since $\frac{\sin 90^o}{\sin r_1} = \mu$

$\Rightarrow \sin r_1 = \frac{1}{\mu} \Rightarrow \cos r_1 = \frac{\sqrt{\mu^2 - 1}}{\mu}$

$\therefore \sin i_2 = \mu\left[\frac{\sqrt{u^2-1}}{\mu}\sin A - \cos A \frac{1}{\mu}\right]$

$\therefore \sin i_2 = \left[\sqrt{\mu^2 - 1}\sin A - \cos A\right]$

$\therefore i_2 = \sin^{-1}\left[\sin A\sqrt{\mu^2-1} - \cos A\right]$ which is also the angle of emergence

$\therefore$ a, b and c are correct

4. **(AB)**

$U = -\frac{Ke^2}{3r^3}, F = \frac{-du}{dr} = \frac{3ke^2}{r^4}$

and $\frac{mv^2}{r} = \frac{3ke^2}{r^4}$, $mvr = \frac{nh}{2\pi}$

5. **(ABC)**

The change in magnetic flux is zero, hence the current in the ring will be zero.

6. **(AD)**

When capacitance is removed then circuit becomes L–R circuit with

$\tan\phi = \frac{\omega L}{R}$ …(i)

When inductance is removed, the circuit becomes C–R circuit with

$\tan\phi = \frac{1}{\omega CR}$ …(ii)

from (i) and (ii) we get,

$\omega L = \frac{1}{\omega C}$ or $X_L = X_C$

So, in LCR circuit Z = R

and circuit is in resonance.

Hence $i = \frac{V}{Z} = \frac{V}{R} = \frac{200}{100} = 2A$

i = 2A

$P_{av} = V_{rms} i_{rms} \cos\phi = 200 \times 2 \times 1$

= 400 W.

7. **(ABC)**

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

$$a_1 = \frac{2}{3}\sqrt{1} = \frac{2}{3}a_0$$

$$a_2 = \sqrt{I} = a_0$$

$$\therefore \quad \frac{I_{max}}{I_{min}} = 25$$

If an identical paper is pasted across second slit shifted C.B.F. will back in central point.

$$\text{shift} = (\mu - 1)\frac{tD}{d}$$

$$\text{fringe width } = \frac{n\lambda D}{d}$$

$$\therefore \quad n = \frac{\text{shift}}{\text{fringe width}} = \frac{(\mu - 1)t}{\lambda} = 15 .$$

8. **(ACD)**

PV = nRT

$$= \frac{n}{V}RT$$

$$\frac{1}{\rho} = \frac{R}{P}T$$

9. **(D)**

Anywhere on screen because there is no relation between θ, μ

10. **(A)**

Total path difference

$\Delta x = (\mu - 1)t - d\sin\theta$

11. **(C)**

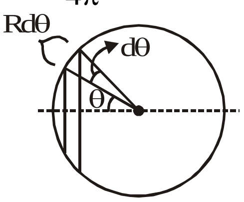
12. **(D)**

13. **(8)**

$$dq = \frac{q}{2\pi R}.Rd\theta = \frac{q}{2\pi}.d\theta$$

$$di = \frac{dq}{T} = \frac{qd\theta\omega}{2\pi 2\pi}$$

$$di = \frac{q\omega}{4\pi^2}.d\theta$$



$$dB = \frac{\mu_0 di(R\sin\theta)^2}{2R^3}$$

$$\int dB = \int_0^{\pi} \frac{\mu_0 \sin^2\theta}{2R}\left(\frac{q\omega}{4\pi^2}\right)d\theta$$

$$B = \frac{\mu_0 q\omega}{16\pi R}$$

$\phi = B\pi a^2$

$$\phi = \pi a^2 . \frac{\mu_0 q\omega}{16\pi R}$$

$$\phi = \frac{\mu_0 q\omega a^2}{16R}$$

$$|\varepsilon| = \left|\frac{d\phi}{dt}\right|$$

$$|\varepsilon| = \frac{\mu_0 q a^2}{16R}\alpha .$$

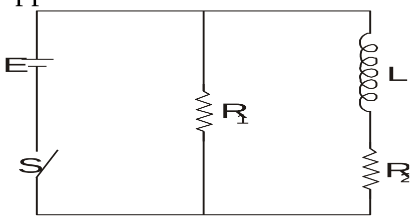
= 8 volt

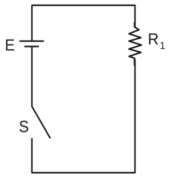
$$i = \frac{8}{1} = 8\text{ A.}$$

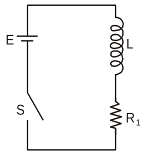
14. (6)

