07/12/2025

Set-1 (Online)

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Medical|IIT-JEE|Foundations

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MM : 180

AIATS For Two Year JEE(Advanced)-2027 (XI Studying-P2)_Test-1A_Paper-1_ONLINE

Time : 180 Min.

PHYSICS

Section-I

1. (B)

2. (A)

3. (C)

4. (D)

Section-II

5. (B,C)

6. (A,D)

7. (A,B)

Section-III

8. (16)

9. (3)

10. (60)

11. (97)

12. (2)

13. (72)

Section-IV

14. (B)

15. (D)

16. (C)

17. (D)

CHEMISTRY

Section-I

18. (A)

19. (A)

20. (B)

21. (D)

Section-II

22. (B,D)

23. (C,D)

24. (B,C,D)

Section-III

25. (2)

26. (4)

27. (5)

28. (20)

29. (46)

30. (6)

Section-IV

31. (A)

32. (B)

33. (C)

34. (A)

MATHEMATICS

Section-I

35. (A)

36. (A)

37. (A)

38. (B)

Section-II

39. (B,D)

40. (C,D)

41. (B,D)

Section-III

42. (2)

43. (25)

44. (11)

45. (3)

46. (15)

47. (4)

Section-IV

48. (A)

49. (A)

50. (B)

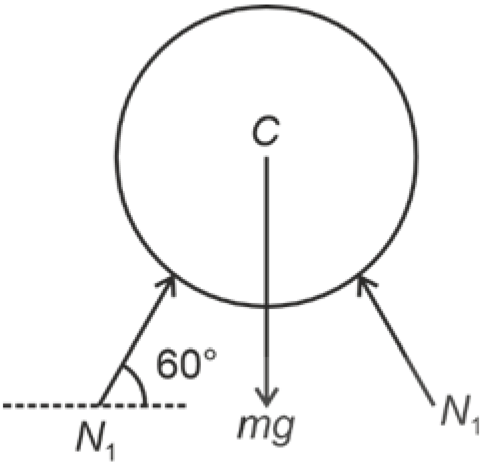
51. (A)

Hints and Solutions

PHYSICS

Section-I

(1) **Answer :** (B)
Hint:
$N_{AB} = 0$
Solution:



$2N_1 \cdot \frac{\sqrt{3}}{2} = mg$

$N_1 = \frac{mg}{\sqrt{3}}$

(2) **Answer :** (A)
Hint:
$S_{rel} = 0$
Solution:

$a_{rel} = \frac{4}{3} - \frac{3}{4} = \frac{7}{12}$ m/s^2

$\frac{45}{8} = -2t + \frac{1}{2} \cdot \frac{7}{12}t^2$

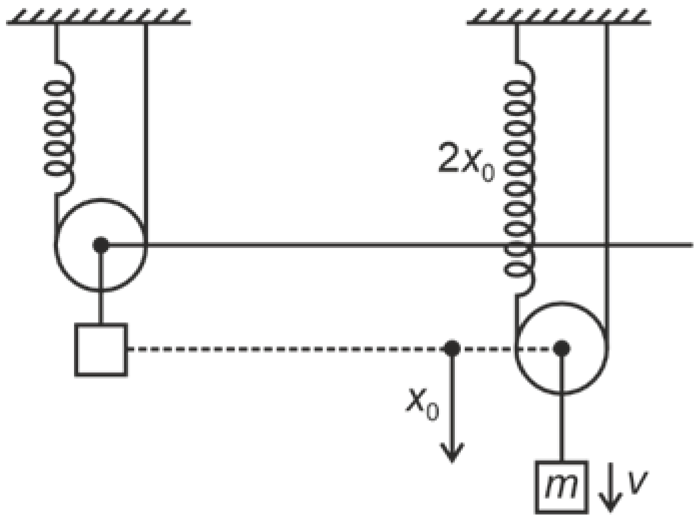
⇒ $t = 9$ sec

(3) **Answer :** (C)
Hint:
Apply pseudo force
Solution:

$T - mg = \frac{mg}{2}$

⇒ $T = 3g$

(4) **Answer :** (D)
Hint:
Work energy theorem
Solution:



