26/04/2026

Code-A_Online

Medical | IIT-JEE | Foundations

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot No. 13, Sector-18, Udyog Vihar, Gurugram, Haryana - 122015, ***Ph.***+91-1244168300

MM : 180

AIATS For One Year JEE(Advanced)-2026 (XII Studying & XII Passed)_Test-6A_Paper-1_ONLINE

Time : 180 Min.

MATHEMATICS

Section-I

1. (D)

2. (C)

3. (A)

4. (D)

Section-II

5. (A,B)

6. (A,B,C)

7. (A,B)

Section-III

8. (11)

9. (51)

10. (9)

11. (30)

12. (87)

13. (32)

Section-IV

14. (B)

15. (A)

16. (B)

17. (C)

PHYSICS

Section-I

18. (C)

19. (B)

20. (B)

21. (B)

Section-II

22. (A,C)

23. (A,C)

24. (A,B,D)

Section-III

25. (10)

26. (14)

27. (2)

28. (1)

29. (7)

30. (8)

Section-IV

31. (C)

32. (C)

33. (C)

34. (C)

CHEMISTRY

Section-I

35. (A)

36. (C)

37. (C)

38. (C)

Section-II

39. (A,C,D)

40. (C,D)

41. (B,D)

Section-III

42. (6)

43. (4)

44. (8)

45. (6)

46. (4)

47. (20)

Section-IV

48. (B)

49. (C)

50. (A)

51. (C)

Hints and Solutions

MATHEMATICS

Section-I

(1) **Answer :** (D)

Hint:

Use roots of $x^2 - ax + a^2 = 0$ are $-aw$ and $-aw^2$, where w is a cubic roots of unity.

Solution:

$(m^2 + \sqrt{5}) = -5^{1/4}m$

Squaring both sides,

$m^4 + 2\sqrt{5}m^2 + 5 = \sqrt{5}m^2$

$\Rightarrow$ $m^4 + 5 = -\sqrt{5}m^2$ (Again squaring)

$\Rightarrow m^8 + 10m^4 + 25 = 5m^4$

$\Rightarrow m^8 + 5m^4 + 25 = 0$

$\Rightarrow m^8 = -25 - 5m^4$

Multiplying by m^4,

$m^{12} = -25m^4 - 5(-25 - 5m^4)$

$\Rightarrow m^{12} = 125 \Rightarrow (m^{12})^8 = (125)^8$

$\Rightarrow m^{96} = 5^{24}$

Similarly, $n^{96} = 5^{24}$

$\Rightarrow m^{96}(m^{12} - 1) + n^{96}(n^{12} - 1) = 5^{24}(124) \times 2$

(2) **Answer :** (C)

Hint:

$P(E') = 1 - P(E)$

Solution:

D : Joseph reaches late.

Q_1 : Joseph goes to office by walking.

Q_2 : Joseph takes cab to office.

E_1 : Joseph will be on time for atleast one out of 2 consecutive days.

$P(Q_1) = \frac{4}{5},\ P(Q_2) = \frac{1}{5}$

$P\left(\frac{D}{Q_1}\right) = \frac{1}{4},\ P\left(\frac{D}{Q_2}\right) = \frac{3}{4}$

$P(D) = P(Q_1 \cap D) + P(Q_2 \cap D)$

$= \frac{4}{5} \cdot \frac{1}{4} + \frac{1}{5} \cdot \frac{3}{4}$

$= \frac{7}{20}$

$P(E) = 1 - P(D \cap D)$

$= 1 - \left(\frac{7}{20}\right)\left(\frac{7}{20}\right)$

$= \frac{400-49}{400}$

$= \frac{351}{400}$

(3) **Answer :** (A)

Hint:

$AX = B$ has unique solution, if $|A| \neq 0$.

Solution:

$[5\sin\theta + 7] \geq 2$

$[\cos\theta + 5] \geq 4$

For unique solution,

$$\Delta = \begin{vmatrix} 5 & 4 & 1 \\ 0 & 10 & 6 \\ 0 & 0 & [5\sin\theta + 7] \end{vmatrix} \neq 0$$

$$\Delta = \begin{vmatrix} 5 & 4 & 1 \\ 0 & 10 & 6 \\ 0 & 0 & \geq 2 \end{vmatrix} \neq 0 \text{ for every } \theta$$

(4) **Answer :** (D)
Hint:
Use $\lim\limits_{x\to a} f(x)^{g(x)} = e^{\lim\limits_{x\to a} g(x)(f(x)-1)}$
Solution:
$e^{\lim\limits_{x\to 0^+}\left(\frac{\tan(\tan\alpha x^2)\,+\,\cos x + x^2 - 1}{x^2}\right)2} = e^3$

$\Rightarrow\ e^{\lim\limits_{x\to 0^+}\left(\frac{\tan(\tan\alpha x^2)}{\tan\alpha x^2}\cdot\frac{\alpha x^2}{x^2} + \frac{x^2}{x^2} - \frac{(1-\cos x)}{x^2}\right)2} = e^3$

$\Rightarrow\ e^{2\left(\alpha + 1 - \lim\limits_{x\to 0^+}\left(\frac{1-\cos x}{x^2}\right)\right)} = e^3$

$\Rightarrow\ e^{2\left(\alpha+1-\frac{1}{2}\right)} = e^3$

$\Rightarrow\ e^{2\left(\alpha+\frac{1}{2}\right)} = e^3$

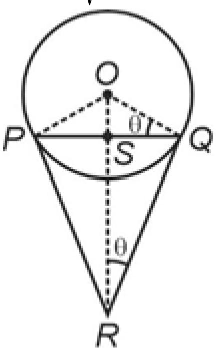
$\Rightarrow\ \alpha = \frac{3}{2} - \frac{1}{2}$

