02/11/2025

PS_Set-1
Online

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MM : 180 AIATS For One Year JEE(Advanced)-2026 (XII Passed)_Test-1A_Paper-1_Online **Time : 180 Min.**

PHYSICS

Section-I

1. (C)

2. (D)

3. (D)

4. (C)

Section-II

5. (B,C)

6. (B,C,D)

7. (B,C)

Section-III

8. (2)

9. (1)

10. (6)

11. (21)

12. (12)

13. (10)

Section-IV

14. (B)

15. (C)

16. (D)

17. (D)

CHEMISTRY

Section-I

18. (A)

19. (B)

20. (B)

21. (D)

Section-II

22. (A,B)

23. (A,C)

24. (A,B,C,D)

Section-III

25. (4)

26. (8)

27. (75)

28. (3)

29. (5)

30. (3)

Section-IV

31. (A)

32. (B)

33. (C)

34. (A)

MATHEMATICS

Section-I

35. (D)

36. (B)

37. (A)

38. (A)

Section-II

39. (B,D)

40. (B,C,D)

41. (B,C)

Section-III

42. (2)

43. (1)

44. (5)

45. (3)

46. (3)

47. (39)

Section-IV

48. (A)

49. (B)

50. (B)

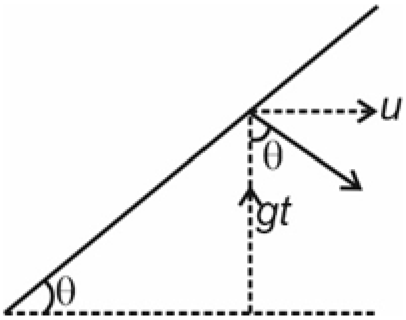
51. (B)

Hints and Solutions

PHYSICS

Section-I

(1) **Answer :** (C)
Hint:
Projectile motion
Solution:

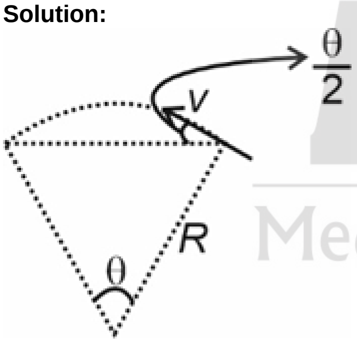


$\tan\theta = \frac{u}{gt}$ also $\tan\theta = \frac{H - \frac{1}{2}gt^2}{ut}$

$u = \sqrt{\frac{2gh}{2t\cot^2\theta}}$

$u = 4\sqrt{5}$ m/s

(2) **Answer :** (D)
Hint:
Range equal to $2R\sin\frac{\theta}{2}$
Solution:



$\frac{1}{2}mv^2 = mg \cdot \frac{5R}{2} - mg\,R\left(1 + \cos\frac{\theta}{2}\right)$

Range = $2R\sin\frac{\theta}{2} = \frac{v^2 \cdot \sin\theta}{2g}$

$\frac{\theta}{2} = 60^\circ$

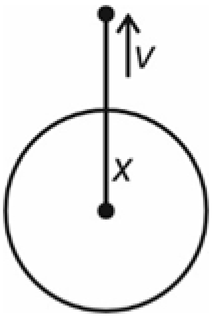
θ = 120°

$\frac{\theta}{3} = 40$

(3) **Answer :** (D)
Hint:
$Mg + T = F_B$
Solution:

$\frac{\pi R^3}{3}\rho g - \frac{\pi R^3 \rho g}{6} = T$

(4) **Answer :** (C)
Hint:
$\frac{dx}{dt} = \sqrt{\frac{2GM}{x}}$
Solution:



$\frac{1}{2}mv^2 - \frac{GMm}{x} = 0$

$v = \sqrt{\frac{2GM}{x}}$

$\frac{dx}{dt} = \sqrt{\frac{2GM}{x}}$

$$\int_R^{4R} \sqrt{x}\,dx = \sqrt{2GM}\int_0^t dt$$

$t = \frac{14}{3}\sqrt{\frac{R^3}{2GM}}$

Section-II

(5) **Answer :** (B,C)
Hint:
$a = 4(8 - v)$
Solution:
$a = 4(8 - v)$

$$\int_4^v \frac{dv}{8-v} = \int_0^t 4dt$$

$v = 8 - 4e^{-4t}$
$v(\ln 2) = 8 - 4e^{-4\ln 2}$
$= 8 - 4 \cdot \frac{1}{16}$
$= 8 - \frac{1}{4}$
$= \frac{31}{4}$ m/s

