14/12/2025

Set-2

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 Two Year JEE(Advanced)-2027 (XI Studying-P1)_Test-2A_Paper-2_Online

Time : 180 Min.

CHEMISTRY

Section-I

1. (D)

2. (C)

3. (C)

4. (A)

Section-II

5. (A,B,D)

6. (A,D)

7. (A,B,D)

Section-III

8. (43)

9. (3)

10. (50)

11. (20)

12. (24)

13. (9)

Section-IV

14. (00.40)

15. (00.02)

16. (05.00)

17. (07.00)

MATHEMATICS

Section-I

18. (B)

19. (B)

20. (D)

21. (C)

Section-II

22. (A,B,C,D)

23. (A,C)

24. (A,D)

Section-III

25. (3)

26. (4)

27. (35)

28. (40)

29. (2)

30. (2)

Section-IV

31. (03.00)

32. (21.00)

33. (10.00)

34. (28.00)

PHYSICS

Section-I

35. (C)

36. (A)

37. (B)

38. (B)

Section-II

39. (A,C)

40. (A,B,C,D)

41. (A,D)

Section-III

42. (3)

43. (2)

44. (1)

45. (5)

46. (7)

47. (4)

Section-IV

48. (08.40)

49. (02.80)

50. (75.00)

51. (10.00)

Hints and Solutions

CHEMISTRY

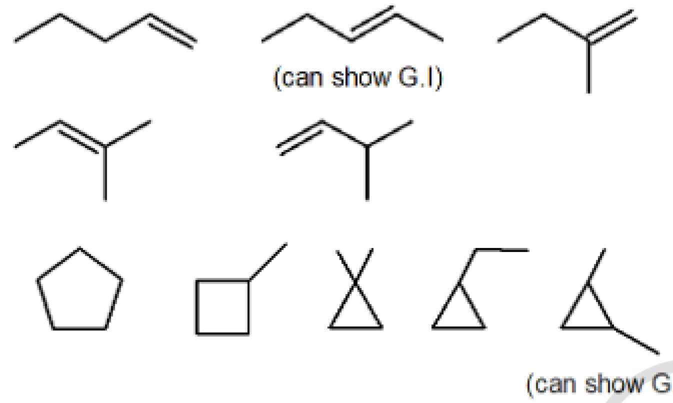
Section-I

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

Hint:

Compound having 1 degree of unsaturation can form alkene or cyclic structure.

Solution:



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

Hint:

$\alpha = \frac{D-d}{d(n-1)}$

D = theoretical vapour density

d = observed vapour density

Solution:

$D = \frac{Molar\ mass\ of\ A}{2} = \frac{92}{2} = 46$

n – 1 = 1

$\alpha = \frac{D}{d} - 1$

α + 1 = $\frac{D}{d}$

$d = \frac{D}{\alpha+1}$

$d_1 = \frac{46}{1.25} = 36.8$

$d_2 = \frac{46}{1.5} = 30.6$

$d_3 = \frac{46}{1.75} = 26.29$

$d_4 = \frac{46}{2} = 23$

$d_1 > d_2 > d_3 > d_4$

(3) **Answer :** (C)

Hint:

For phase transition;

$\boxed{\Delta S = \frac{\Delta H}{T}}$

Solution:

$$\underset{263\ K}{H_2O(s)} \rightarrow \underset{273\ K}{H_2O(s)}; \quad \Delta S_1 = \int_{263\ K}^{273\ K} \frac{C_{p,m}\, dT}{T}$$

$$\underset{273\ K}{H_2O(s)} \rightleftharpoons \underset{273\ K}{H_2O(l)}; \quad \Delta S_2 = \frac{\Delta H_{m,\,fus}}{T_f}$$

$$\underset{273\ K}{H_2O(l)} \rightarrow \underset{373\ K}{H_2O(l)}; \quad \Delta S_3 = \int_{273\ K}^{373\ K} \frac{C_{p,m}\, dT}{T}$$

$$\underset{373\,K}{H_2O(l)} \rightleftharpoons \underset{373\,K}{H_2O(g)}; \quad \Delta S_4 = \frac{\Delta H_{m,\,vap}}{T_b}$$

$$\underset{373\,K}{H_2O(g)} \rightarrow \underset{423\,K}{H_2O(g)}; \quad \Delta S_5 = \int_{373\,K}^{423\,K} \frac{C_{p,m}\,dT}{T}$$

$\Delta S_{total} = \Delta S_1 + \Delta S_2 + \Delta S_3 + \Delta S_4 + \Delta S_5$

(4) **Answer :** (A)

Hint:

Gram equivalent of $CuSO_4$ = gram equivalent of $Na_2S_2O_3$

Solution:

$(M \times V \times n_f)_{CuSO_4} = (M \times V \times n_f)_{hypo}$

M × 200 × 1 = 0.2 × 100 × 1

$M_{CuSO_4} = \frac{20}{200} = 0.1\ M$

Section-II

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

Hint:

At equilibrium ΔG = 0

Solution:

$\Delta G° = -RT\ln K_{eq}$

If $K_{eq} = 1$

ΔG° = 0

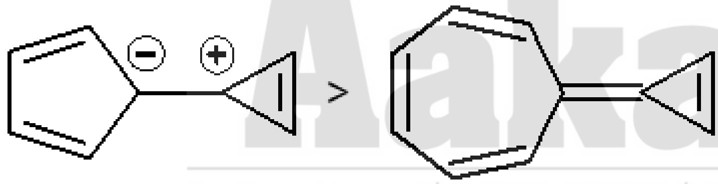
ΔG° < 0 reaction may be spontaneous but if ΔG < 0, reaction is always spontaneous

(6) **Answer :** (A,D)

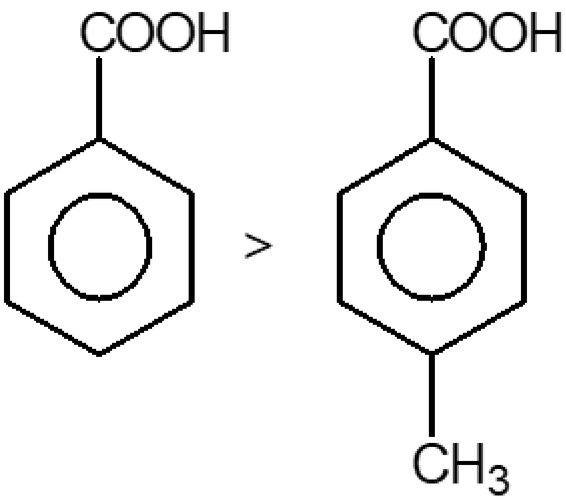
Hint:

ERG at para position of benzoic acid destablises conjugate base.