$\Rightarrow \alpha = 1$

Section-II

(5) **Answer :** (A,B)
Hint:
$OP = OQ = 7$
Solution:
Now, $OP = OQ = 7$

$OS = \sqrt{(2-0)^2 + (3-0)^2} = \sqrt{13}$



Let $\angle OQS = \theta$, then $\angle SRQ = \theta$
∴ From ΔOSQ,

$\cos(90-\theta) = \frac{OS}{OQ} = \frac{\sqrt{13}}{7}$

$\Rightarrow\ \sin\theta = \frac{\sqrt{13}}{7}$

$\Rightarrow\ \cot\theta = \frac{6}{\sqrt{13}}$

Area of quadrilateral $OPRQ$ = $2\times\frac{1}{2}\times OQ\times QR$

In ΔOQR, $\cot\theta = \frac{QR}{OQ} = \frac{QR}{7}$

Area of quadrilateral $OPRQ$ = $7 \times 7\cot\theta = 49\cot\theta$

$= (49)\cdot\frac{6}{\sqrt{13}}$

$= \frac{294}{\sqrt{13}}$

∴ $m + n = 307$ (Prime)
∴ Number of divisors of $m + n = 2$

(6) **Answer :** (A,B,C)
Hint:
Use $\int\limits_a^b f(x)\,dx = \int\limits_a^b f(a+b-x)\,dx$
Solution:
Let $I = \int\limits_{\sin^2 t}^{\cos^2 t} \frac{x^\alpha}{x^\alpha + (1-x)^\alpha}\,dx$ …(i)

$$I=\int_{\sin^2 t}^{\cos^2 t}\frac{(1-x)^{\alpha}}{(1-x)^{\alpha}+x^{\alpha}}\,dx \ \ldots\text{(ii)}$$

Adding (i) and (ii),

$$2I=\int_{\sin^2 t}^{\cos^2 t}1\cdot dx=\cos 2t$$ (Independent on α)

Similarly, for option (B),

$$I=\int_{\sin^2\alpha}^{\cos^2\alpha}\frac{(1-x)^{2025}}{x^{2025}+(1-x)^{2025}}dx$$

$2I = \cos^2\alpha - \sin^2\alpha$

$I=\frac{\cos 2\alpha}{2}$

(7) **Answer :** (A,B)

Hint:

Integrating factor of $\frac{dy}{dx}+Py=Q$ is $e^{\int Pdx}$.

Solution:

$$\text{IF}=e^{\int\frac{-5x^9\tan^{-1}\left(x^5\right)}{\left(1+x^{10}\right)^{3/2}}dx}$$

Put $\tan^{-1}(x^5) = t$

⇒ $\frac{1.5x^4}{1+x^{10}}dx=dt$

⇒ $e^{\int-\frac{\tan t\cdot t}{\sec t}dt}$

⇒ $e^{-\int\sin t\,dt}=e^{t\cos t-\sin t}$

Integrating factor = $e^{\frac{\tan^{-1}(x^5)}{\sqrt{1+x^{10}}}-\frac{x^5}{\sqrt{1+x^{10}}}}$

Solution is

$$y\cdot e^{\frac{\tan^{-1}x^5}{\sqrt{1+x^{10}}}-\frac{x^5}{\sqrt{1+x^{10}}}}=\int 4x\,dx+c$$

$$y\cdot e^{\frac{\tan^{-1}x^5-x^5}{\sqrt{1+x^{10}}}}=2x^2+c\ \ldots\text{(i)}$$

⇒ $y(0) = 0$ ⇒ $c = 0$

$$y=\frac{(2x^2)}{e^{\frac{\tan^{-1}(x^5)-x^5}{\sqrt{1+x^{10}}}}}$$

Here, $h(x)=e^{\frac{\tan^{-1}(x^5)-x^5}{\sqrt{1+x^{10}}}}$

$\lim\limits_{x\to\infty}h(x)=e^{0-1}=\frac{1}{e}$

∴ If $y(0) = 0$

⇒ From (i), $0\cdot1 = 0 + c$

⇒ $c = 0$

Put $x = 1$

$$y\cdot e^{\frac{\frac{\pi}{x}-1}{\sqrt{2}}}=2$$

$$y(1)=2\cdot e^{\frac{4-\pi}{4\sqrt{2}}}$$

Section-III

(8) **Answer :** 11

Hint:

$T_n = a + (n-1)d$

Solution:

Series S with common terms are 31, 51, …

$T_9 = 31 + (9-1)20$

= 31 + 160
= 191
∴ Sum of digits = 11

(9) **Answer :** 51
Hint:
$A(\text{adj}A) = |A|I$
Solution:
$Q\text{adj}Q = |Q|I$
$[Q(\text{adj}Q)] = |Q|I$

$$\Rightarrow \left|Q\right| = \begin{vmatrix} 1 & -2 & -1 \\ 3 & 5 & 2 \\ 0 & 1 & 2 \end{vmatrix}$$

$|Q| = 1(10 - 2) + 2(6) - 1(3)$
$|Q| = 8 + 12 - 3$
$|Q| = 17$

$$\therefore\ [Q(adjQ)Q^{-1}]Q = \begin{bmatrix} 17 & 0 & 0 \\ 0 & 17 & 0 \\ 0 & 0 & 17 \end{bmatrix}$$