(6) **Answer :** (B,C,D)
Hint:
Work energy theorem.
Solution:
Conceptual

(7) **Answer :** (B,C)
Hint:
$\Delta z = \frac{2\Delta v}{v} + \frac{\Delta r}{r}$
Solution:
Let $t = \frac{v^2}{R}$ $z = \ln t$
$\Delta z = \frac{\Delta t}{t}$
$\Delta z = \frac{\Delta t}{t} = \frac{2\Delta v}{v} + \frac{\Delta z}{z}$
$\Delta z = 2 \times 0.02 + 0.04$
$= 0.08$

Section-III

(8) **Answer :** 2
Hint:
$\cos 2\theta + \mu \sin\theta = 0$
Solution:
$t = \sqrt{\frac{2l\sec\theta}{a}} = \sqrt{\frac{2l\sec\theta}{g\sin\theta - \mu g\cos\theta}}$

$\frac{dt}{d\theta} = 0$

cos2θ + μ sin2θ = 0

$\tan 2\alpha = -\frac{1}{\mu} = -\frac{1}{0.4}$

2tan2α + 7 = 2

(9) **Answer :** 1

Hint:

$\overrightarrow{F} = -\frac{\partial U}{dr}$

Solution:

$U = \sqrt{2}\sin\left(x^2+y\right)$

$\overrightarrow{F} = -\frac{\partial U}{\partial x}\hat{i} - \frac{\partial U}{\partial y}\hat{j}$

= $-\sqrt{2}\cos\left(x^2+4\right)\cdot 2x\,\hat{i} - \sqrt{2}\cos\left(x^2+y\right)\hat{j}$

$\overrightarrow{F} = \sqrt{2}\cdot\frac{1}{\sqrt{2}}\hat{j}$

$\left|\overrightarrow{F}\right| = 1\ \ N$

(10) **Answer :** 6

Hint:

rF sinθ = τ

Solution:

$\tau = \frac{1}{2}\times 20\times\frac{3}{5}$

= 6

(11) **Answer :** 21

Hint:

stress = $\frac{F}{A}$

Solution:

$\frac{(\text{Stress})_A}{(\text{Stress})_B} = \left(\frac{M_A+M_B}{M_A}\right)\times\frac{A_B}{A_A}$

= $\left(\frac{\rho_A r_A^2\cdot l_A}{\rho_B r_B^2\cdot l_B}+1\right) = \frac{r_B^2}{r_A^2}$

= $\left(6\times\frac{1}{9}\times 2+1\right)\cdot 3^2$

= $\frac{7}{3}\times 3\times 3$

= 21

(12) **Answer :** 12

Hint:

$\overrightarrow{E}_1 = \frac{\rho r}{3\varepsilon_0}$

Solution:

$\overrightarrow{E}_1 = \frac{\rho\overrightarrow{r}}{3\varepsilon_0} = \frac{\rho R}{6\varepsilon_0}$ $\overrightarrow{E}_2 = -\frac{\rho R}{24\varepsilon_0}$

$\overrightarrow{E} = \overrightarrow{E}_1 + \overrightarrow{E}_2$

= $\frac{\rho R}{6\varepsilon_0} - \frac{\rho R}{24\varepsilon_0} = \frac{\rho R}{8\varepsilon_0}$

$F = \frac{3m}{8}\frac{GM}{R^2}$

= $\frac{3}{8}\times 16\times 2$

= 12

(13) **Answer :** 10

Hint:

Apply pseudo force on ball.

Solution:

$mgl = ml^2\alpha$

$\alpha = \frac{g}{l}$

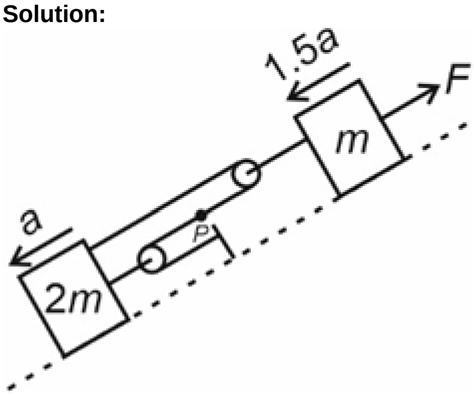
Section-IV

(14) **Answer :** (B)

Hint:

Use string constraint.