Solution:

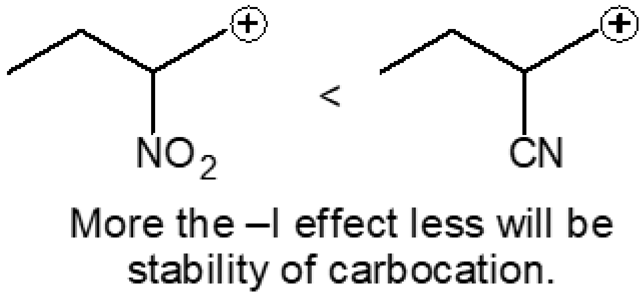
(A) 

Aromatic, so more dipole moment

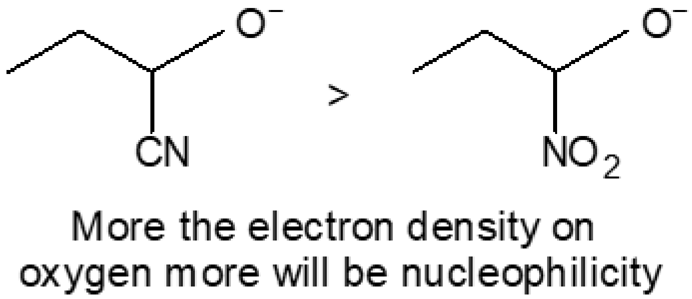
(B) 

CH_3 destablises conjugate base

(C)



(D)



(7) **Answer :** (A,B,D)
Hint:
dG = VdP – SdT
Solution:
dG = VdP – SdT
At constant pressure
dG = –SdT
$\left(\frac{\partial G}{\partial T}\right)_P = -S$
dG = VdP – SdT
At constant temperature
dT = 0
$\left(\frac{\partial G}{\partial P}\right)_T = V$

Section-III

(8) **Answer :** 43
Hint:
Apply law of equivalence
Solution:
$(n \times n_f)_{Ba(OH)_2} + (M \times V \times n_f)_{NaOH} = (NV)_{HCl}$
n × 2 + 0.2 × 0.15 × 1 = 0.5 × 0.1
2n = 0.05 – 0.03
n = 0.01
Mass of $Ba(OH)_2$ = 171 × 0.01 = 1.71 g
% purity = $\frac{1.71}{2} \times 100 = 85.5\%$ = x
$\Rightarrow \quad \frac{x}{2} = 42.75 \approx 43$

(9) **Answer :** 3
Hint:
Heat of solution = Lattice energy + hydration energy
Solution:
-0.95×10^x = 700 – 1000 – 650
-0.95×10^x = –950
x = 3

(10) **Answer :** 50
Hint:
$\frac{1}{2}P_2 + \frac{1}{2}Q_2 \rightarrow PQ \quad \Delta H_r = -100\ \text{kJ/mol}^{-1}$
$\Delta H_r = \sum$ BE (reactant) $- \sum$ BE (product)
Solution:
$\frac{1}{2}P_2 + \frac{1}{2}Q_2 \rightarrow PQ$
$\Delta H = \frac{BE_{P_2}}{2} + \frac{BE_{Q_2}}{2} - BE_{PQ}$

$-100\ kJ\ =\ \frac{3}{2}x + \frac{x}{2} - 4x$
–2x = –100 kJ
x = 50 = 50 kJ/mol

(11) **Answer :** 20
Hint:
$(NH_4)_3PO_4 \cdot 12MoO_3$
Molar mass of ammonium phosphomolybdate = 1877 g/mol
Solution:
Mol of $(NH_4)_3PO_4 \cdot 12MoO_3 = \frac{7.5}{1877} = 0.004\ mol$
Mass of P = 0.004 × 31
= 0.124 g
% of P in OC = $\frac{0.124}{0.62} \times 100 = 20\%$

(12) **Answer :** 24
Hint:
$\Delta G° = -RT\ln K_P$
$K_P = \frac{-\Delta G^{\circ}}{RT}$
Solution:
$K_P = \frac{-\Delta G^{\circ}}{RT} = \frac{-8600}{8.314 \times 298}$
$\ln K_P = -3.47$
$K_P = 0.031 = P_{H_2O}$
P_{H_2O} = 0.031 atm
1 atm = 760 torr
P_{H_2O} = vapour pressure = 23.56 $\simeq 24\ torr$

(13) **Answer :** 9
Hint:

$$AgCl \rightleftharpoons \underset{S}{Ag^+} + \underset{S}{Cl^-}$$

Solution:
$K_{sp} = S^2$
$10^{-10} = S^2$
$S = 10^{-5}$ M
$M = \frac{n}{V} = 10^{-5}$
$10^{-5} = \frac{12.915 \times 10^{-3}}{143.5 \times V}$
$V = \frac{12.915 \times 10^{-3}}{143.5 \times 10^{-5}} = 9\ L$

Section-IV

(14) **Answer :** 00.40
Hint:
The pressure of B in both the reaction will be same
Solution:
As mole ratio represents pressure ratio for gases for the following equilibria we have.