∴ Sum of elements = 3(17) = 51

(10) **Answer :** 9
Hint:
Use $\tan x(1 + \sec 2x) = \tan 2x$
Solution:

$$g(x) = \tan\left(\frac{x}{2}\right)(1+\sec x)(1+\sec 2x)$$
$$(1+\sec 2^2 x)...(1+\sec 2^7 x)$$

$$g(x) = \frac{\sin\frac{x}{2}}{\cos\frac{x}{2}}\left(\frac{2\cos^2\frac{x}{2}}{\cos x}\right)\left(\frac{1+\cos 2x}{\cos 2x}\right)...\left(\frac{\cos 2^7 x+1}{\cos 2^7 x}\right)$$

$$g(x) = \tan x\left(\frac{2\cos^2 x}{\cos 2x}\right)\left(\frac{2\cos^2 2x}{\cos 4x}\right)...\left(\frac{1+\cos 2^7 x}{\cos 2^7 x}\right)$$

$g(x) = \tan 2^7 x$

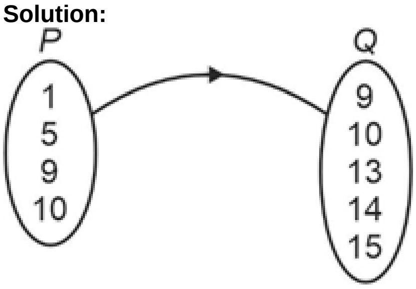
Now, $g\left(\frac{\pi}{384}\right) = \tan\left(2^7\cdot\frac{\pi}{384}\right)$

$$= \tan\left(2^7\cdot\frac{\pi}{2^7\cdot 3}\right)$$

$$= \tan\left(\frac{\pi}{3}\right) = \sqrt{3}$$

$\Rightarrow 3\alpha^2 \Rightarrow 9$

(11) **Answer :** 30
Hint:
Number of one-one functions from A having n elements to set B having m elements is ^mP_n .
Solution:



$\alpha = {^5C_4}\times 4! = 5!$ = Total number of ways
Finding number of ways when $f(k) = k$
Case 1 : When exactly 2 elements of P maps to itself, *i.e.*, $f(9) = 9$, $f(10) = 10$
∴ Remaining number of ways = $^3C_2\times 2! = 6$
Case 2 : When exactly one element of P maps to itself, *i.e.*, $f(9) = 9$
Now, 10 can be map in 3 ways and remaining in 3 × 2 = 6
∴ $^2C_1 \times 3 \times 2 = 36$
Total number of ways = 36 + 6 = 42
$\Rightarrow \alpha = 5! - 42 = 78 \Rightarrow \alpha = 78$
$\beta = (2)(4)(3)(2)(0) = 48$
$\therefore \alpha - \beta = 30$

(12) Answer : 87

Hint:

Use differentiation

Solution:

$g(x) = 2x^3 - x^2 g'(2) + 5xg''(3) + 2g'''(1)$

$g'(x) = 6x^2 - 2xg'(2) + 5g''(3)$ …(i)

$g''(x) = 12x - 2g'(2)$ …(ii)

$g'''(x) = 12$

From (i), put $x = 2$, we get

$5g'(2) - 5g''(3) = 24$ …(iii)

From (ii), put $x = 3$, we get

$2g'(2) + g''(3) = 36$ …(iv)

From (iii) and (iv), we get

$g'(2) = \frac{68}{5},\ g'(3) = \frac{44}{5}$

$\therefore g(x) = 2x^3 - 13.6x^2 + 44x + 24$

$[|g(x)|] = 87$

(13) Answer : 32

Hint:

$e = \sqrt{1 + \frac{b^2}{a^2}}$

Solution:

$e = \sqrt{1 + \frac{9+k}{2+k}}$

$e = \sqrt{\frac{2k+11}{2+k}}$

Put $k = 7$

$e = \sqrt{\frac{25}{9}}$

$e = \frac{5}{3}$

$\therefore\ \frac{x^2}{9} - \frac{y^2}{16} = 1$

$l = \frac{2(16)}{3}$

$l = \frac{32}{3}$

Section-IV

(14) Answer : (B)

Hint:

Use $-\sqrt{a^2+b^2} \le a\cos x \pm b\sin x \le \sqrt{a^2+b^2}$

Solution:

$y = 5\sin^2 x + 8\sqrt{2}\sin x\cos x + 9\cos^2 x$

$y = \frac{5}{2}(1-\cos 2x) + 4\sqrt{2}\sin 2x + \frac{9}{2}(1+\cos 2x)$

$y = \left(\frac{5}{2}+\frac{9}{2}\right) + \left(\frac{9}{2}-\frac{5}{2}\right)\cos 2x + 4\sqrt{2}\sin 2x$

$y = 7 + 2\cos 2x + 4\sqrt{2}\sin 2x$ …(i)

$\therefore$ Let $f(x) = 2\cos 2x + 4\sqrt{2}\sin 2x$

$f(x)_{\max} = \sqrt{(4\sqrt{2})^2 + (2)^2} = \sqrt{32+4} = 6$

$f(x)_{\min} = -\sqrt{(4\sqrt{2})^2 + (2)^2} = \sqrt{32+4} = -6$

$\therefore$ From (1),

$y_{\max} = 7 + 6 = 13$

$y_{\min} = 7 - 6 = 1$

$\Rightarrow 1 \le \text{range}(y) \le 13$

$\therefore\ g(x) = \frac{1}{2}$ and $g(x) = \frac{27}{2}$ has no solutions.

$\therefore A = \phi = B$

$n(A) = n(B) = 0$

$n(P(P(A))) = 2$

$n(P(P(P(B)))) = 2^2 = 4$

(15) Answer : (A)

Hint:

Any point on the line $\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$ can be taken as $(x_1 + lk, y_1 + mk, z_1 + nk)$ for $k \in R$.