$2T = mg$

$2(k2x_0) = mg$

$x_0 = \frac{mg}{4k}$

$\frac{1}{2}mv^2 = mg.\frac{mg}{4k} - \frac{1}{2}k\left(\frac{mg}{2k}\right)^2$

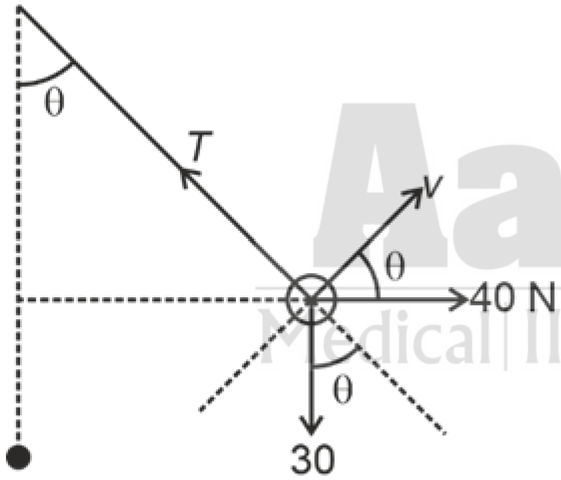
Section-II

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

Hint:

$a_t = 0$

Solution:



v is maximum when

θ = 53°

$10 \cdot l \cdot \sin\theta - 20l(1 - \cos\theta) = \frac{1}{2}mv^2$

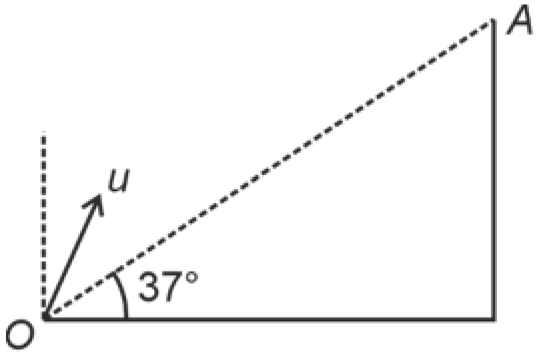
$v = \sqrt{40}$

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

Hint:

$R_{\max} = \frac{u^2}{g(1+\sin\theta)}$

Solution:



OA should maximum range

$25 = \frac{u^2}{g(1+\sin 37^\circ)}$

u = 20 m/s

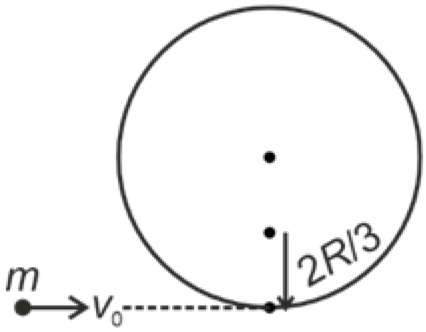
Projected along angle bisector of vertical and *OA* line.

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

Hint:

Angular momentum conservation

Solution:



v : Velocity of combined com

ω : Angular velocity of disc.

$L_i = L_f$

$\frac{mv_0 2R}{3} = \left[m\left(\frac{2R}{3}\right)^2 + \frac{2mR^2}{2} + 2m\left(\frac{R}{3}\right)^2\right]\omega$

$\omega = \frac{2}{5}\ \frac{v_0}{R}$

$P_i = P_F \quad mv_0 = 3mv$

$\boxed{v = \frac{v_0}{3}}$

Speed of particle $= \frac{v_0}{3} + \frac{2}{5}\frac{v_0}{R} \times \frac{2R}{3}$

$= \frac{3v_0}{5}$

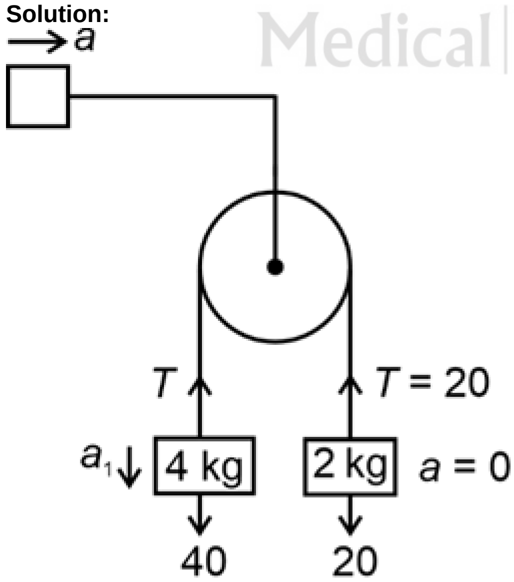
Section-III

(8) **Answer :** 16

Hint:

$a_B = 0$

Solution:



$a_1 = \frac{40-20}{4} = 5$ m/s^2

$a = \frac{a_1}{2} = \frac{5}{2}$

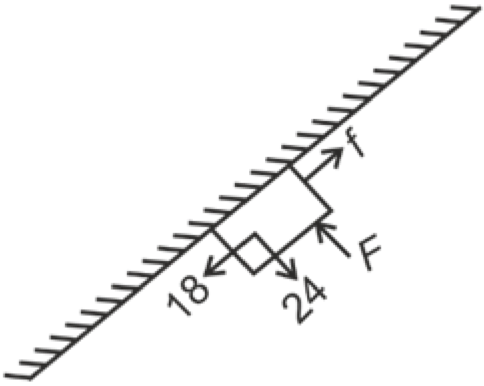
$2\tau = M.\frac{5}{2}$

$2 \times 20 = \frac{5}{2} \times M$

M = 16 kg

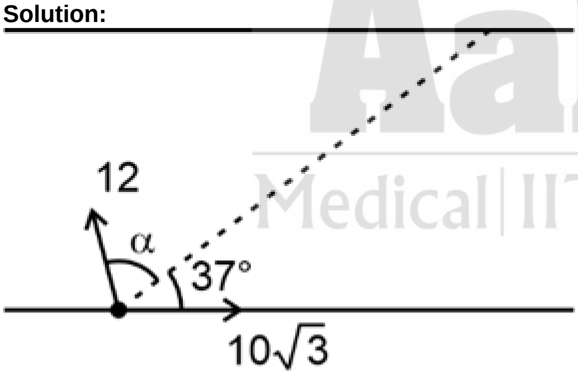
(9) **Answer :** 3
Hint:
$\frac{\Delta A}{A} = \frac{\Delta l}{l} + \frac{\Delta b}{b}$
Solution:
l = 10 ± 0.5 cm
b = 4 ± 0.1 cm
$\frac{\Delta A}{40} = \left[\frac{0.5}{10} + \frac{0.1}{4}\right]$
ΔA = 2 + 1 = 3 cm^2

(10) **Answer :** 60
Hint:
$mg\sin\theta = \mu N$
Solution:



f = 18
$\mu(F - 24) = 18$
$F - 24 = 36$
$F = 60$

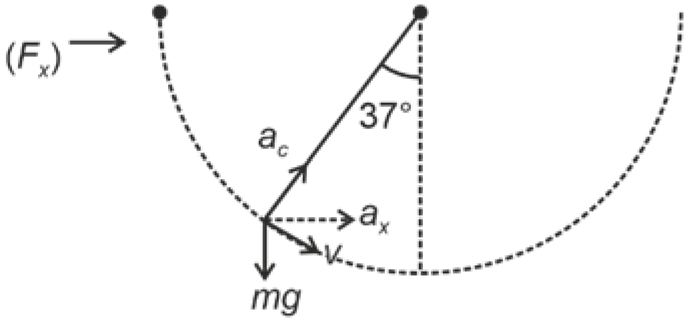
(11) **Answer :** 97
Hint:
V_{net} is parallel to AB.
Solution:



Net velocity must be along Line AB.
$12\sin\alpha = 10\sqrt{3}\sin 37^\circ$
$12\sin\alpha = 10\sqrt{3}\cdot\frac{3}{5}$
$\sin\alpha = \frac{\sqrt{3}}{2}$
$\alpha = 60°$ $\theta = 60^\circ + 37^\circ = 97$