	$A(g)$	$+$	$B(g)$	$\rightleftharpoons$	$C(g)$
$Initially$	$3P$		$5P$		$-$
$At\ eq^m$	P_1		0.5		P_2

$$\underset{0.5}{2B(g)} \rightleftharpoons \underset{P_3}{D(g)} \qquad K_{P_2} = 8$$

$K_{P_2} = \frac{P_3}{(0.5)^2}$
$P_3 = K_{P_2} \times (0.5)^2$
= 8 × 0.25 = 2 atm
$P_3 = P_D$ = 2 atm

Now out of 3P atm of A(g) and P_2 atm of its converts to P_2 atm of C(g)
$3P - P_2 = P_1$ atm …(i)

As B(g) converts to both C(g) and D(g) out of 5P atm of B(g) P_2 atm converted to P_2 atm of C(g) and 4 atm of it gave 2 atm of D(g) and 0.5 atm of B(g) remained at equilibrium

$5P - P_2 - 4 = 0.5$ atm …(ii)

At equilibrium total pressure

i.e. $P_A + P_B + P_C + P_D = 5.5$ atm

$P_1 + 0.5 + P_2 + 2 = 5.5$ atm …(iii)

From equation (i), (ii) and (iii)

$P_1 = 2.5$ atm; $P_2 = 0.5$ atm

$K_{P_1} = \frac{P_C}{P_A \cdot P_B}$

$K_{P_1} = \frac{0.5}{2.5 \times 0.5} = 0.4\ atm^{-1}$

(15) Answer : 00.02

Hint:

The pressure of B in both the reaction will be same

Solution:

As mole ratio represents pressure ratio for gases for the following equilibria we have.

2A(g) + 2B(g) $\rightleftharpoons$ 2C(g) K = $(K_{P_1})^2$

D(g) $\rightleftharpoons$ 2B(g) $K' = \left(\frac{1}{K_{P_2}}\right)$

2A(g) + D(g) $\rightleftharpoons$ 2C K″ = $\frac{(K_{P_1})^2}{K_{P_2}}$

$= \frac{0.4 \times 0.4}{8} = 0.02\ atm^{-1}$

(16) Answer : 05.00

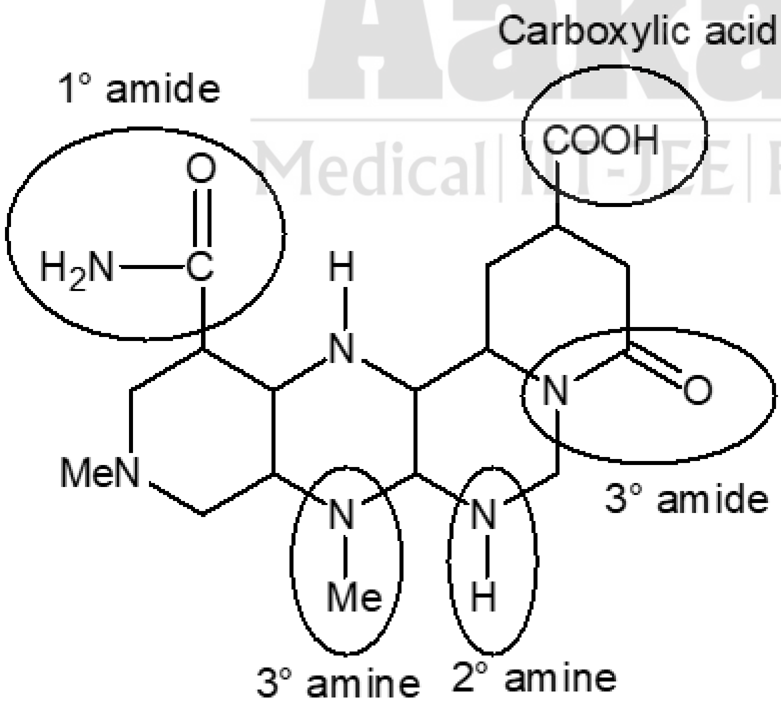
Hint:

1°, 2° and 3° amines are different functional group

Degree of unsaturation = $C + 1 - \frac{H}{2} - \frac{X}{2} + \frac{N}{2}$

Degree of unsaturation = number of rings + π bonds.

Solution:



x = 5

Degree of unsaturation

Number of rings = 4

π bonds = 3

y = 7

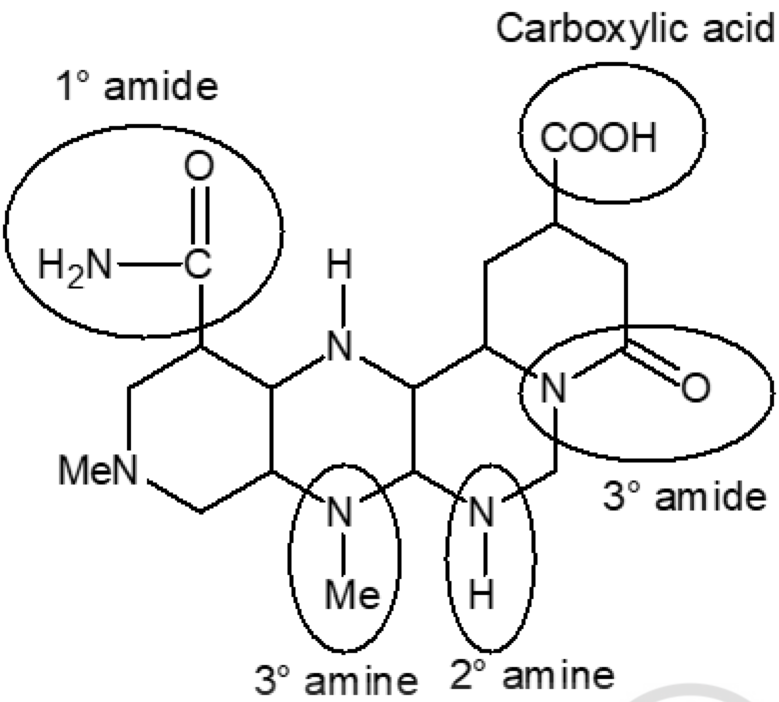
(17) Answer : 07.00

Hint:

1°, 2° and 3° amines are different functional group

Degree of unsaturation = $C + 1 - \frac{H}{2} - \frac{X}{2} + \frac{N}{2}$

Degree of unsaturation = number of rings + π bonds.
Solution:



x = 5
Degree of unsaturation
Number of rings = 4
π bonds = 3
y = 7

MATHEMATICS

Section-I

(18) **Answer :** (B)
Hint:
Based on basic concepts
Solution:

A → $\frac{6!}{2!}$

E → $\frac{6!}{2!}$

G → $\frac{6!}{2!}$

I → $\frac{6!}{2!}$

L → 6!

VA → $\frac{5!}{2!}$

VE → $\frac{5!}{2!}$

VG → $\frac{5!}{2!}$

VIA → $\frac{4!}{2!}$

VIE → $\frac{4!}{2!}$

VIG → $\frac{4!}{2!}$

VILA → 3!
VILE → 3!
VILG → 3!
VILLAEG → 1
VILLAGE → 1

Position of VILLAGE = $4 \times \frac{6!}{2!} + 6! + 3 \times \frac{5!}{2!} + 3 \times \frac{4!}{2!} + 3 \times 3! + 2$
= 2396

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

${}^{n}C_{r} + {}^{n}C_{r+1} = {}^{n+1}C_{r+1}$

Solution:

${}^{21}C_0 + {}^{21}C_1 + {}^{22}C_2 + \ldots + {}^{29}C_9 = {}^{22}C_1 + {}^{22}C_2 + \ldots + {}^{29}C_9 = {}^{30}C_9$

(20) **Answer :** (D)

Hint:

Using A.M. – G.M. inequality

Solution:

Equation of line L be $y - 2 = m(x - 8)$, $m < 0$

Coordinates of A and B are

$A\left(8 - \frac{2}{m},\ 0\right)$ and $B(0,\ 2 - 8m)$

So, $OA + OB = 8 - \frac{2}{m} + 2 - 8m$

$= 10 - \frac{2}{m} - 8m$

$\geq\ 10 + 2\sqrt{\frac{2}{-m} \times 8(-m)}$

≥ 18

So, absolute minimum value of $OA + OB = 18$

(21) **Answer :** (C)

Hint:

Make cases

Solution:

$941111 \to \frac{6!}{4!} = 30$

$661111 \to \frac{6!}{4!2!} = 15$

$236111 \to \frac{6!}{3!} = 120$

$232311 \to \frac{6!}{2!2!2!} = 90$

$922111 \to \frac{6!}{3!2!} = 60$

$433111 \to \frac{6!}{3!2!} = 60$

Total number = 120 + 90 + 60 + 60 + 30 + 15

= 375

Section-II

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

Hint:

$d_1 + d_2 = 0$

Solution:

$\because a_1 = 25$ and $b_1 = 75$

$\because a_{100} + b_{100} = 100$

$\Rightarrow a_1 + 99d_1 + b_1 + 99d_2 = 100$

$\therefore d_1 = -d_2$

Hence, $a_n + b_n = a_1 + (n - 1)d_1 + a_2 + (n - 1)\, d_2$

$= a_1 + a_2 = 100$ and $\sum_{r=1}^{100} (a_r + b_r) = 100 \times 100 = 10000$

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

Hint:

Considering, $4x^2 + pxy - 6y^2 = (y - m_1x)(y + m_2x)$ & $4x^2 + qxy + 6y^2 = \left(y + \frac{1}{m_1}x\right)(y + m_2x)$

Solution:

Considering, $4x^2 + pxy - 6y^2 = (y - m_1x)(y + m_2x)$ & $4x^2 + qxy + 6y^2 = \left(y + \frac{1}{m_1}x\right)(y + m_2x)$

Comparing $m_1m_2 = \frac{4}{6}$ and $\frac{m_2}{m_1} = \frac{4}{6}$

$\Rightarrow\ m_1 = \pm 1,\ \ m_2 = \pm\frac{4}{6}$

Now $\frac{p}{-6} = m_1 + m_2$ and $\frac{q}{6} = \frac{1}{m_1} + m_2$

$\Rightarrow p = 2$ or $p = -2$ and $q = 10$ or $q = -10$

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

Hint:

Select 4 gaps out of 6 gaps

Solution:

For option (A) and (C) Select 4 gaps out of 6 gaps between the balls to create 5 distinct partition

Total ways = ${}^{6}C_4 \times 7!$

For option (B) and (D)

Number of non-negative integral
Solution of the equation $x_1 + x_2 + x_3 + x_4 + x_5 = 7$

Total ⇒ ${}^{11}C_7$

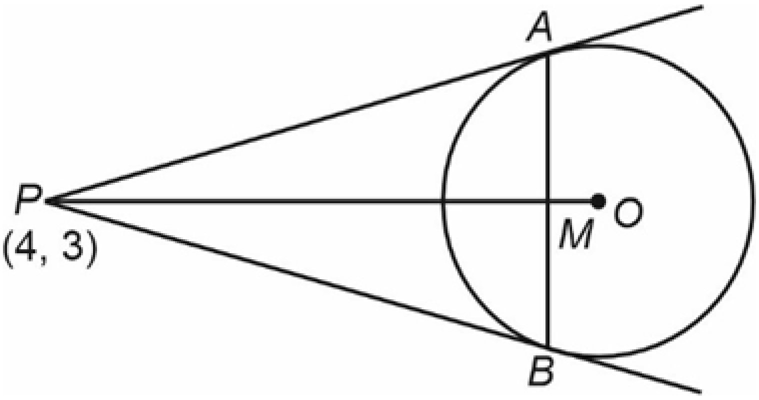
Section-III

(25) **Answer :** 3

Hint:

Equation of chord of contact is $4x + 3y - 9 = 0$

Solution:



Area = $\frac{RL^3}{L^2+R^2}$

= $\frac{192}{25}$

(26) **Answer :** 4

Hint:

Simplifying $f(x)$

Solution:

Simplifying $f(x)$

We get $f(x) = 2\left(x^2 + \frac{1}{x^2}\right)$

Using A.M. ≥ G.M. inequality

⇒ min. value is 4

(27) **Answer :** 35

Hint:

$a = k$, $h = -5$, $b = 12$, $g = \frac{5}{2}$, $f = -8$, $c = -3$

Solution:

$a = k$, $h = -5$, $b = 12$, $g = \frac{5}{2}$, $f = -8$, $c = -3$

$k(12)(-3) + 2(-8)(-5) - \lambda(64) - \left(\frac{25}{4}\right) 12 + 3(25) = 0$

⇒ $100k = 200$

⇒ $k = 2$

So, the equation is $2x^2 - 10xy + 12y^2 + 5x - 16y - 3 = 0$

$(2x - 6y - 1)(x - 2y + 3) = 0$

Here lines are

$2x - 6y = 1$

And $x - 2y = -3$

Solving we get intersection point

as $\left(-10, -\frac{7}{2}\right)$

Product = 35

(28) **Answer :** 40

Hint:

Based on basic concepts

Solution:

$$\sum_{k=1}^{30}\left((k+1)^{2}\ {}^{30}C_k - k^2\ {}^{30}C_{k-1}\right)$$

$= (31)^2\ {}^{30}C_{30} - {}^{30}C_{30}$

= 960

(29) **Answer :** 2

Hint:

$a^3 - b^3 = (a-b)(a^2 + b^2 + ab)$

Solution:

$\frac{a^2+b^2+ab}{a+b} = \frac{a^3-b^3}{a^2-b^2}$

$\frac{4+\sqrt{3}}{1+\sqrt{3}} + \frac{8+\sqrt{15}}{\sqrt{3}+\sqrt{5}} + \frac{12+\sqrt{35}}{\sqrt{5}+\sqrt{7}} + ... = 549\ k$

$\frac{(\sqrt{3})^3-(1)^3}{(\sqrt{3})^2-(1)^2} + \frac{(\sqrt{5})^3-(\sqrt{3})^3}{(\sqrt{5})^2-(\sqrt{3})^2} + ... + \frac{(\sqrt{169})^3-(\sqrt{167})^3}{(\sqrt{169})^2-(\sqrt{167})^2}$

= $\frac{1}{2}\left[\left(\sqrt{169}\right)^3 - 1\right]$

$= \frac{1}{2} \times 2196$

= 1098

⇒ k = 2

(30) **Answer :** 2

Hint:

(4, 4) lies on Director Circle.

Solution:

(4, 4) lies on Director Circle.

Section-IV

(31) **Answer :** 03.00

Hint:

Make cases

Solution:

$a_1 + 4d = 31$ & $2a_1 + 5d = p$(p is prime)

a_1 is prime

⇒ Possible cases $a_1 = 3$, $d = 7$;

$a_1 = 11$, $d = 5$;

$a_1 = 19$, $d = 3$

$\Rightarrow\ S_{100} = \frac{100}{2}[2a + 99d]$

When $a = 3$, $d = 7$

$S_{100} = 34950$

(32) **Answer :** 21.00

Hint:

Make cases

Solution:

$a_1 + 4d = 31$ & $2a_1 + 5d = p$(p is prime)

a_1 is prime

⇒ Possible cases $a_1 = 3$, $d = 7$;

$a_1 = 11$, $d = 5$;

$a_1 = 19$, $d = 3$

$\Rightarrow\ S_{100} = \frac{100}{2}[2a + 99d]$

When $a = 3$, $d = 7$

$S_{100} = 34950$

(33) **Answer :** 10.00

Hint:

Centre $\left(\frac{8-k}{2},\ 0\right)$

Solution:

$(x - 4)^2 + (y - 3)(y + 3) + k(x - 4) = 0$

$x^2 + y^2 - 8x + 16 - 9 + kx - 4k = 0$

$x^2 + y^2 + (k - 8)x - 4k + 7 = 0$

Centre $\left(\frac{8-k}{2},\ 0\right)$

radius $= \sqrt{\frac{k^2+64-16k}{4} + 4k - 7}$

$= \sqrt{\frac{k^2+36}{4}}$

radius $= \frac{\sqrt{k^2+36}}{2}$

$\frac{\sqrt{k^2+36}}{2} = \frac{|5|}{1}$

$\sqrt{k^2+36} = 10$

$k^2 + 36 = 100$

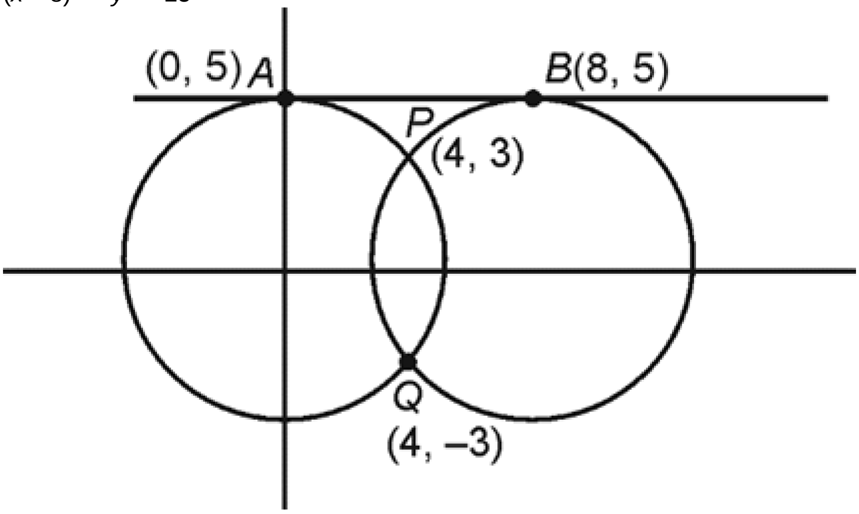
⇒ $k^2 = 64$

$\Rightarrow k = \pm 8$

$S : x^2 + y^2 = 25$

$S' : x^2 + y^2 - 16x + 39 = 0$

$(x - 8)^2 + y^2 = 25$



Midpoint of AB = (4, 5)