Solution:

Equation of line parallel to $\frac{x-1}{2}=\frac{y-5}{4}=\frac{z-7}{3}$ through $A(2, -1, 3)$ is

$\frac{x-2}{2}=\frac{y+1}{4}=\frac{z-3}{3}=\lambda$

⇒ $x = 2\lambda + 2$, $y = 4\lambda - 1$, $z = 3\lambda + 3$

Putting in plane P_1, we get

$x - 3y + z = -6$

⇒ $2\lambda + 2 - 12\lambda + 3 + 3\lambda + 3 = -6$

⇒ $-7\lambda + 8 = -6$

⇒ $-7\lambda = -14$

⇒ $\lambda = 2$

∴ $B \equiv (6, 7, 9)$

Equation of line passing through B(6, 7, 9) perpendicular to P_1 is

$\frac{x-6}{1}=\frac{y-7}{-3}=\frac{z-9}{1}=\mu$

⇒ $x = \mu + 6$, $y = -3\mu + 7$, $z = \mu + 9$

Putting in plane P_2, *i.e.*, $3x + y + z = 35$, we get

$3\mu + 18 - 3\mu + 7 + \mu + 9 = 35$

⇒ $\mu = 1$

∴ $C \equiv (7, 4, 10)$

$\therefore\ AB \equiv \sqrt{(6-2)^2+(7+1)^2+(9-3)^2}$

Perimeter of $\Delta ABC = AB + BC + CA$

$=2\sqrt{29}+\sqrt{11}+3\sqrt{11}$

$=2\sqrt{29}+4\sqrt{11}$

Centroid of $\Delta ABC \equiv \left(\frac{15}{3},\ \frac{10}{3},\ \frac{22}{3}\right) \equiv \left(5,\ \frac{10}{3},\ \frac{22}{3}\right)$

⇒ $p + 3(q + r) = 37$

∴ Number of divisors = 2

(16) Answer : (B)

Solution:

$\int \frac{1}{1+x^2} = \tan^{-1}(x) + c$

Sol. : $\int \frac{(e^x-1)(\cos x+\sin x)-x\sin x}{\cos^2 x\left(1+\left(\frac{e^x-x-1}{\cos x}\right)^2\right)}\ dx$ …(i)

Put $\frac{e^x-x-1}{\cos x}=t$

⇒ $\frac{\cos x(e^x-1)+(e^x-x-1)\sin x}{\cos^2 x}dx = dt$

⇒ $\frac{(e^x-1)+(e^x-x-1)\sin x}{\cos^2 x}dx = dt$

∴ From (i),

$\int \frac{dt}{1+t^2} = \tan^{-1}(t) + c$

$= \tan^{-1}\left(\frac{e^x-1-x}{\cos x}\right) + c$

$g(x) = \frac{e^x-1-x}{\cos x},\ g(0) = 0$

Now, $g\left(\left|\sin x\right|\right) = \frac{e^{|\sin x|}-\left|\sin x\right|-1}{\cos(|\sin x|)}$

Local minimum will occur at $x = n\pi\ \ \forall\ n \in Z$.

∴ $\forall\ n \in (-\pi, \pi)$

There exists one local minimum and 2 local maximum.

∴ $\alpha = 2$, $\beta = 1$

$g\left|x\right| = \frac{e^{\left|x\right|-1-\left|x\right|}}{\cos|x|} = \frac{1+\left|x\right|+\frac{|x|^2}{2}+...(-\left|x\right|-1)}{\cos|x|}$

$= \frac{|x|^2}{2\cos(|x|)}$ is differentiable $\forall\ x \in R$

$e^{\lim\limits_{x\to 0}\left(1+\frac{e^x-1-x}{\sin x}-1\right)\cdot\frac{4}{x}} = e^{\lim\limits_{x\to 0}\left(\frac{e^x-1-x}{x^2}\right)\cdot 4} \Rightarrow e^2$

(17) Answer : (C)

Hint:

Number of diagonals = $\frac{n(n-3)}{2}$

Solution:

(P) Number of ways = $\frac{8!}{(4!)^2} = \frac{8 \cdot 7 \cdot 6 \cdot 5}{4!} = 70$

(Q) Number of diagonals = $\frac{n(n-3)}{2} = \frac{9(6)}{2} = 27$

(R) Number of solutions = ${}^{n-1}C_{r-1}$

$n = 13$, $r = 3$

$= {}^{12}C_2 = 66$

(S) Number of divisors of ${}^{9}C_4 = 3^2 \times 7 \times 2$

$= (2 + 1)(2)(2) = 12$

PHYSICS

Section-I

(18) Answer : (C)

Hint:

$\vec{s} = \left(\frac{\vec{u} + \vec{v}}{2}\right)t$

Solution:

$\vec{s} = \left(\frac{\vec{u} + \vec{v}}{2}\right)t$

$\vec{g}\,t = \vec{v} - \vec{u}$

$\vec{s} \times \vec{g} = 2\vec{u} \times \vec{v}$

(19) Answer : (B)

Hint:

$E = \frac{hc}{\lambda}$

Solution:

$\sqrt{\frac{1+\frac{1}{3}}{1-\frac{1}{3}}} + \sqrt{\frac{1-\frac{1}{3}}{1+\frac{1}{3}}}$

$\sqrt{2} + \frac{1}{\sqrt{2}} \quad \Rightarrow \quad \frac{3\sqrt{2}}{2}$

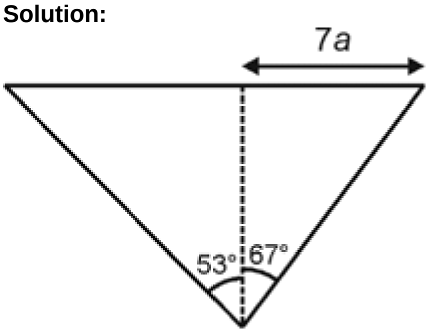
% increase = $\frac{\frac{3\sqrt{2}}{2} - 2}{2} \times 100 = 6.05\%$