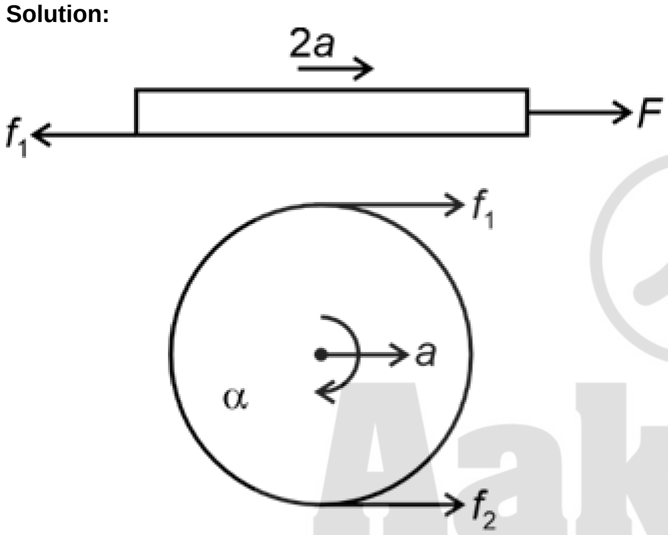
(12) **Answer :** 2
Hint:
$R = \frac{V^2}{a_1}$
Solution:
$\frac{dy}{dt} = \frac{2x dx}{dt} - 6\frac{dx}{dt} \Rightarrow (2x-6)\frac{dx}{dt}$
At $x = 3$ $v_y = 0$ ⇒ $v = v_x$
So $a_1 = a_y$
$\frac{d^2y}{dt^2} = \frac{d^2x}{dt^2}(2x-6) + 2\left(\frac{dx}{dt}\right)^2$
$x = 3$ $a_y = 2v^2$
$ROC = \frac{v^2}{a_1} = \frac{v^2}{2v^2} = \frac{1}{2}$

(13) **Answer :** 72
Hint:
$F = ma$
Solution:



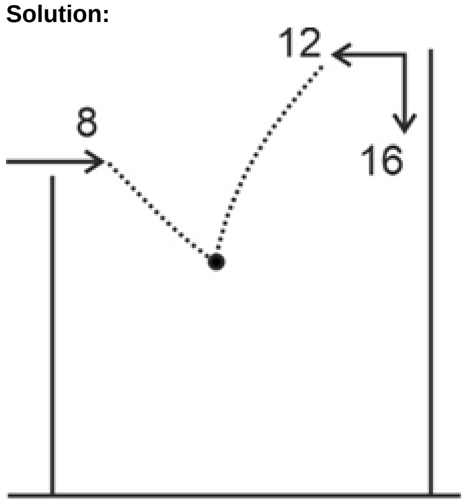
Section-IV

(14) **Answer :** (B)
Hint:
$a = \alpha R$
Solution:



$F - f_1 = 2ma$
$f_1 + f_2 = ma$
$(f_1 - f_2)R = \left(\frac{mR^2}{2}\right)\frac{a}{R}$

(15) **Answer :** (D)
Hint:
Ball will be at same height at that instant.
Solution:



$(S_A)_x + (S_B)_x = 40$
$20t = 40$
$t = 2$ sec.
$(S_y)_A = \frac{1}{2} \times 10 \times 2^2 = 20$ m

Position of A = 30 – 20 = 10 m

$H_{T_2} = 10 + 16 \times 2 + \frac{1}{2} \times 10 \times 2^2$

= 10 + 32 + 20

= 62 m

(16) **Answer :** (C)

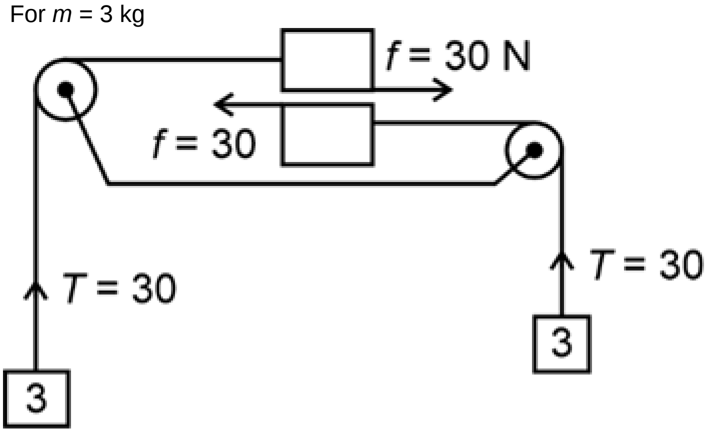
Hint:

Make FBD

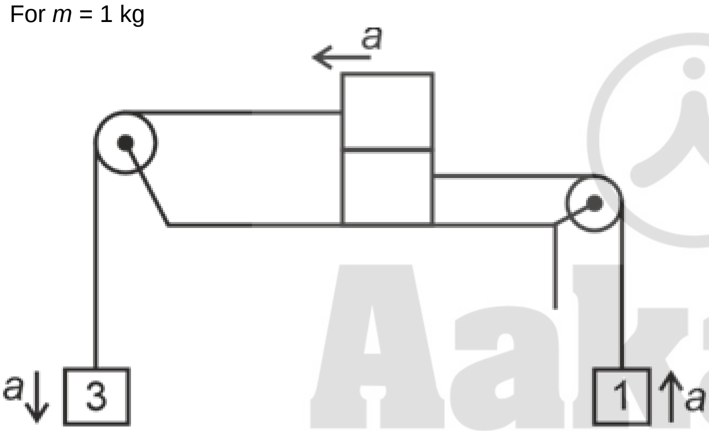
Solution:

Maximum available friction = 32 N

For m = 3 kg



For m = 1 kg



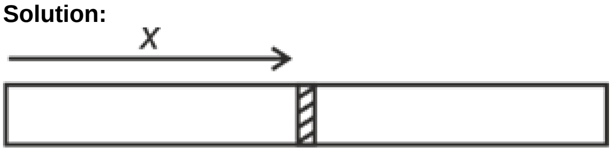
$a = \frac{30-10}{10} = 2$ m/s^2

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

Hint:

$Mg - F_H = Ma_{com}$

Solution:



$x_{com} = \frac{\int_0^L \lambda_0 x dx \cdot x}{\int_0^L \lambda_0 x dx} = \frac{2L}{3}$

$M = \int_0^L \lambda_0 x dx$

$M = \frac{\lambda_0 L^2}{2}$ $\quad I = \int_0^L \lambda_0 x \cdot x^2 dx \cdot = \frac{\lambda_0 L^4}{4}$

$\frac{\lambda_0 L^4}{4} \alpha = \frac{\lambda_0 L^2}{2} \cdot g \cdot \frac{2L}{3}$

$\alpha = \frac{4g}{3L}$

$a_{\text{com}} = \frac{4g}{3L} \cdot \frac{2L}{3} \Rightarrow \frac{8g}{9}$

$Mg - F_H = m.\frac{8g}{9} \Rightarrow F_H = \frac{mg}{9}$

$mg \cdot \frac{2L}{3} = \frac{1}{2} I\omega^2$

$\omega^2 = \frac{8g}{3L}$

CHEMISTRY

Section-I

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

Hint:

H_3PO_2 has only one acidic H.

Solution:

$\underset{(n_f=1)}{H_3PO_2} + NaOH \rightarrow NaH_2PO_2 + H_2O$

Equivalent weight = $\frac{66}{1} = 66$

(19) **Answer :** (A)

Hint:

SF_6 has bond angle of 90°.

Solution:

Bond angle of SF_6 < H_2O < NH_3 < BF_3
(90°) (104.5°) (106.5°) (120°)

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

Hint:

$W_{net} = W_{AB} + W_{BA}$

Solution:

For process A → B

$\int Pdv = \int_3^5 (-V^2 + 8V - 12)dV$

$= \left[\frac{-V^3}{3} + \frac{8V^2}{2} - 12V\right]_3^5$

$= \left[-\frac{125}{3} + 4 \times 25 - 12 \times 5\right] - \left[\frac{-27}{3} + 4 \times 9 - 36\right]$

= –1.67 + 9 = 7.33

$W_{AB} = -\int Pdv$ = –7.33 L-atm

For process B → A

$\int Pdv = \int_5^3 (V^2 - 8V + 18)\, dV$

$= \left[\frac{V^3}{3} - 4V^2 + 18V\right]_5^3$

= [9 – 36 + 54] – $\left[\frac{125}{3} - 100 + 90\right]$

= 27 – 31.67 = –4.67

$W_{BA} = -\int Pdv$ = 4.67 L-atm

So, $W_{net} = W_{AB} + W_{BA}$ = –7.33 + 4.67
= –2.66 L-atm

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

Hint:

$V_n \propto \frac{z}{n}$

Solution:

$V_n \propto \frac{z}{n}$

$\frac{z}{n}$ is maximum for 3^{rd} orbit of Be^{3+} ion in the given options.

Section-II

(22) **Answer :** (B,D)
Hint:
I.E. for fully filled or half filled orbital is high.
Solution:
2^{nd} ionisation enthalpy of : O > F > N > C

(23) **Answer :** (C,D)
Hint:
Solution contain amphiprotic species
Solution:

	H_2CO_3	+ NaOH	→ $NaHCO_3$	+ H_2O
$t_{initial}$	10 mmol	10 mmol	–	–
t_{final}	–	–	10 mmol	

$pH = \frac{6.35 + 10.33}{2} = 8.34$

(24) **Answer :** (B,C,D)
Hint:
Upper curve : Isothermal
Lower curve : Adiabatic
Solution:
XY : Isothermal
XZ : adiabatic
For isothermal : ΔU = 0
For adiabatic : ΔU = W = –ve

Section-III

(25) **Answer :** 2
Hint:
$\frac{1}{\lambda} = RZ^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$
Solution:
For 2^{nd} line of Balmer series : $n_1 = 2$, $n_2 = 4$ for transition from n_2 to n_1.