Given $R_1 = R_2 = 2\Omega$, $E = 12\ V$

and L = 400 mH = 0.4 H. Two parts of the circuit are in parallel with the applied battery. So, the upper circuit can be broken as :



(A) 

+ (B) 

Now refer figure (B) :

This is a simple $L - R$ circuit, whose time constant

$\tau_L = L/R_2 = \frac{0.4}{2} = 0.2$ s

and steady state current $I = E_1/R_2 = 12/2 = 6$A

Therefore, if switch S is closed at time $t = 0$, then current in the circuit at any time t will be given by

$i(t) = i_0\,(1 - e^{-t/\tau_L})$

$i(t) = 6(1 - e^{-t/02})$

$= 6(1 - e^{-5t}) = i$(say)

Therefore, potential drop across L at any time t is :

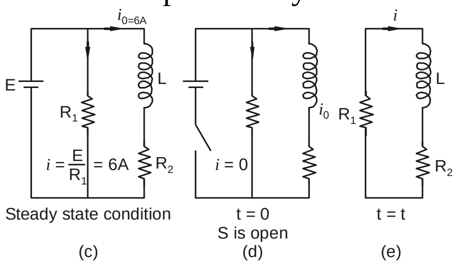
$$V = \left|L\frac{di}{dt}\right| = L(30e^{-5t})$$

$= (0.4)(30)e^{-5t}$ or $V = 12e^{-5t}$ volt

The steady state current in L or R_2 is

$i = 6$ A

Now, as soon as the switch is opened, current in R_1 is reduced to zero immediately. But in L and R_2 it decreases exponentially. The situation is as follows:



Refer figure (e) :

Time constant of this circuit would be

$$\tau_L = \frac{L}{R_1 + R_2} = \frac{0.4}{(2+2)} = 0.1 \text{ s}$$

$\therefore$ Current through R_1 at any time t is

$i = i_o \times e^{-t/\tau} L' = 6 \times e^{-10t}$.

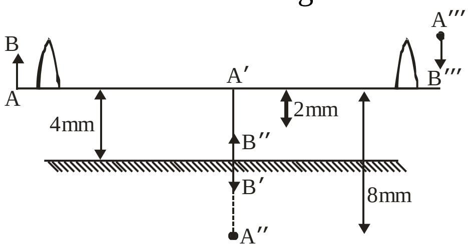
15. **(8)**

The first half–lens forms the image A′B′ (= 6 mm).

$$\therefore \quad \frac{1}{v} - \frac{1}{-20} = \frac{1}{15} \quad \Rightarrow \quad v = +60 \text{ cm.}$$

$\therefore \quad m_1 = -3.$

The plane mirror forms the image A″B″ with A″ located 8 mm below the principal axis. The second half lens forms the image A‴B‴. Now u = – 60 cm



$\Rightarrow \quad v = +20$ cm

$$\therefore \quad m_2 = -\frac{1}{3}$$

$\therefore$ A‴ is located at $\frac{8}{3}$ mm above the principal axis.

$\therefore \quad n = 8.$

16. **(9)**

According to the law of conservation of momentum in the case of γ-decay we have

$$Mv_2 = \frac{E}{c}.$$

Here $M = 226 \times 1.66 \times 10^{-27}$ kg

$= 3.75 \times 10^{-25}$ kg is the mass of a ^{226}Ra nucleus, E_α the γ-quantum energy practically coincident with the total energy E_2 released in the γ-decay, and c the velocity of light in vacuum. Whence for the kinetic energy T_2 of the recoil nucleus we have,