(20) Answer : (B)

Hint:

$\frac{\lambda}{4\pi\varepsilon_0 r}(\sin\theta_1 + \sin\theta_2)$

Solution:



$E = 4\pi\varepsilon_0 R^2 \frac{\sin\left(\frac{\theta}{2}\right)}{\frac{\theta}{2}}$

$\frac{\theta}{2} = \frac{120}{2}$

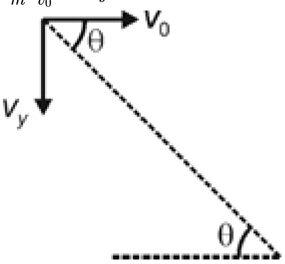
(21) Answer : (B)

Hint:

$\frac{qE}{m}\frac{t}{v_0} = v_y$

Solution:

$\frac{qE}{m}\frac{t}{v_0} = v_y$



$\theta = \frac{h}{d} = \frac{v_y}{v_0} = \frac{qEt}{mv_0^2}$

Section-II

(22) **Answer :** (A,C)

Hint:

$\frac{1}{2}\varepsilon_0 E^2 CA\Delta t = \Delta E$

Solution:

$\frac{1}{2}\varepsilon_0 E^2 CA\Delta t = \Delta E$

$P = \frac{I}{C}$

$F\Delta t = \Delta P$

$\frac{I}{C}\frac{A\Delta t}{A\Delta t} = \frac{\Delta P}{AC\Delta T}$

$\frac{\Delta P}{\Delta V} = \frac{I}{C^2} = \frac{1}{2}\frac{\varepsilon_0 E_0^2}{C}$

$= 8.85 \times 10^{-8} = \frac{8.85\times 10^{-12} E_0^2}{2C}$

(23) **Answer :** (A,C)

Hint:

LC = MSD – VSD

Solution:

$5.4 - \frac{1.25\times 3}{10} = 5.3 - \frac{2.5}{10} = 50.25\ \text{mm}$

0, 1, 2, 3, 4 mm

1.25, 2.5, 3.75, 5 mm

Δ = 0.25 mm

(24) **Answer :** (A,B,D)

Hint:

$\vec{E} = -\vec{V} \times \vec{B}$

Solution:

$\vec{E} = -\vec{V} \times \vec{B}$

$E = CB \sin\theta$

$\frac{E}{CB} = \frac{10^4}{3\times 10^8 \times \frac{2}{3} \times 10^{-4}} = \frac{1}{2.01} = \sin\theta$

$V = \frac{10^4}{6.7\times 10^{-5}} = \frac{100}{67} \times 10^8$

Section-III

(25) **Answer :** 10

Hint:

$H = -kA\frac{dT}{dx}$

Solution:

$H = -kA\frac{dT}{dx}$

$\frac{Hl}{A} = \alpha \cdot \frac{3T_0^2}{2}$

$\alpha = \frac{2\sigma A 15 T_0^4 l}{A 3 T_0^2} = 10\sigma l T_0^2$

(26) **Answer :** 14

Hint:

$F = mg\sin(\phi - \theta)$

$= mg(\sin\phi\cos\theta - \sin\theta\cos\phi)$
Solution:
ϕ : angle of friction
$F = mg\sin(\phi - \theta)$
$= mg(\sin\phi\cos\theta - \sin\theta\cos\phi)$
$\tan\phi = \mu$

$$F = mg\left\{\frac{\mu}{\sqrt{\mu^2+1}}\cos\theta - \frac{1}{\sqrt{\mu^2+1}}\sin\theta\right\}$$

$$F = \frac{mg}{5\sqrt{2}} = \sqrt{2}$$

(27) **Answer :** 2
Hint:
Q_{net} = zero
Solution:
Q_{net} = zero

$$\frac{1}{2}L_{eq}i^2_{\max} = \frac{1}{2}C_1q_1^2 + \frac{1}{2}C_2q_2^2$$

(28) **Answer :** 1
Hint:

$$i = \frac{\varepsilon_0 d\phi}{dt}$$

Solution:

$$i = \varepsilon_0\frac{d\phi_E}{dt};\ \ E = E_0\sin(\omega t)$$

$j = \varepsilon_0 E_0\omega$

$$\frac{8.85\times\pi\times10^{-10}}{10^{-10}} = 8.85\times10^{-12}\times E_0\times 2\pi\frac{C}{\lambda}$$

$$E_0 = \frac{10^{-3}}{10^{-3}} = 1$$

(29) **Answer :** 7
Hint:
$\phi = Mi$
Solution:

$$\phi = \frac{2KM}{r^3}a^2$$

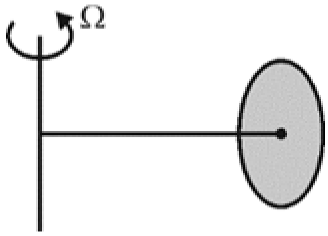
$$M = \frac{2\mu_0}{4\pi d^3}\pi a^4$$

$$M = \frac{\mu_0 a^4}{2d^3}$$

(30) **Answer :** 8
Hint:
LC = MSD – VSD
Solution:
1 VSD = $\frac{5}{8}$ mm
VS value = $\frac{5}{8}, \frac{5}{4}, \frac{15}{8}, \frac{5}{2}, \frac{25}{8}$
MS value = 0, 1, 2, 3
Difference = $\frac{5}{8}, \frac{3}{4}, \frac{1}{4}, \frac{1}{8}$