$\frac{1}{\lambda} = RZ^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\frac{1}{\lambda} = RZ^2 \left[\frac{1}{4} - \frac{1}{16}\right] = RZ^2 \left[\frac{3}{16}\right]$

$\lambda = \frac{16}{3R} \times \frac{1}{Z^2}$

λ : $\frac{4}{3R} = \frac{16}{3R} \times \frac{1}{Z^2}$

$Z^2 = 4$
⇒ Z = 2

(26) **Answer :** 4
Hint:
Nd, Eu, Ce, Gd belongs of *f*-block series
Solution:
Cs : [Xe] $6s^1$ Eu : [Xe] $6s^2$ $4f^7$
Gd : [Xe] $6s^2$ $5d^1$ $4f^7$
Ba : [Xe] $6s^2$ Y : [Kr] $5s^2$ $4d^1$
Ce : [Xe] $6s^2$ $4f^1 5d^1$ Sc : [Ar] $4s^2$ $3d^1$
Nd : [Xe] $6s^2$ $4f^4$ Cr : [Ar] $4s^1$ $3d^5$

(27) **Answer :** 5
Hint:
For reversible isothermal process
$W = -nRT \ln\frac{V_2}{V_1}$
Solution:
$W = -nRT \ln\frac{V_2}{V_1}$
28721 = n × 8.314 × 300 ln $\frac{180}{18}$

n = $\frac{28721}{8.314\times300\times2.303\ \log 10}$ = 5

(28) **Answer :** 20
Hint:
Equal moles of H^+ and OH^- are reacted.
Solution:
$[H^+]_{new} = \frac{0.2+0.1\times2}{2}$ = 0.2 M
Moles of NaOH reacted = V × 0.1 = 0.2 × 50
⇒ V = 100 mL
$\frac{V}{5} = 20$

(29) **Answer :** 46
Hint:
Mass % of N = $\frac{mass\ of\ N}{mass\ of\ compound} \times 100$
Solution:
Molar mass of guanine = 151
% N = $\frac{14\times5}{151}\times100$ = 46.357%

(30) **Answer :** 6
Hint:
B.O. = $\frac{N_b - N_a}{2}$
Solution:
B_2, C_2, C_2^- , B_2^- , N_2, O_2^+ , F_2^- , O_2^-
B.O.: 1 2 2.5 1.5 3 2.5 0.5 1.5

Section-IV

(31) **Answer :** (A)
Hint:
sp^3 : tetrahedral
Solution:

SO_3	: sp^2 : triangular planar	XeF_4	: sp^3d^2 : square planar
I_3^-	: sp^3d : linear	$SOCl_2$	: sp^3 : pyramidal

(32) **Answer :** (B)
Hint:
Bohr's model : $2\pi r_n = \frac{nh}{2\pi}$
Solution:
Potential Energy $\propto \frac{1}{n^2}$ (magnitude)
Velocity of $e^{\ominus}$ $\propto \frac{1}{n}$
Number of revolutions per sec $\propto \frac{1}{n^3}$
Bohr's radius ∝ n^2

(33) **Answer :** (C)
Hint:
Addition of inert gas at constant volume, does not shift equilibrium.
Solution:
In $\Delta n_g > 0$, on increasing volume, reaction moves in forward direction and vice versa. For endothermic process on increasing temperature reaction moves in forward direction.

(34) **Answer :** (A)
Hint:
Bigger size smaller ionisation energy
Solution:
F : Most electronegative element
Cs : Lowest Ionisation Enthalpy
He : Highest Ionisation Enthalpy
Fe : d-block metal

MATHEMATICS

Section-I

(35) **Answer :** (A)
Hint:
$y_{\text{min}} = \frac{-1}{4}$ and $y_{\text{max}} = 2$
Solution:
Let $y = x^2 - 3x + 2 = \left(x - \frac{3}{2}\right)^2 - \frac{1}{4}$. Then $y_{\text{min}} = \frac{-1}{4}$ and $y_{\text{max}} = 2$ as $x = \frac{3}{2}$ and $x = 0$ respectively. Therefore

$\frac{1}{8}\left(2a - a^2\right) \leq -\frac{1}{4},\ 2 \leq 3 - a^2,$

$a^2 - 2a - 2 \geq 0,\ a^2 \leq 1,$

$|a - 1| \geq \sqrt{3},\ |a| \leq 1,$

thus, the range of a is $\left\{\left\{a \leq 1 - \sqrt{3}\right\} \cup \left\{a \geq 1 + \sqrt{3}\right\}\right\} \cap \left\{-1 \leq a \leq \quad 1\right\} = \left\{-1 \leq a \leq 1 - \sqrt{3}\right\}$.