$$T_2 = \frac{E_2^2}{2MC^2} = 0.095 \text{ eV}.$$

In the case of α-decay the laws of conservation or energy and momentum yield

$$(M - M_\alpha)v_1 = M_\alpha v_\alpha$$

$$\frac{1}{2}(M - M_\alpha)v_1^2 + \frac{1}{2}M_\alpha v_\alpha^2 = E_1$$

where v_α and v_1 are the velocities of the α-particle and recoil nucleus, respectively, and M_α the α-particle mass. From where, by eliminating v_α, we obtain the following

$$T_1 = \frac{M\alpha}{M}E_1 = 87 \text{ keV}.$$

Finally, the ratio of the kinetic energies is

$$\frac{T1}{T2} = \frac{2M\alpha C^2 E_1}{E_2^2} = 9 \times 10^5.$$

17. (2)

The activity of radioactive sample of decay constant λ at time t is given by

$A = A_0 e^{-\lambda t}$ …….(1)

Where A_0 is initial activity

The charge on capacitor in series

RC-circuit after time t is

$Q = Q_0 e^{-\frac{t}{RC}}$ ….(2)

Where Q_0 is initial charge

Dividing (2) by (1) , we get

$$\frac{Q}{A} = \frac{Q_0}{A_0}\frac{e^{t/RC}}{e^{-\lambda t}}$$

$$\Rightarrow \quad \frac{Q}{A} = \frac{Q_0}{A_0}e^{\left(\lambda - \frac{1}{RC}\right)t}$$

Clearly this ratio will be independent of t if

$$\lambda - \frac{1}{RC} = 0 \Rightarrow \lambda = \frac{1}{RC} \Rightarrow R = \frac{1}{C\lambda}$$

or as $\lambda = \frac{1}{\tau}$

$$\Rightarrow R = \frac{\tau}{C} = \frac{20 \times 10^{-3}s}{100 \times 10^{-6}F} = 200\Omega$$

$\Rightarrow y = 2$

18. (4)

$$W_{net} = (2P_0v_0) - (P_0v_0) - \frac{\pi P_0 v_0}{4}$$

$$W_{net} = P_0v_0 - \frac{\pi P_0 v_0}{4} = (4 - \pi)\frac{P_0v_0}{4};$$

Put $\pi = 3.14$

$$W_{net} = \frac{0.86}{4}P_0v_0 = (0.22)(P_0v_0)$$

Now,

$$\left.\begin{aligned} T_1 &= \frac{P_0 v_0}{R} \\ T_2 &= \frac{4P_0 v_0}{R} \\ T_3 &= \frac{2P_0 v_0}{R} \end{aligned}\right\}$$

$$\Delta U_{1\to 2} = 1 \times \frac{3R}{2}\left[T_2 - T_1\right]$$

Thus, $\Delta U_{2\to 3} = 1 \times \frac{3R}{2}\left[T_3 - T_2\right]$

$$\Delta U_{3\to 1} = 1 \times \frac{3R}{2}\left[T_1 - T_3\right]$$

$\Delta Q_{1\to 2} = (4.5)(P_0 v_0) + (1.22)(P_0 v_0)$

$= (5.72)(P_0 v_0)$

$\Delta Q_{2\to 3} = -3P_0 v_0 + 0 = -3(P_0 v_0)$

$\Delta Q_{3\to 1} = -1.5\,(P_0 v_0) - (P_0 v_0) = -2.5(P_0 v_0)$

Thus efficiency $\eta = \frac{W_{net}}{+ve\,heat}$

$\eta = \frac{0.22(P_0 v_0)}{(5.72)\,(P_0 v_0)} = 0.04$

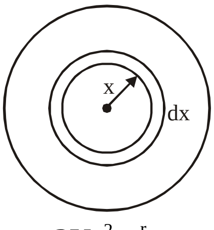
Thus efficiency is 4%

19. **(2)**

$E = \frac{x}{2}\frac{dB}{dt}$

$E = \frac{3Kxt^2}{2}$

$d\tau = \frac{3Kxt^2}{2} \times \frac{2\pi x dx}{\pi r^2} q.x$



$\tau = \frac{3Kt^2 q}{r^2}\int_0^r x^3 dx$

$\tau = \frac{3Kq.t^2}{4}.r^2 \quad \ldots(i)$

torque due to friction force

$d\tau = \mu dmgx$

$\tau = 2\mu g \frac{qm}{r^2}\int_0^r x^2 dx = \frac{2}{3}\mu mgr \ \ldots(ii)$

$\frac{3Kq.t^2r^2}{4} = \frac{2}{3}\mu mgr$

$t = \sqrt{\frac{8\mu mg}{9Kqr}}$ = 2 seconds.