Coordinate of $R \equiv (4, 7)$

(34) **Answer :** 28.00

Hint:

Centre $\left(\frac{8-k}{2},\ 0\right)$

Solution:

$(x - 4)^2 + (y - 3)(y + 3) + k(x - 4) = 0$

$x^2 + y^2 - 8x + 16 - 9 + kx - 4k = 0$

$x^2 + y^2 + (k - 8)x - 4k + 7 = 0$

Centre $\left(\frac{8-k}{2},\ 0\right)$

radius $= \sqrt{\frac{k^2+64-16k}{4} + 4k - 7}$

$= \sqrt{\frac{k^2+36}{4}}$

radius $= \frac{\sqrt{k^2+36}}{2}$

$\frac{\sqrt{k^2+36}}{2} = \frac{|5|}{1}$

$\sqrt{k^2+36} = 10$

$k^2 + 36 = 100$

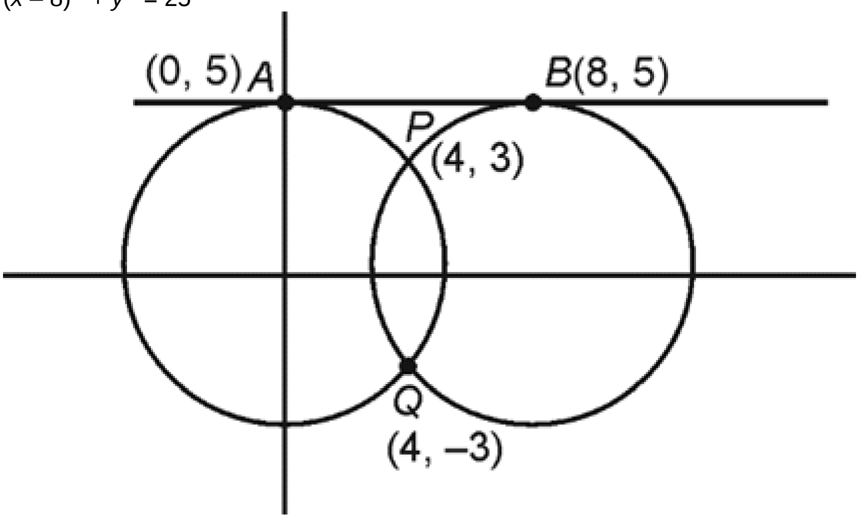
$\Rightarrow k^2 = 64$

$\Rightarrow k = \pm 8$

$S : x^2 + y^2 = 25$

$S' : x^2 + y^2 - 16x + 39 = 0$

$(x - 8)^2 + y^2 = 25$



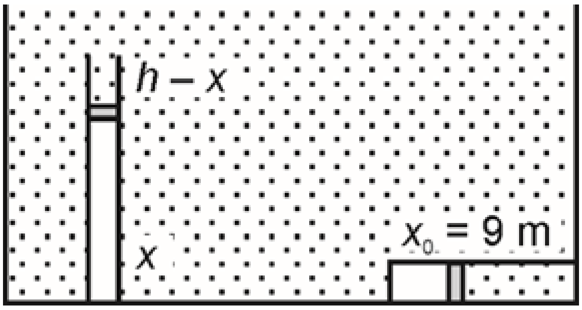
Midpoint of AB = (4, 5)
Coordinate of $R \equiv (4, 7)$

PHYSICS

Section-I

(35) **Answer :** (C)
Hint:
$B = -\frac{dP}{\left(\frac{dV}{V}\right)}$
Solution:
Variation in static pressure $\frac{dP}{dh} = -\rho g$
$B = -\frac{dP}{\left(\frac{dV}{V}\right)}$
Let a sample of fluid having mass M.
Then $V = \frac{M}{\rho}$, $dV = \frac{M}{r^2}\,dr$
Hence $\frac{dV}{V} = \frac{dr}{r}$
$\frac{Bd\rho}{\rho} = \rho g dh$
$$\int_{\rho_0}^{\rho} \frac{d\rho}{\rho^2} = \int_0^h \frac{gdh}{B}, \ \frac{1}{\rho_0} - \frac{1}{\rho} = \frac{gh}{B} \quad \ldots\text{(i)}$$
$dP = -\frac{BdV}{V} = B\frac{d\rho}{\rho}$
$$\int_{P_0}^{P} dP = B\int_{\rho_0}^{\rho} \frac{d\rho}{\rho}$$
$$P - P_0 = B\ln\left(\frac{\rho}{\rho_0}\right) \quad \ldots\text{(ii)}$$
From equation (i),
$1 - \frac{\rho_0}{\rho} = \frac{\rho_0 gh}{B}$
So $\ln\left(\frac{\rho}{\rho_0}\right) = -\ln\left(1 - \frac{\rho_0 gh}{B}\right)$
From equation (ii),
$P - P_0 = -B\ln\left(1 - \frac{\rho_0 gh}{B}\right)$

(36) **Answer :** (A)
Hint:
$P = P_0 + \rho gh$
Solution:
$P_2 = \rho g(h - x)$, $P_1 = \rho gh$
$v_2 = Ax$, $v_2 = Ax_0$