Section-IV

(31) **Answer :** (C)
Hint:
$L = I\omega$
Solution:



$\omega = \Omega = 1$

$$\omega_{net} = \sqrt{2}$$

$L = \sqrt{(I_s\omega)^2 + (I_0\omega)^2}$

$= \sqrt{\frac{1}{4} + \left(\frac{5}{4}\right)^2}$

$= \sqrt{\frac{4}{10} + \frac{25}{10}} = \frac{\sqrt{29}}{4}$

$K = \frac{1}{2} I_0 \Omega^2 + \frac{1}{2} I_s \omega^2$

$= \frac{1}{2}\frac{5}{4} + \frac{1}{2} \times \frac{1}{2} \times 1$

$K = \frac{5}{8} + \frac{1}{4} = \frac{7}{8}$

$\alpha = \omega^2 = 1$

(32) **Answer :** (C)
Hint:
Q = BE of product – BE of reactant
Solution:
$16 \times 12 \times 1.1 + 2 \times 4 \times E_0 - 200 \times 1.8E_0 = -140.8$
$200 \times 1.8E_0 - 2 \times 56 \times 2E_0 - 22 \times 4E_0 = 48E_0$
$56 \times 2E_0 + 10 \times 16 \times 1.1E_0 - 4 \times 4E_0 - 200 \times 1.8E_0 = -88$
$6 \times 4E_0 + 2 \times 16 \times 1.1E_0 - 56 \times 2E_0 = -52.8$

(33) **Answer :** (C)
Hint:
$TV^{\gamma - 1}$ = Constant
Solution:
$TV^{\gamma - 1}$ = Constant

$T_0 V_0^{\gamma-1} = T\left(\frac{V_0}{2}\right)^{\gamma-1}$

$\sqrt{2}T_0 = T$

$P_0 V_0^{\tau} = P\left(\frac{V_0}{2}\right)^{\gamma}$

$2\sqrt{2}P_0 = P$

$\frac{P_0 V_0}{T_0} = \frac{2\sqrt{2}P_0}{T}\frac{3V_0}{2}$

$T = 3\sqrt{2}T_0$

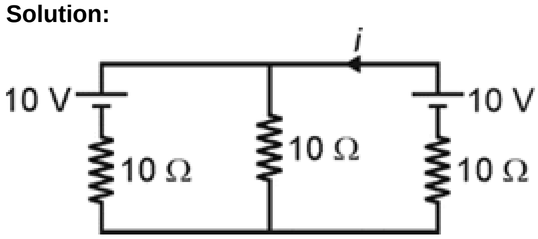
$\Delta Q = \mu C_V \Delta T + \mu C_V \Delta T$

$= 2\mu R(\sqrt{2}-1)T_0 + 2\mu R(3\sqrt{2}-1)T_0$

$= 2\mu R T_0\{4\sqrt{2}-2\}$

$\Delta Q = 4\mu R T_0\{2\sqrt{2}-1\}$

(34) **Answer :** (C)
Hint:
$R = \frac{R_1 R_2}{R_1 + R_2}$
Solution:



$i_1 = \frac{10}{15} = \frac{2}{3}\ A$

$10 - \frac{20}{3} - 10i = 0 \Rightarrow i = \frac{1}{3}$

$\frac{4}{9} \times 10 \times 2 + 10 \times \frac{1}{9} = P + \frac{1}{3} \times 10$

$\Rightarrow \frac{20}{3} = P$

CHEMISTRY

Section-I

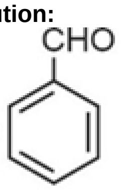
(35) **Answer :** (A)
Hint:
Liquation is used for metals with low melting point.
Solution:
Liquation method is used to purify metals like Sn, Pb and Bi.

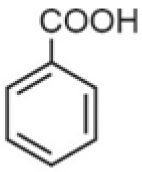
(36) **Answer :** (C)
Hint:
Ionisation energy depends on size, Z_{eff} and electronic configuration of atom.
Solution:
IE_3 for C > N
IE_2 of K > Ca
IE_3 of S > P
IE_2 of B > Be

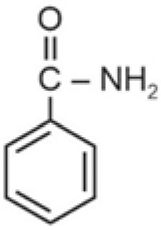
(37) **Answer :** (C)
Hint:
Positive sol is formed if [Cation] > [Anion].
Solution:
AS_2S_3 ⇒ Negatively charged sol
$$20\ \text{mL},\ 0.1\ \text{M}\ \text{AgNO}_3 + \underset{\text{(excess)}}{25\ \text{mL},\ 0.1\ \text{M}\ \text{KI}} \rightarrow$$
AgI/I^- (negatively charged sol)
$$\underset{\text{(excess)}}{25\ \text{mL},\ 0.1\ \text{M}\ \text{AgNO}_3} + 25\ \text{mL},\ 0.1\ \text{M}\ \text{KI} \rightarrow$$
AgI/Ag^+ (positively charged sol)
$$FeCl_3 + NaOH + H_2O \xrightarrow{\text{Boil}}$$
$Fe(OH)_3/OH^-$ (negatively charged sol)

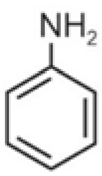
(38) **Answer :** (C)
Hint:
Stronger the synergic bonding, lower is stretching frequencies.
Solution:
More the π-accepting tendency of auxiliary ligand more will be the stretching frequency of CO bond.
Order of π-acceptor tendency
NO > CO > PF_3 > PCl_3
NH_3 is σ-donor ligand.