20. **(5)**

For translational motion

$T + 100 - 80 = 8a_G$ (1)

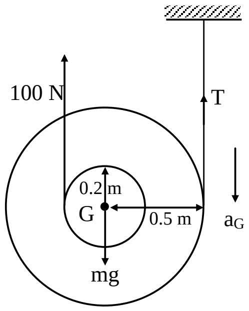
For rational motion about G

$(100N)(0.2m) - T(0.5m) = 8\left(\frac{1}{2\sqrt{2}}\right)^2 \frac{a_G}{0.5}$

$20 - 0.5\,T - 2a_G$ (2)

Solving equations (1) and (2)

$a_G = 5\ m/s^2$



CHEMISTRY PAPER – II (SOLUTION)

21. **(AB)**
A- Due to Lanthanide Contraction ionization energy increases in 5d Transition series element.
B- N has half filled orbital due to which IE is high .
C – Correct order of IE: P>S>Si
D- Correct order of IE : Fe>Mn>Cr

22. **(BC)**
A- PH is 6.98
B – $H_2PO^-{}_4 \rightarrow H^+ + HPO_4{}^{2-}$
C- Kw increases with temperature increase
D- Hydrolysis will take place at that point

23. **(AD or ABD)**
B- Van der Waals constants vary to some extent with temperature

24. **(BC)**

25. **(AD)**

D - Due to increase in concentration of OH^- , PH value increases .

26. **(CD)**

Al_2O_3 and SnO_2 are amphoteric oxides **.**

27. **(BCD)**

Me_2CCl_2 upon hydrolysis at undergoes hydrolysis and formed $Me_2C{=}O$ shows P-P overlapping **.**

28. **(ABC)**

$a \rightarrow b$ & $c \rightarrow d$ represent conversion from liquid to vapour and $b \rightarrow c$ represent vapor to liquid .

29. **(C)**

$$Pb(NO_3)_2 \xrightarrow{Conc.H_2SO_4/\Delta} \underset{Brown}{NO_2} \uparrow$$

$$Pb(NO_3)_2 \xrightarrow{H_2S/H^+} PbS$$

30. **(D)**

$$\underset{Black}{PbS\downarrow} \xrightarrow{H_2O_2} \underset{White}{PbSO_4\downarrow}$$

31. **(B)**

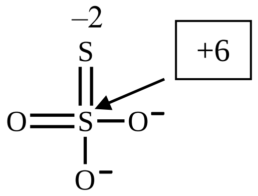
1(M) of 2-chloropentane = $\dfrac{106.5}{1000} = 0.1065 g/ml$

10 cm = 1 dm

$$\therefore\ [\alpha] = \frac{\theta}{\ell \times c} = \frac{3.64}{1 \times 0.1065} = 34.2°$$

32. **(B)**
100% pure (–) enantiomer specific relation = –50°
∴ where rotation is –35°C that indicates 70% of (–) enantiomer in excess
∴ total (–) enantiomer (70 + 15) = 85

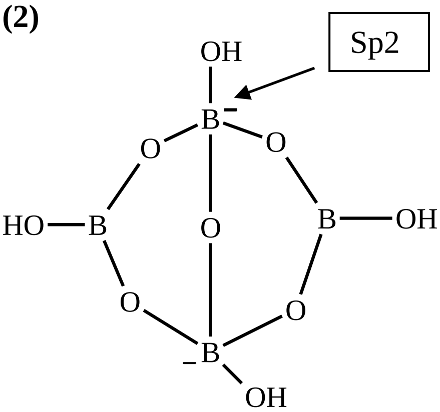
33. **(6)**



34. **(4)**

Ka = 10^{-4} , PH=PK_a + log[Salt]/[Acid]

35. **(2)**



36. **(2)**
Ag^+ and Pb^{2+}

37. **(3)**

PCl3F2 , XeF4 , BF3 have no dipole moment .