Solution:



$mg - 3T = 2ma$

$2T + \frac{mg}{2} - F = 1.5\,ma$

$\frac{7}{4}mg - \frac{3}{2}F = \frac{17}{4}ma$

$a = \frac{4g}{17}$

$T = \frac{mg - 2m \cdot \frac{4g}{17}}{3}$

$T = \frac{3mg}{17}$

$a_p = 2a = \frac{8g}{17}$

(15) **Answer :** (C)

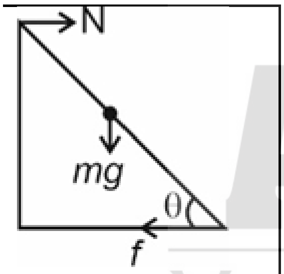
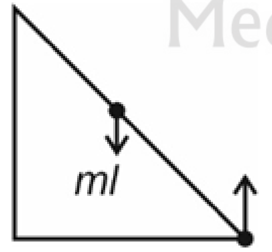
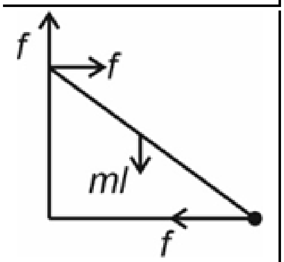
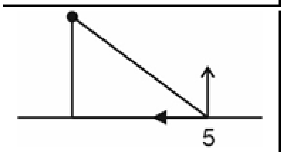
Hint:

Use wedge constraint.

Solution:

$\sqrt{3}\,mg\;R\sin\;\theta = ml\,R(1 - \cos\theta) \Rightarrow \theta = 120°$

$T = \sqrt{3}\,mg\;\;\cos 30^{\circ} - mg\cos 60^{\circ}$

(1)		$mg\frac{l}{2}\cos 37$ = Nl sin 37 $2 \times \frac{4}{5} = \frac{3}{5}\;N$
(2)		$N = \frac{mg}{2} = 1$
(3)		f(sin37 + cos37) = $mg\frac{\cos 37}{2}$ $\frac{7}{5}f = \frac{4}{5}$
(4)		$5 \times \frac{3}{5} + 1 \times \frac{4}{5} = \frac{4}{5}N$

(16) **Answer :** (D)

Hint:

$W_{mg} = \frac{\rho_0 l^4 g}{8}$

Solution:

$\frac{kl}{4} = \left(\frac{\rho_0}{2}\right) l^3 g \Rightarrow k = 2\rho_0 l^2 g$

$kx_2 = \omega_{app}$

$n_1 = \frac{l}{4}, x_2 = \frac{l}{4}$

$\omega_g = mg\frac{l}{2}$

$\omega_{sp} = 0$

(17) **Answer :** (D)

Hint:

Central force is conservative force.

Solution:

Force is a central force centered at (1, 2).

CHEMISTRY

Section-I

(18) **Answer :** (A)

Hint:

$\Delta G^\circ{}_{net} = \Delta G^\circ{}_{LHE} + \Delta G^\circ{}_{RHE}$

Solution:

	ΔG°
LHE : $Ag \rightarrow Ag^+ + e^-$	$-nFE^\circ{}_{Ag/Ag^+}$
RHE : $AgCl + e^- \rightarrow Ag + Cl^-$	$-nFE^\circ{}_{Cl^-/AgCl/Ag}$
Cell reaction : $AgCl \rightarrow Ag^+ + Cl^-$	

Now, $-RT \ln K_{sp} = -nF \left[E^\circ{}_{Ag\,|\,Ag^+} + E^\circ{}_{Cl^-\,|\,AgCl\,|\,Ag}\right]$

$\Rightarrow -\frac{RT}{nF}\ln\frac{1}{K_{sp}} = E^\circ{}_{Cl^-\,|\,AgCl\,|\,Ag} - E^\circ{}_{Ag^+\,|\,Ag}$

$\Rightarrow E^\circ{}_{Ag^+\,|\,Ag} - \frac{RT}{F}\ln\frac{1}{K_{sp}} = E^\circ{}_{Cl^-\,|\,AgCl\,|\,Ag}$

As $K_{sp}\uparrow \frac{1}{K_{sp}}\downarrow - \ln\frac{1}{K_{sp}}\uparrow \left[E^\circ{}_{Cl^-\,|\,AgCl\,|\,Ag}\right]\uparrow$

(19) **Answer :** (B)

Hint:

Out of 12 tetrahedral voids 8 tetrahedral voids are inside the unit cell.