Section-II

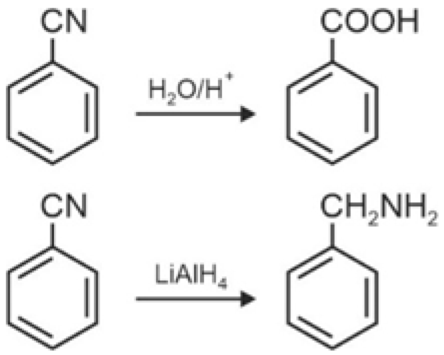
(39) **Answer :** (A,C,D)
Hint:
R – CN form imine which hydrolyses to form aldehyde.
Solution:
P = 

Q = 

R = 

S = 

Aniline (compound S) has higher pK_b value than CH_3NH_2 because lone pair in aniline is delocalised.
Benzaldehyde (compound P) shows Cannizzaro reaction because no α-H is present.

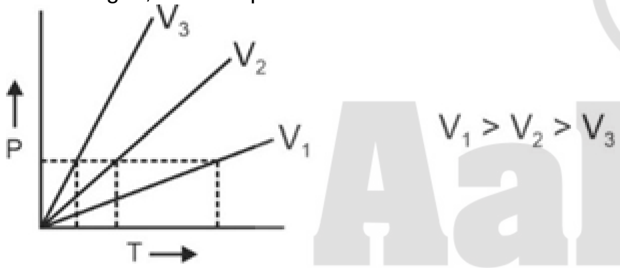


(40) **Answer :** (C,D)
Hint:
Haemoglobin is positive charged sol.
Solution:
Diastase enzyme converts starch into maltose.
Ostwald's process :

$$4\,NH_3\left(g\right) + 5O_2\left(g\right) \xrightarrow{Pt(s)} 4\,NO\left(g\right) + 6H_2O\left(g\right)$$

It is an example of heterogeneous catalysis.

(41) **Answer :** (B,D)
Hint:
KE for ideal gas ∝ temperature
Solution:
Molecular speed is directly proportional to temperature. As temperature increases, molecular speed of gas increases.
∴ $T_2 > T_1$
At equilibrium state concentration of reactants and products become constant.
For ideal gas, at same pressure V ∝ T



G = H – TS, therefore, slope of option (D), graph is –S. Entropy for solid, liquid and gaseous phase follows gas > liquid > solid order.

Section-III

(42) **Answer :** 6
Hint:
$KE_{max} = h\nu_0 - \phi$
Solution:
We know, by photoelectric effect
$h\nu = h\nu_0 + KE$
∴ $KE_1 = h(\nu_1 - \nu_0)$ …(i)

$KE_2 = h\left(\nu_2 - \nu_0\right) = \frac{KE_1}{2}$ …(ii)

Let equation (ii) ÷ equation (i),

$\frac{1}{2} = \frac{1.2\times10^{15} - \nu_0}{2.2\times10^{15} - \nu_0}$

⇒ $\nu_0 = 2 \times 10^{14}$ Hz
Now, threshold wavelength (λ_{max})

$= \frac{c}{\nu_0}$

$= \frac{3\times10^8\ ms^{-1}}{2\times10^{14}\ s^{-1}}$

$= 1.5 \times 10^{-6}$ m
= 1500 nm

(43) **Answer :** 4
Hint:

g eq of OA = g eq of RA

Solution:

Reaction of I_2 with hypo solution,

$2Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6$

Milliequivalents of hypo = Milliequivalents of I_2

$\Rightarrow 12.6 \times \frac{1}{10} = n \times n_f$

$\Rightarrow \frac{12.6}{10} = n \times 2$

$\Rightarrow n = \frac{12.6}{20}$ m mol

$\Rightarrow n = \frac{12.6}{20000}$ moles

	$2HI(g)$	$\rightleftharpoons$	$H_2(g)$	+	$I_2(g)$
Initial	$\frac{0.80}{128}$		–		–
At equilibrium	$\frac{0.80}{128} - \frac{0.80\alpha}{128}$		$\frac{0.80\alpha}{256}$		$\frac{0.80\alpha}{256}$

So, $\frac{0.80\alpha}{256} = \frac{12.6}{20000} \times 100$

$\therefore \alpha = 20.16\%$

(44) Answer : 8

Hint:

Potassium hydroxide absorbs CO_2.

Solution:

C_aH_b	+ $\left(a+\frac{b}{4}\right)O_2$	$\rightarrow$ aCO_2	+ $\frac{b}{2}H_2O$
50 mL	–	–	–
–	–	$a \times 50$	$\frac{b}{2} \times 50$

Now, mixture contains CO_2, H_2O and excess of O_2.

On cooling the mixture, H_2O is separated.

$\therefore$ Volume of H_2O = 150 mL

$\frac{b}{2} \times 50 = 150$

b = 6

Aqueous KOH absorbs CO_2, hence 100 mL contraction is because of CO_2 which is absorbed.

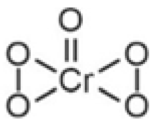
a × 50 = 100

a = 2

$\therefore$ Molecular formula of hydrocarbon is C_2H_6.