38. **(7)**

39. **(3)**

40. **(2)**

Ti = 2a/Rb
Tb = a/Rb

MATHS PAPER – II (SOLUTION)

41. **(ABCD)**

Since here Rolle's theorem is applicable to the function f in the interval $[-2, 2]$

$\Rightarrow$ $f(x)$ is continuous in $[-2, 2]$ and differentiable in $(-2, 2)$

Given $f(x)$ is even, so we find those a, b and λ, which make f to be continuous for $x \in [0, 2]$,

Now $f(x)=\begin{cases} ax^2+b, & 0\le x<1 \\ 1, & x=1 \\ \lambda/x, & 1<x\le 2 \end{cases}$.

Since $f(x)$ is continuous in $[0, 2]$

$\Rightarrow$ $f(x)$ is continuous at $x = 1$

$\Rightarrow a + b = 1 = \lambda$ (1)

Now $f'(x)=\begin{cases} 2ax, & 0<x<1 \\ -\lambda/x^2, & 1<x<2 \end{cases}$

Since $f(x)$ is differentiable in $(0, 2)$

$\Rightarrow$ $f(x)$ is differentiable at $x = 1$

$\Rightarrow 2a = -\lambda$ (2)

Solving (1) and (2), we get $a=-\frac{1}{2}, b=\frac{3}{2}, \lambda=1$.

Since f is even, so $f(-2) = f(2)$ is already true.

Thus Rolle's theorem is applicable to f, if $a=-\frac{1}{2},\ b=\frac{3}{2},\ \lambda=1$.

42. **(BCD)**

If a < b < c < 4, then a = 1, b = 2, c = 3, so A = 2. Hence (B) true. Further this is a known fact that A = H iff a = b = c. Hence (C) is true. Also if not all a, b, c are equal, then this is a known fact that A > G > H.

43. **(CD)**

44. **(ACD)**

We have $\frac{\log a}{\log(b+c)}+\frac{\log a}{\log(c-b)}=\frac{2\log a}{\log(c+b)}.\frac{\log a}{\log(c-b)}$

$\Rightarrow \log(c - b) + \log(c + b) = 2\log a$

$\Rightarrow \log(c^2 - b^2) = \log a^2$

$\therefore$ $c^2 - b^2 = a^2$

$\Rightarrow \Delta ABC$ is right angled triangle with $C = \frac{\pi}{2}$.

45. **(AC)**

46. **(AB)**

$\because$ z_1, z_2 be the roots of the equation $az^2 + bz + c = 0$ with $|z_1| = 1$

$\therefore$ $z_1 + z_2 = -\frac{b}{a}$ and $z_1 z_2 = \frac{c}{a}$

$\therefore$ $|z_1+z_2|=\left|-\frac{b}{a}\right|=1$ and $|z_1z_2|=\left|\frac{c}{a}\right|=1$

Now $|z_1 + z_2| = 1$

$\Rightarrow\ (z_1+z_2)(\bar{z}_1+\bar{z}_2)=1 \quad \Rightarrow\ 2+\bar{z}_1 z_2+z_1\bar{z}_2=1$

$\Rightarrow\quad 2+\dfrac{z_2}{z_1}+\dfrac{z_1}{z_2}=1 \quad \Rightarrow\ \dfrac{(z_1+z_2)^2}{z_1 z_2}=1 \quad \Rightarrow\ \dfrac{b^2}{a^2}=\dfrac{c}{a}$

$\Rightarrow\ b^2 = ac.$

Now $|z_1 + z_2| = 1$

$\Rightarrow\quad |z_1|\,|1+e^{i\theta}| = 1 \qquad (\because\ z_2 = z_1 e^{i\theta})$

$\Rightarrow\ 2\cos\dfrac{\theta}{2}\left|\cos\dfrac{\theta}{2}+i\sin\dfrac{\theta}{2}\right|=1$

$\Rightarrow\quad 2\cos\dfrac{\theta}{2}=1 \quad \Rightarrow\ \dfrac{\theta}{2}=\dfrac{\pi}{3} \quad \Rightarrow\ \theta=\dfrac{2\pi}{3}$