Solution:

Number of tetrahedral voids inside unit cell is 8.

Z = 8

(20) **Answer :** (B)

Hint:

$[P]_t = [Q]_t$

Solution:

	P	$\rightarrow$	nQ.
t = 0	P_0		–
t = t	$P_0 - x$		nx

$\Rightarrow P_0 - x = nx$ (at intersection)

So, $P_0 = x(n + 1)$

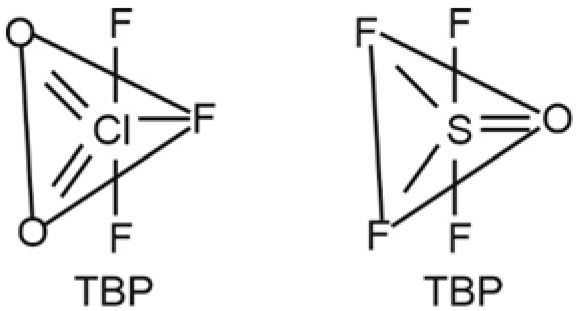
So, $nx = \frac{nP_0}{(n+1)}$

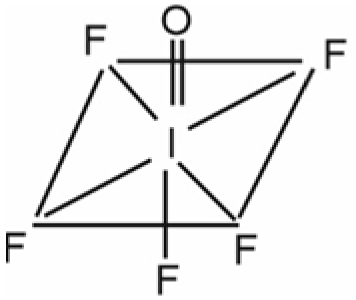
(21) **Answer :** (D)

Hint:

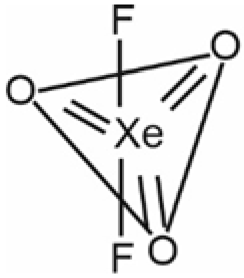
Isostructural species have same shape.

Solution:

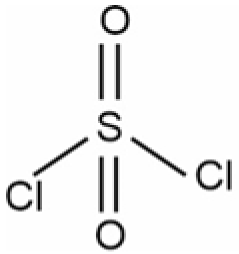




Polar, sp^3d^2



XeO_3F_2
(all O-atoms lie in equatorial position)



sp^3 hybridised
2($p\pi$–$d\pi$ bonds)

Section-II

(22) **Answer :** (A,B)
Hint:
$\Delta T_f = K_f \times m$
Solution:
Ideal gases cannot be liquefied. ΔT_f depends on K_f – nature of solvent.

(23) **Answer :** (A,C)
Hint:
Radial nodes = n – l – 1
Solution:
Radial part of above function depends on n and l.
Number of radial nodes = n – l – 1
Number of angular nodes = l

(24) **Answer :** (A,B,C,D)
Hint:
Element having intermediate oxidation state can undergo disproportionation reaction.
Solution:
$P_4 + NaOH + H_2O \rightarrow PH_3 + H_3PO_2$
$S_8 + NaOH \rightarrow Na_2S_2O_3 + Na_2S$
$Cl_2 + NaOH \rightarrow NaCl + NaClO_3$
$Cl_2O_6 + NaOH \rightarrow NaClO_3 + NaClO_4 + H_2O$

Section-III

(25) **Answer :** 4
Hint:

$d = \frac{Z \times M}{N_A \times a^3}$

Solution:

$1.8125 = \frac{Z \times 58}{6 \times 10^{23} \times (6 \times 10^{-8})^3}$

Solving, Z = 4

(26) Answer : 8

Hint:

$K_f \propto \frac{T_f^2}{\Delta H_f}$

Solution:

$\frac{K_f}{K_b} = \frac{(T_f)^2}{(\Delta H_f)} \times \frac{(\Delta H_v)}{(T_b)^2} = \left(\frac{290}{580}\right)^2 \left(\frac{\Delta H_v}{\Delta H_f}\right)$

$\frac{\Delta H_v}{\Delta H_f} = \left(\frac{580}{290}\right)^2 \times \frac{4.64}{2.32} = 8$

(27) Answer : 75

Hint:

$k = \frac{1}{t} \ln \frac{A_0}{A}$

Solution:

$$H_2O_2\,(aq) \rightarrow H_2O\,(l) + \frac{1}{2}O_2\,(g)$$

After a long time $\quad A_0 \qquad\qquad \frac{A_0}{2}$

So, initial concentration ∝ 200 mL.