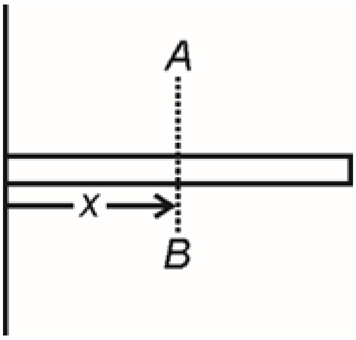
$\rho g(h - x)Ax = \rho gh(Ax_0)$
$x^2 - hx + hx_0 = 0$
x = 10 m, 90 m
$x < l$
x = 10 m

(37) **Answer :** (B)
Hint:

$I = \frac{ML^2}{12}$

Solution:

$I_{AB} = 10L\left[\frac{(L-x)^2}{4}L - \frac{1}{10}\left(L-x\right)L^2 + \frac{1}{60}L^3\right]$



$\frac{dL_{AB}}{dx} = 0$

$x = \frac{4L}{5}$

(38) Answer : (B)

Hint:

$P = \vec{F} \cdot \vec{v}$

Solution:

P = *F*·*v*

$mv\frac{dv}{dt} = kv$

$\frac{v^2}{2} = \frac{k}{m}x$

$v = x^{\frac{1}{2}}$

Section-II

(39) Answer : (A,C)

Hint:

$\Delta x = \frac{\Delta x_1 m_1 + \Delta x_2 m_2}{m_1 + m_2}$

Solution:

$a_C = \frac{F}{2m}$

$\Delta x_C = \frac{1}{2}a_C t^2 = \frac{Ft^2}{4m} = t^2$

$(\Delta x)_C = \frac{m_1 \Delta x_1 + m_2 \Delta x_2}{m_1 + m_2} = \frac{Ft^2}{4m}$

Or, $\Delta x_1 + \Delta x_2 = \frac{Ft^2}{2m}$

Here $\Delta x_2 - \Delta x_1 = x_0$

So, $\Delta x_1 = (\Delta x)_A = \frac{1}{2}\left[\frac{Ft^2}{2m} - x_0\right] = t^2 - 0.5x_0$

$\Delta x_2 = (\Delta x)_B = \frac{1}{2}\left[\frac{Ft^2}{2m} + x_0\right] = t^2 + 0.5x_0$

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

Hint:

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

Solution:

$F = -\frac{\partial U}{dr}$ = $(-2\hat{i} - 4\hat{j})$ N

at t = 0, at (4, 4), P = 24 J, K.E. = 0

Total energy = U + K + 24

and $\vec{a}$ = $(-\hat{i} - 2\hat{j})$ m/s²

To cross x-axis, along y, $4 = \frac{1}{2}a_y t_1^2,\ \ t_1 = 2\ \text{sec}$

To cross y-axis, along x,

$4 = \frac{1}{2}a_x t_2^2,\ \ t_2 = 2\sqrt{2}\ \text{sec}$

Also, crossing the x-axis , coordinates

are $\left(4 - \frac{1}{2}a_x t_1^2,\ 0\right)$ = $(2,\ 0)$

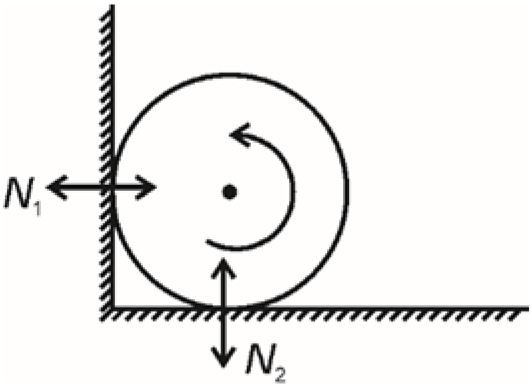
$P = 4$ J, $K =$ 20 J

Similarly for y-axis, $P = -16$ J, $K =$ 40 J

(41) Answer : (A,D)

Hint:

Apply net force and torque.
Solution:
$\mu N_1 + N_2 = mg$
$N_1 = \mu N_2$



$N_1 = \frac{\mu mg}{1+\mu^2}$

and $N_2 = \frac{\mu mg}{1+\mu^2}$

Torque about com

$\mu(N_1 + N_2)R = mR^2\alpha$

$\alpha = \frac{\mu(1+\mu)g}{(1+\mu^2)R}, \quad \tau = \frac{\mu(1+\mu)}{1+\mu^2}mgR$

$\omega^2 = \omega_0^2 - 2\alpha\theta$

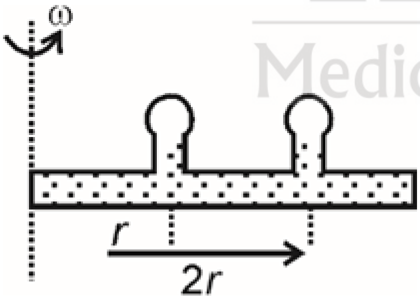
$\theta = \frac{\omega_0^2}{2\alpha} = \frac{\omega_0^2(1+\mu^2)\ R}{2\mu(1+\mu)g}$

Number of rotation

$N = \frac{\omega_0^2 R(1+\mu^2)}{2\mu(1+\mu)g \times 2\pi} = \frac{\omega_0^2(1+\mu^2)R}{4\pi\mu g(1+\mu)}$

Section-III

(42) **Answer :** 3
Hint:
$\Delta P = \frac{1}{2}\rho\omega^2 r^2$
Solution:

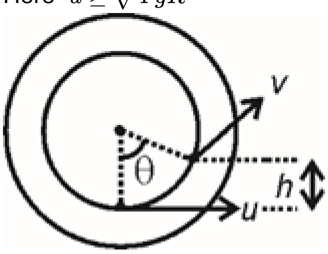


$P_2 - P_1 = \frac{1}{2}\rho\omega^2(r_2^2 - r_1^2)$

$= \frac{3\rho\omega^2 r^2}{2}$

So, $n = 3$

(43) **Answer :** 2
Hint:
Use energy conservation
Solution:
Here $u \geq \sqrt{4\ gR}$