Now $PQ = |z_2 - z_1|$

$= |z_1|\,|e^{i\theta}-1|$

$= 1.|\cos\theta - 1 + i\sin\theta|$

$= \left|1-2\sin^2\dfrac{\theta}{2}-1+2i\sin\dfrac{\theta}{2}\cos\dfrac{\theta}{2}\right|$

$= \left|-2\sin\dfrac{\theta}{2}\right| . \left|\sin\dfrac{\theta}{2}-i\cos\dfrac{\theta}{2}\right|$

$= \left|2\sin\dfrac{\theta}{2}\right| = \sqrt{3} \qquad [\because\ \theta=\dfrac{2\pi}{3}]$

$\therefore\quad PQ = |z_2 - z_1| = \sqrt{3}$

47. **(ABC)**

$x_1 + x_2 + \ldots\ldots + x_{100} = \dfrac{100}{2}(x_1 + x_{100}) = -1$ (1)

$x_2 + x_4 + \ldots\ldots + x_{100} = \dfrac{50}{2}(x_1 + d + x_{100}) = 1$ (2)

solving (1) and (2) we get $d=\dfrac{3}{50}$

Now $x_1 + x_1 + 99d = -1$

$\Rightarrow\quad x_1 = -\dfrac{149}{50}$

$\Rightarrow\quad x_1^2 + x_2^2 + \ldots\ldots + x_{100}^2 = \dfrac{14999}{50}$

$t_{100} = x_1 + (100-1)d = \dfrac{-149}{50} + 99\times\dfrac{5}{50} = \dfrac{74}{25}$

48. **(AB)**

Focus of the parabola $y^2 = 2px$ is $\left(\dfrac{p}{2},\ 0\right)$

$\therefore$ Centre of circle is $\left(\dfrac{p}{2},\ 0\right)$

Radius of the circle = Distance between focus and directrix

= semi latusrectum

= p

$\therefore$ Equation of circle is $\left(x-\dfrac{p}{2}\right)^2 + (y-0)^2 = p^2$ (1)

Solving eq. (i) and $y^2 = 2px$, then

$$\left(x - \frac{p}{2}\right)^2 + 2px = p^2$$

$\Rightarrow \quad x^2 + px = \frac{3p^2}{4}$

$\Rightarrow \quad 4x^2 + 4px - 3p^2 = 0$

$\therefore \quad x = p/2$ and $x = -3p/2$

$\because \quad y^2 = 2px = 2p\left(\frac{p}{2}\right) = p^2$

$\Rightarrow \quad y = \pm p$

and $y^2 = 2p\left(-\frac{3p}{2}\right) = -3p^2$

$\Rightarrow$ y is imaginary (Impossible)

$\therefore$ Point of intersection are $\left(\frac{p}{2},\ p\right)$ and $\left(\frac{p}{2},\ -p\right)$

49. (D)

$f(x) = x^4 - 2x^2 + k = 0$ then $0 < \alpha < \beta < 1$

$\Rightarrow \quad f(\alpha) = f(\beta) = 0$

then for same $c \in (\alpha, \beta, f'(c) = 0$

$\Rightarrow \quad 4c^3 - 4c = 0 \Rightarrow c = 0$ or

but none of these value c lies in (α,β) so $m \in \phi$.

50. (C)

$h(x) = (f'(x) - f'(a))\,(g'(b) - g'(x))$

Apply Rolles Theorem

$\therefore$ their exist some $c \in (a, b)$ such that $h'(c) = 0$

$\Rightarrow \quad h'(x) = f''(x)(g'(b) - g'(x)) - g''(x)\,(f'(x) - f'(a))$

$\Rightarrow \quad h'(c) = f''(c)\,.\,(g'(b) - g'(c)) - g''9c)\,(f'(c) - f'(a) = 0$

$\Rightarrow \quad \frac{f'(c) - f'(a)}{g'(b) - g'(c)} = \frac{f''(c)}{g''(c)}.$

51. (D)