1 hr 25 mins = 85 mins = $2t_{\frac{1}{2}}$

Concentration of H_2O_2 remaining ∝ $\frac{200}{(2)^2}$ = 50

Concentration of H_2O_2 consumed ∝ 150

V_{O_2} produced = $\frac{150}{2}$ = 75 mL

(28) Answer : 3

Hint:

w = –nRΔT

Solution:

W = –nRΔT = –1 × 8 × 75 = –600 = –0.6 kJ

ΔU = q + w = 1800 – 600 = 1200 J

$\gamma = \frac{\Delta H}{\Delta U} = \frac{1800}{1200} = 1.5$

(29) Answer : 5

Hint:

Number of equivalents is same.

Solution:

Number of equivalents of $CuSO_4 \cdot xH_2O$ = number of equivalents of H_2SO_4 = Number of equivalents of NaOH

$\frac{1.25}{\frac{159.5+18x}{2}} = 5 \times 2 \times 10^{-3}$

⇒ x = 5.03 ≈ 5

(30) Answer : 3

Hint:

$N_\alpha \propto \frac{1}{\sin^4\left(\frac{\theta}{2}\right)}$

Solution:

$N_\alpha \propto \frac{1}{\sin^4\left(\frac{\theta}{2}\right)} \Rightarrow \frac{N_{60^\circ}}{N_{90^\circ}} = \left[\frac{\sin\left(\frac{90^\circ}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)}\right]^4$

$\frac{36}{N_{90^\circ}} = \frac{4}{1} \Rightarrow N_{90^\circ} = 9$

So, N = 15 × 9 = 135, scattered α – particles

Section-IV

(31) Answer : (A)

Hint:

Noble gases have high IE.

Solution:

Highest value of IE_1 refers to noble gas or group 18 element. Lowest the value of IE_1, more reactive the metal.

(32) Answer : (B)

Hint:

Down the group IE decreases.

Solution:

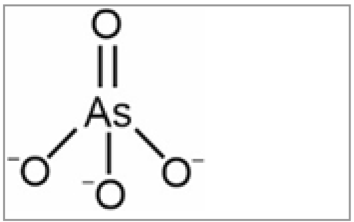
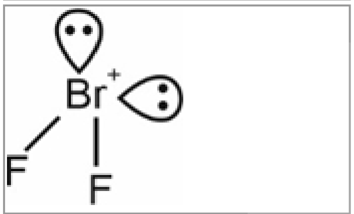
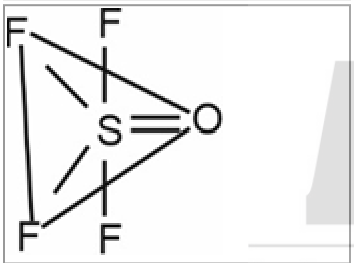
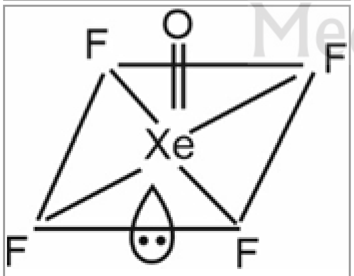
Down the group IE decreases. Electronegativity decreases generally. Cations have larger affinity for electrons ⇒ Fe^{2+} has larger magnitude of electron gain enthalpy.

(33) Answer : (C)

Hint:

AsO_4^{3-} is having sp^3 hybridised As-atom.

Solution:

	Hybridisation → sp^3 Tetrahedral Number of $p\pi$-$d\pi$ bonds = 1
	sp^3 Shape-V Br-F bonds have same bond lengths
	$sp^3d_{z^2}$ Trigonal bipyramid Number of pπ-dπ bonds = 1.
	sp^3d^2 shape : square pyramidal. Number of $p\pi$-$d\pi$ bonds = 1

(34) Answer : (A)

Hint:

$\mathrm{pH} = \mathrm{pK_a} + \log \frac{[\mathrm{Salt}]}{[\mathrm{Acid}]}$

Solution:

(P) $\mathrm{pH} = \mathrm{pK_{a_1}} + \log \left[\frac{H_2XO_4^-}{[H_3XO_4]}\right] = 4$