(36) **Answer :** (A)
Hint:
$\{x + n\} = \{x\}$, if $n \in I$
Solution:
Here, $f(x) = \{x\} + \{x\} + \ldots$ to 10 terms $= 10\{x\}$, since $\{x + [x]\} = \{x\}$

$\therefore\ f\left(\sqrt{2}\right) = 10\left\{\sqrt{2}\right\} = 10\left\{1.414\right\}$

$= 10 \times 0.414 = \frac{10 \times 414}{1000} = \frac{414}{100} = 4.14$

$\Rightarrow\ \left[f\left(\sqrt{2}\right)\right] = 4$

(37) **Answer :** (A)
Hint:
$f(x) = 3\left(\left(\cos^2 x - \frac{1}{2}\right)^2 + \frac{1}{12}\right)$
Solution:
$f(x) = \sin^6 x + \cos^6 x$

$= 1 - 3\cos^2 x(1 - \cos^2 x)$

$= 3\left(\cos^4 x - \cos^2 x + \frac{1}{3}\right)$

$= 3\left(\left(\cos^2 x - \frac{1}{2}\right)^2 + \frac{1}{12}\right)$

Least value of $f(x)$ is $\frac{1}{4}$, when $\cos^2 x - \frac{1}{2} = 0$

Greatest value of $f(x)$ is 1, when $\cos^2 x = 0$ or 1

Range is $\left[\frac{1}{4},\ 1\right]$

(38) **Answer :** (B)
Hint:
8 M, 6 W + 9 W, 5 W + 10 M, 4 W
Solution:
8 M, 6 W + 9 W, 5 W + 10 M, 4 W

${}^{10}C_8 \cdot {}^{10}C_6 + {}^{10}C_9 \cdot {}^{10}C_5 + {}^{10}C_{10} \cdot {}^{10}C_4$

= 9450 + 2520 + 210

= 12180

Section-II

(39) **Answer :** (B,D)
Hint:
$b^2 = ac$
Solution:
$\log a, \log b, \log c$ are in A.P.

$\Rightarrow\ 2\log b = \log a + \log c$

$\therefore\ b^2 = ac \qquad \ldots(1)$

$\Rightarrow$ a, b, c are in G.P. $\Rightarrow$ (B)

also given $(\log a - \log 2b), (\log 2b - \log 3c), (\log 3c - \log a)$ are in A.P.

$\Rightarrow\ 2(\log 2b - \log 3c) = \log 3c - \log 2b$
$\Rightarrow\ 3\log 2b = 3\log 3c$
$\therefore\ 2b = 3c \Rightarrow 4b^2 = 9c^2 \qquad \ldots(2)$
from (1) and (2)
$4ac = 9c^2 \Rightarrow a = \frac{9c}{4}$ and $b = \frac{3c}{2}$

$a = \frac{9c}{4}; b = \frac{3c}{2}$ and $c = c$ $\therefore$ a, b, c forms the sides of triangle $\Rightarrow$ (D)
$a + b > c;\ b + c > a;\ c + a > b$
but $a, 2b$ and $3c$ are not in H.P.
similarly verify (A)

(40) Answer : (C,D)
Hint:
Let $z = x + iy$
Solution:
Let $z = x + iy$ from 2^{nd} equation $x = 6$ put in (1)
$3|(x-12) + yi| = 5|x + (y-8)i|$
$9\left[36 + y^2\right] = 25\left[36 + (y-8)^2\right]$ (substituting $x = 6$)
$9 \cdot 36 + 9y^2 = 25 \cdot 36 + 25\left[y^2 + 64 - 16y\right]$
$16y^2 - 25 \cdot 16y + 36 \cdot 16 + 25 \cdot 64 = 0$
$y^2 - 25y + 36 + 100 = 0$
$y^2 - 25y + 136 = 0$
$(y-17)(y-8) = 0$
then $y = 17$ or $y = 8$