Let the line be $x = -1 + r\cos\theta$ and $y = 1 + r\sin\theta$

$\Rightarrow \quad y^2 = 4x$

$r^2\sin^2\theta - 2\,(2\cos\theta - \sin\theta)\,r + 5 = 0$

If r_1, r_2 are the roots them

$r_1 + r_2 = \frac{2(2\cos\theta - \sin\theta)}{\sin^2\theta}$ and $r_1 r_2 = \frac{5}{\sin^2\theta}$

$\Rightarrow \quad r = \frac{2r_1r_2}{(r_1 + r_2)} \Rightarrow 2r\cos\theta - r\sin\theta = 5$

Locus of P $2(x + 1) - (y - 1) = 5$

$\Rightarrow \quad 2x - y - 2 = 0$

52. (C)

$r = \frac{r_1 + r_2}{2} = \frac{2\cos\theta - \sin\theta}{\sin^2\theta} \Rightarrow (r\sin\theta)^2 = 2r\cos\theta - r\sin\theta$

$\Rightarrow \quad (y-1)^2 = 2(x+1) - (y-1) \Rightarrow y^2 - 2x - y - 2 = 0$

53. **(1)**

Imposing the conditions; $\frac{b}{2a} > 2$, $b^2 \geq 48a$ and f(2) i.e., $2a - b + 6 > 0$ there is only one solution for $(a, b) \equiv (1, 7)$

54. **(7)**

The sum of coefficients of terms not containing $y = 3^6$
The sum of coefficients of terms not containing both x & $y = 2^6$
So the required number $= 3^6 - 2^6 = 665$.

55. **(3)**

56. **(2)**

$a + b = 10c$ & $ab = -11d$, $c + d = 10a$ & $cd = -11b$.
$a + b + c + d = 10(c + a)$ & $abcd = 12\ 1bd \quad \Rightarrow \quad ac = 121$
We have $a^2 - 10ac - 11d = 0$
& $\quad c^2 - 10ac - 11b = 0$
$a^2 + c^2 - 20ac - 11(b + d) = 0$
$(a + c)^2 - 22 \times 121 - 11 \times 9(a + c) = 0$
$a + c = 121 - 22$
For $a + c = -22$ we get $a = c$ (Not possible)
$\therefore\ a + b + c + d = 10(a + c) = 1210 \Rightarrow 605\lambda = 1210 \Rightarrow \lambda = 2$

57. **(6)**

Since the product of the slopes of the four lines represented by the given equation is 1 and a pair of lines represent the bisectors of the angles between the other two, the product of the slopes of each pair is –1. So let the equation of one pair be $ax^2 + 2hxy - ay^2 = 0$.

The equation of its bisector is $\frac{x^2 - y^2}{2a} = \frac{xy}{h}$

By hypothesis

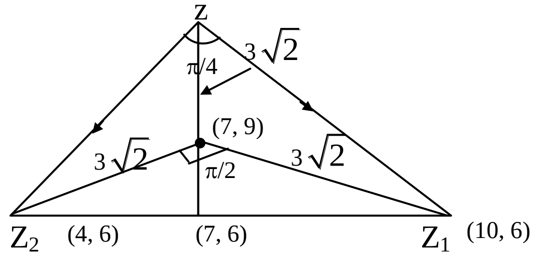
$$x^4 + x^3y + cx^2y^2 - xy^3 + y^4$$
$$= (ax^2 + 2hxy - ay^2)(hx^2 - 2axy - hy^2)$$
$$= ah(x^4 + y^4) + 2(h^2 - a^2)(x^3y - xy^3) - 6ahx^2y^2$$

Comparing the respective co–efficient we get

$ah = 1$ and $c = -6\ ah = -6$

58. **(4)**

$\Rightarrow |z - 7 - 9i| = 3\sqrt{2}$
$\Rightarrow [|z - 7 - 9i|] = \left[3\sqrt{2}\right] = 4$.



59. **(6)**

60. **(9)**

Put $x = t^6$

$$I = \int \frac{(t^6 + t^4 + t)6t^5}{t^6(1+t^2)} dt = 6\int \frac{t^5 + t^3 + 1}{1+t^2} dt$$

$$= 6\int t^3 dt + 6\int \frac{dt}{t^2+1} = \frac{3}{2}x^{2/3} + 6\tan^{-1} x^{1/6} + C$$

$\therefore$ 2A + B = 9.