(Q) $\mathrm{pH} = \mathrm{pK_{a_2}} + \log \left[\frac{HXO_4^{2-}}{[H_2XO_4^-]}\right] = 8$

(R) $\mathrm{pH} = \mathrm{pK_{a_3}} + \log \left[\frac{XO_4^{3-}}{[HXO_4^{2-}]}\right] = 12$

(S) $\mathrm{pH} = \frac{1}{2}\left[\mathrm{pK_{a_1}} + \mathrm{pK_{a_2}}\right] = \frac{1}{2}[4+8] = 6$

MATHEMATICS

Section-I

(35) **Answer :** (D)
Hint:
$P(x)$ divides both of them, hence $P(x)$ also divides
Solution:
∵ $P(x)$ divides both of them, hence $P(x)$ also divides
$(3x^4 + 4x^2 + 28x + 5) - 3(x^4 + 6x^2 + 25)$
$= -14x^2 + 28x - 70$
$= -14(x^2 - 2x + 5)$; ∴ $P(1) = 4$

(36) **Answer :** (B)
Hint:
$(z+w)^2 = zw \Rightarrow z^2 + zw + w^2 = 0$
Solution:
$(z+w)^2 = zw \Rightarrow z^2 + zw + w^2 = 0$
Let $\frac{z}{w} = t \Rightarrow \frac{z}{w} = \frac{-1\pm\sqrt{3}i}{2}$
$\arg z - \arg w = \frac{2\pi}{3}$ or $\arg z - \arg w = -\frac{2\pi}{3}$.

(37) **Answer :** (A)
Hint:
3, 5, 7 → A.P.
Solution:
3, 5, 7 → A.P. but if they are in G.P. then, $y^2 = xz$ but y is prime. So not possible.

(38) **Answer :** (A)
Hint:
$(-1)^{r-1}\left(1+\frac{1}{2}+\frac{1}{3}+\ldots+\frac{1}{r}\right)\cdot {}^nC_r$
Solution:
T_r (r^{th} term of the series)
$(-1)^{r-1}\left(1+\frac{1}{2}+\frac{1}{3}+\ldots+\frac{1}{r}\right)\cdot {}^nC_r$
Now $(-1)^{r-1}\left(1+x+x^2+\ldots+x^{r-1}\right)\cdot {}^nC_r = \left(\frac{1-x^r}{1-x}\right)(-1)^{r-1}\cdot {}^nC_r$
Now
$\frac{1}{(1-x)}\sum_{r=1}^{n}\left[(-1)^{r-1}\cdot {}^nC_r - (-1)^{r-1}\cdot x^r\cdot {}^nC_r\right]$
$= \frac{1}{(1-x)}\left[(-1)\sum_{r=1}^{n}(-1)^r\cdot {}^nC_r + \sum_{r=1}^{n}(-1)^r\cdot x^r\cdot {}^nC_r\right]$
$= \frac{1}{(1-x)}\left[(-1)\left\{(1-1)^n - 1\right\} + \left\{(1-x)^n - 1\right\}\right]$
$= \frac{(1-x)^n}{(1-x)} = (1-x)^{n-1}$
$\Rightarrow \sum_{r=1}^{n}(-1)^{r-1}\left(1+x+x^2+\ldots.+x^{r-1}\right)\cdot {}^nC_r = (1-x)^{n-1}$
Integrating above equation, we get
$\int_0^1\left[\sum_{r=1}^{n}(-1)^{r-1}\left(1+x+x^2+\ldots.+x^{r-1}\right)\cdot {}^nC_r\right]dx = \int_0^1(1-x)^{n-1}dx$
$\Rightarrow \sum_{r=1}^{n}(-1)^{r-1}\cdot {}^nC_r\int_0^1\left(1+x+x^2+\ldots.+x^{r-1}\right)dx = \left[-\frac{(1-x)^n}{n}\right]_0^1$
$\Rightarrow \sum_{r=1}^{n}(-1)^{r-1}\cdot {}^nC_r\left[x+\frac{x^2}{2}+\frac{x^3}{3}+\ldots..+\frac{x^2}{r}\right]_0^1 = \frac{1}{n}$
$\Rightarrow \sum_{r=1}^{n}(-1)^{r-1}\cdot {}^nC_r\left[1+\frac{1}{2}+\frac{1}{3}+\ldots+\frac{1}{r}\right] = \frac{1}{n}$