$v^2 = u^2 - 2gh, \quad h = R(1 - \cos\theta)$

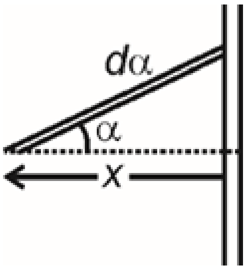
(44) **Answer :** 1

Hint:
$\omega = \frac{d\theta}{dt},\ \ T = \frac{2\pi}{\omega}$
Solution:
$\omega^2 R = R\frac{d\omega}{dt}$
$\omega = \frac{d\theta}{dt} = \frac{\omega_0}{1-\omega_0 t}$
$T = \frac{R}{v_0}(1-e^{-\pi})$

(45) **Answer :** 5
Hint:
Bernoulli's theorem
Solution:
$\Delta P = \frac{1}{2}\rho v^2$
$= \frac{\rho\omega^2 r^2}{2} - \rho g h, \quad h^1 = \frac{v^2}{2g} = \frac{\omega^2 r^2}{2g} - h.$

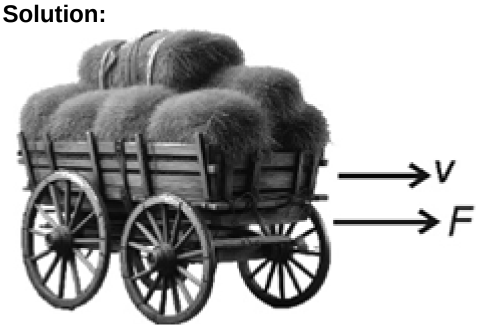
(46) **Answer :** 7
Hint:
$F = \frac{Gm_1m_2}{r^2}$
Solution:
At equilibrium

For rod $dM = \rho \cdot dl = \rho \cdot \frac{x\,d\alpha}{\cos\alpha}$



Centripetal force
$dF = \frac{GmdM}{\left(\frac{x}{\cos\alpha}\right)}\ \cos\alpha$
$F = \frac{2mG\rho}{x}$
Here $K(r) = \frac{2Gm\rho}{9r},\ \ K = \frac{2Gm\rho}{9r^2},\ \ \beta - \alpha = 7$

(47) **Answer :** 4
Hint:
$F = v_r \cdot \frac{dm}{dt}$
Solution:



as $F = V_r \cdot \frac{dm}{dt}$
$m = m_0 - \mu t$
$(m_0 - \mu t)\frac{dv}{dt} = F$
$v = \frac{F}{\mu}\ln\left(\frac{m_0}{m_0-\mu t}\right)$
$8 = F\ln\left(\frac{80}{80-60}\right)$
$F = \frac{4}{\ln(2)},$ so $n = 4$

Section-IV

(48) **Answer :** 08.40
Hint:

$\frac{25\cos\theta}{r} = h\rho g$

Solution:

$\frac{2\times S}{0.2\times10^{-3}} = 6\times10^{-2}\times1400\times10$

10S = 84 × 10^{-2}

$\frac{2S'}{0.2\times10^{-3}}\times\frac{1}{2} = 2.5\times10^{-2}\times1400\times10$

(49) **Answer :** 02.80

Hint:

$\frac{\Delta S}{\Delta T} =$ rate

Solution:

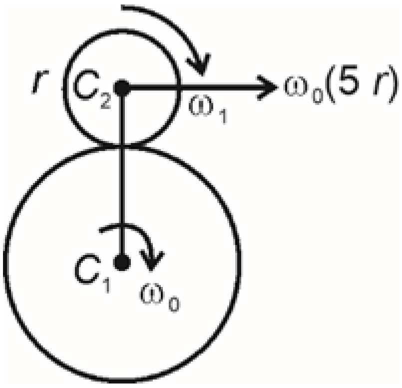
So $\frac{\Delta T}{\Delta\theta} = \frac{T_{50}-T_0}{50-0} = \frac{1.4}{50}\times10^{-2} = 2.8\times10^{-4}$

(50) **Answer :** 75.00

Hint:

K.E. $= \frac{1}{2}mV^2 + \frac{1}{2}I\omega_0^2$

Solution:



$\omega_1 r = \omega_0(5r)$

$\omega_1 = 5\omega_0$

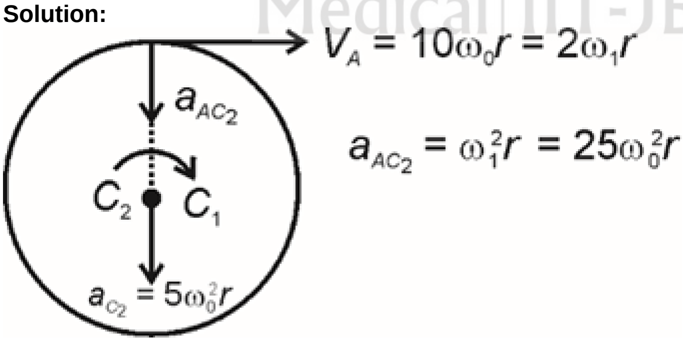
K.E. $= \frac{1}{2}mV^2 + \frac{1}{2}I\omega_0^2 = \frac{75\,m\,\omega_0^2 r^2}{4}$

(51) **Answer :** 10.00

Hint:

$\vec{a}_A = \vec{a}_{AC_2} + \vec{a}_{C_2}$

Solution:



$\vec{a}_A = \vec{a}_{AC_2} + \vec{a}_{C_2}$

$= 30\,\omega_0^2 r$

$= \frac{(10\omega_0 r)^2}{\rho}$

$\rho = \frac{10r}{3}$