(45) Answer : 6

Hint:

Structure of CrO_5 

Solution:

Molecules	Number of π-bonds
P_4O_{10}	4
XeO_3F_2	3
Acetylene (C_2H_2)	2
CrO_5	1
SO_3	3

(NH_2 – CN) cyanamide π-bond = 2

Anthracene ($C_{14}H_{10}$) = 7
N_2O_5 = 2

(46) Answer : 4
Hint:
pH of at first equivalence point = $\left(\frac{pK_{a_1}+pK_{a_2}}{2}\right)$

Solution:
$H_2A + NaOH \rightarrow NaHA + H_2O$
(10 × M) = 20 × 0.1
M = Molarity of H_2A = 0.2 M
pH at first equivalence point = x

$= \left(\frac{pK_{a_1}+pK_{a_2}}{2}\right)$

$= \left(\frac{4.6+8}{2}\right) = 6.3$

pH at second equivalence point = y

$= 7 + \left(\frac{pK_{a_2}+\log C}{2}\right)$

$= 7 + \left(\frac{8+\log C}{2}\right)$

C = [Na_2A] = $\frac{2 \text{ millimoles}}{50 \text{ millilitre}} = \frac{1}{25}$

logC = –log25 = –1.4

$y = 7 + \left(\frac{8-1.4}{2}\right) = 10.3$

(y – x) = 10.3 – 6.3 = 4

(47) Answer : 20
Hint:
$\Delta T_f = iK_f m$
Solution:

$\left(\frac{1.50}{MW}\right) = \frac{60\times0.1}{1000}$

MW = 250 g/mole
$\Delta T_f = (i)(K_f)(m)$

$0.186 = (i)(1.86)\left(\frac{1.5}{(250)(0.1)}\right)$

i = 1.6667

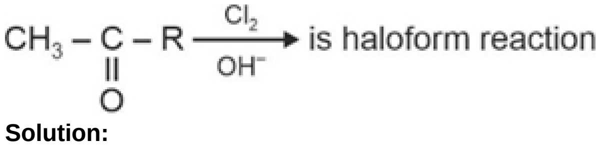
$\alpha = 0.6667 = \frac{2}{3}$

30α = 20

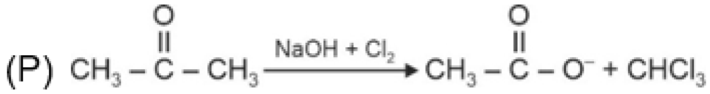
Section-IV

(48) Answer : (B)
Hint:
Stronger the synergic bonding, smaller will be the metal ligand bond.
Solution:
Compound containing metal-carbon covalent bond are organometallic compound.
Complex compounds contain p-acceptor ligands can show synergic bonding.
More the number of d-electron more will be synergic bonding and more will bond length of CO.

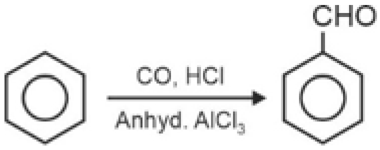
(49) Answer : (C)
Hint:



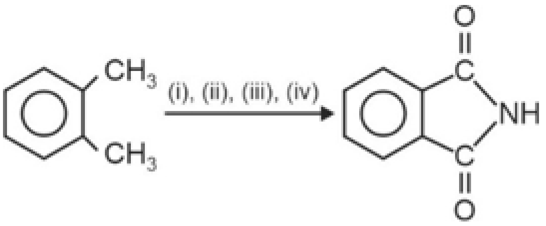
Solution:



$CHCl_3$ is used in carbylamine reaction and Reimer-Tiemann reaction.

(Q) 

Benzaldehyde is used in Cannizzaro and Tischenko reaction.

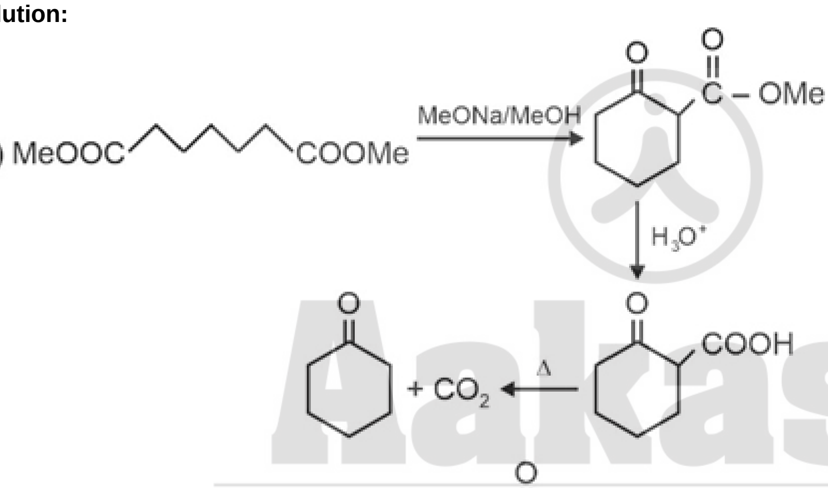
(R) 

Product is used in Gabriel phthalimide reaction.

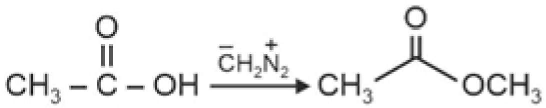
(S) $CH_3-CN \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } SnCl_2,\ HCl} CH_3-\overset{\overset{O}{||}}{C}-H$

It is used in Tischenko reaction.

(50) **Answer :** (A)
Hint:
Pimelic acid on heating forms cyclohexanone.
Solution:

(P) 

(Q) 

(R) 

(S) $CH_3-\overset{\overset{O}{||}}{C}-OH \xrightarrow[\text{(ii) } Br_2/h\nu]{\text{(i) AgOH}} CH_3-Br+CO_2$

(51) **Answer :** (C)
Hint:
Due to complex formation, solubility increases.
Solution:
Due to hydrolysis, solubility of AgCN is more than expected.
In presence of common ion, AgCN form complex compound and solubility increases.
$Zn(OH)_2$ is an amphoteric salt, so its solubility increases in acidic as well as basic solution.