Section-II

(39) **Answer :** (B,D)
Hint:

$\frac{6!}{2!2!1!1!2!2!}$

Solution:

Required ways $= \frac{6!}{2!2!1!1!2!2!} \times 4! = 1080$

(40) **Answer :** (B,C,D)

Hint:

$X^4 = I$

Solution:

$AX = B$

$\Rightarrow AX^2 = BX$

$\Rightarrow AX^2 = XB$ ($\because BX = XB$)

$\Rightarrow AX^2 = A$

multiply both the side by A^{-1} ($\because A^{-1}$ exists)

$\Rightarrow X^2 = I$

$\Rightarrow X^4 = I$

$= |X^4 + X^2 + I| = |3I| = 27$

(41) **Answer :** (B,C)

Hint:

$\left|z+\frac{1}{2}\right| \geq \frac{1}{2}$

Solution:

$|z^2 + z + 1| = 1$

$\Rightarrow \quad \left|\left(z+\frac{1}{2}\right)^2+\frac{3}{4}\right| = 1$

$\Rightarrow \quad \left|\left(z+\frac{1}{2}\right)^2+\frac{3}{4}\right| \leq \left|z+\frac{1}{2}\right|^2+\frac{3}{4}$

$\Rightarrow \quad 1 \leq \left|z+\frac{1}{2}\right|^2+\frac{3}{4} \Rightarrow \left|\left(z+\frac{1}{2}\right)\right|^2 \geq \frac{1}{4}$

$\Rightarrow \quad \left|z+\frac{1}{2}\right| \geq \frac{1}{2}$

also $\left|\left(z^2+z\right)+1\right| = 1 \geq \left|\left|z^2+z\right|-1\right|$

$\Rightarrow |z^2 + z| - 1 \leq 1$

$\Rightarrow |z^2 + z| \leq 2$

$\Rightarrow \left|\left|z^2\right|-|z|\right| \leq \left|z^2+z\right| \leq 2$

$\Rightarrow \left|r^2-r\right| \leq 2$

$\Rightarrow \quad r = |z| \leq 2; \ \forall z \in S$

Also we can always find root of the equation

$z^2 + z + 1 = e^{i\theta}$; $\forall \theta \in R$ Hence set 'S' is infinite

Section-III

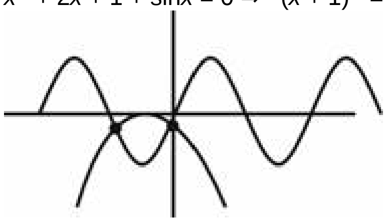
(42) **Answer :** 2

Hint:

$-1 \leq \sin\theta \leq 1$

Solution:

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



(43) **Answer :** 1

Hint:

$20^2 - 4c \geq 0$

Solution:

$20^2 - 4c \geq 0$

$1 \leq c \leq 100$

Product = 1.2.3 ……. 100 = 100!

$n = 100$

Sum of digits = 1

(44) Answer : 5

Hint:

Multiply equation (2) by *i* and add in equation (1)

Solution:

$z_1^3 - 3z_1z_2^2 = 2$ …(1)

$3z_1^2z_2 - z_2^3 = 11$ …(2)

Multiply equation (2) by *i* and add in equation (1)

$z_1^3 - 3z_1z_2^2 + 3iz_2z_1^2 - iz_2^3 = 2 + 11i$

$z_1^3 + i^2 3z_1z_2^2 + 3iz_2z_1^2 + (iz_2)^3 = 2 + 11i$

$(z_1 + iz_2)^3 = 2 + 11i$

Similarly $(z_1 - iz_2)^3 = 2 - 11i$

Multiply the two

$((z_1 + iz_2)(z_1 - iz_2))^3 = 4 + 121$

$(z_1^2 + z_2^2)^3 = 125$

$z_1^2 + z_2^2 = 5$, $5w$, $5w^2$

$|z_1^2 + z_2^2| = 5$

(45) Answer : 3

Hint:

A.M. ≥ G.M.

Solution:

$0 < \sin\alpha \le 1$, $0 < \cos\beta \le 1$, $\tan\gamma \in (0, \infty)$

$\frac{\sin\alpha + \cos\beta + \tan\gamma}{3} \ge (\sin\alpha \cdot \cos\beta \cdot \tan\gamma)^{\frac{1}{3}}$

1 ≥ 1

⇒ A.M. = G.M.

⇒ $\sin\alpha = \cos\beta = \tan\gamma = 1$

⇒ $\sin^2\alpha + \cos^2\beta + \tan^2\gamma = 3$

(46) Answer : 3

Hint:

$\left(\sum_{k=1}^{5} {}^{20}C_{2k-1}\right)^6 = \left(\frac{1}{2}\left({}^{20}C_1 + {}^{20}C_3 + \ldots\ldots + {}^{20}C_{19}\right)\right)^6$

Solution:

$\left(\sum_{k=1}^{5} {}^{20}C_{2k-1}\right)^6 = \left(\frac{1}{2}\left({}^{20}C_1 + {}^{20}C_3 + \ldots\ldots + {}^{20}C_{19}\right)\right)^6$

$= 2^{108} = (2^5)^{21} \times 2^3 = (11 \times 3 - 1)^{21} \times 8$

$= 8(33I - 1) = 8 \times 33I - 8$

$= 11(8 \times 3I - 1) + 3$

(47) Answer : 39

Hint:

1 ball for box 2 and 1 for box 4 in ${}^7C_1 \times {}^6C_1 = 42$ ways

Solution:

1 ball for box 2 and 1 for box 4 in ${}^7C_1 \times {}^6C_1 = 42$ ways

Remaining 5 balls are to be put in 3

boxes $= 3 \times (2^5 - 2) + 3 \times 1 = 93$

Total = 42 × 93 = 3906

Section-IV

(48) Answer : (A)

Hint:

$A^{50} = 25A^2 - 24I$

Solution:

$A^n - A^{n-2} = A^2 - I$

$\Rightarrow A^{50} = A^{48} + A^2 - I$

$A^{48} = A^{46} + A^2 - I$

.

.

.

$A^4 = A^2 + A^2 - I$

$A^{50} = 25A^2 - 24I$

So, $A^{50} = \begin{pmatrix} 1 & 0 & 0 \\ 25 & 1 & 0 \\ 25 & 0 & 1 \end{pmatrix}$

$|A^{50}| = 1$

Trace $(A^{50}) = 3$

$U = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

(49) **Answer :** (B)

Hint:

Use trigonometric identity

Solution:

(P) $\cos^2 2x - \sin^2 x = 0$

$\Rightarrow \cos 3x \cos x = 0$

$\cos 3x = 0$ or $\cos x = 0$

$3x = (2n+1)\frac{\pi}{2}$ or $x = (2n+1)\frac{\pi}{6}$

Hence general solution of equation $(2n+1)\frac{\pi}{6},\ n \in Z$

(Q) $\cos x + \sqrt{3}\sin x = \sqrt{3}$

$\cos\left(x - \frac{\pi}{3}\right) = \frac{\sqrt{3}}{2}$

$x = \left(2n + \frac{1}{2}\right)\pi$ or $x = 2n\pi + \frac{\pi}{6}\ n \in Z$

(R) $\sqrt{3}\tan^2 x - \left(\sqrt{3}+1\right)\tan x + 1 = 0$

$\Rightarrow (\tan x - 1)\left(\sqrt{3}\tan x - 1\right) = 0$

$\tan x = \frac{1}{\sqrt{3}}, 1 \Rightarrow x = n\pi + \frac{\pi}{4}, n\pi + \frac{\pi}{6}, n \in Z$

(S) $\tan x \tan 2x \tan 3x = 0$

$x = n\pi$ or $\frac{n\pi}{2}$ (rejected) or

$\frac{n\pi}{3} \Rightarrow x = \frac{n\pi}{3}, n \in Z$

(50) **Answer :** (B)

Hint:

Quadratic properties

Solution:

For the given conditions roots are 0, –1, –2

$\therefore (a)_{min} = 3$

$(b)_{min} = 2$

$(c)_{min} = 0$

(51) **Answer :** (B)

Hint:

Permutation and combination

Solution:

(P) $xyz = 3^5$

Number of solution (x, y , z) is ${}^{3+5-1}C_5 = 21$

(Q) Number of terms = ${}^{6+3-1}C_{3-1} = 28$.

(R) $x^2 + x - 400 \le 0$

$x(x + 1) \le 400$

solutions are 1, 2, 3, …, 19

Number of solutions = 19.

(S) $x + y + z = 10$

Number of solutions = ${}^{7+3-1}C_{3-1} = {}^9C_2 = 36$