(41) Answer : (B,D)
Hint:
Let $a_2 = x$ then for $n = 3,\ a_3 = \frac{x^2}{2}$
Solution:
Given $a_1 = 2;\ \frac{a_n}{a_{n-1}} = \frac{a_{n-1}}{a_{n-2}} \Rightarrow a_1, a_2, a_3, a_4, a_5, \ldots\ldots$ in G.P.
Let $a_2 = x$ then for $n = 3$ we have
$\frac{a_3}{a_2} = \frac{a_2}{a_1} \Rightarrow a_2^2 = a_1 a_3 \Rightarrow a_3 = \frac{x^2}{2}$
i.e. $2, x, \frac{x^2}{2}, \frac{x^3}{4}, \frac{x^4}{8}$, with common ratio $r = \frac{x}{2}$
given $\frac{x^4}{8} \le 162 \Rightarrow x^4 \le 1296 \Rightarrow x \le 6$
Also x and $\frac{x^4}{8}$ are integers $\Rightarrow x$ must be even then only $\frac{x^4}{8}$ will be an integer. Hence possible values of x is 4 and 6. ($x \ne 2$ as terms are distinct)
hence possible value of $a_5 = \frac{x^4}{8}$ is $\frac{4^4}{8}, \frac{6^4}{8}$
$32, 162 \Rightarrow$ B, D

Section-III

(42) Answer : 2
Hint:
$D \ge 0$
Solution:
$D \ge 0$ implies that
$(2a+b)^2 - 4\left(2a^2 + b^2 - b + \frac{1}{2}\right) \ge 0$
$4a^2 + 3b^2 - 4ab - 4b + 2 \le 0$
$(2a-b)^2 + 2(b-1)^2 \le 0,\ \therefore a = \frac{1}{2}, b = 1$

(43) Answer : 25
Hint:
$\because a_1, a_2, a_3 \ldots. a_{15}$ are in A.P.
Solution:
$\because a_1, a_2, a_3 \ldots. a_{15}$ are in A.P.
$\Rightarrow a_1 + a_{15} = a_2 + a_{14} = \ldots.. = 2a_8$
$\Rightarrow a_1 + a_{15} + a_8 = \frac{3}{2}(a_1 + a_{15}) = 15$
$\Rightarrow a_1 + a_{15} = 10$

$\Rightarrow a_2 + a_3 + a_8 + a_{13} + a_{14} = 2\left(a_1 + a_{15}\right) + a_8$
= 2 × 10 + 5 = 25

(44) **Answer :** 11
Hint:
Let $x = \tan\alpha, y = \tan\beta$ and $z = \tan\gamma$
Solution:
Let $x = \tan\alpha, y = \tan\beta$ and $z = \tan\gamma$. Then

$$\frac{xy+yz+zx}{xyz} = -\frac{4}{5} \quad \ldots(i)$$
$$x+y+z = \frac{17}{6} \quad \ldots(ii)$$
$$\frac{x+y+z}{xyz} = -\frac{17}{5} \quad \ldots(iii)$$

(ii) $\div$ (iii) gives $xyz = -\frac{5}{6}$, then $xy + yz + zx = \frac{2}{3}$. Thus

$$\tan\left(\alpha+\beta+\gamma\right) = \frac{\tan(\alpha+\beta)+\tan\gamma}{1-\tan(\alpha+\beta)\tan\gamma}$$
$$= \frac{\left(\tan\alpha+\tan\beta+\tan\gamma-\tan\alpha\tan\beta\tan\gamma\right)/\left(1-\tan\alpha\tan\beta\right)}{\left(1-\tan\alpha\tan\beta-\tan\alpha\tan\gamma-\tan\beta\tan\gamma\right)/\left(1-\tan\alpha\tan\beta\right)}$$
$$= \frac{x+y+z-xyz}{1-(xy+yz+zx)} = \frac{(17/6)+(5/6)}{1-(2/3)} = 11$$

(45) **Answer :** 3
Hint:
$|z_1 + z_2|^2 = |z_3|^2$
Solution:
Sol.: $\because \quad |z_1 + z_2|^2 = \left|z_3\right|^2$
$\Rightarrow \quad \left|z_1\right|^2 + \left|z_2\right|^2 + z_1\bar{z}_2 + \bar{z}_1 z_2 = \left|z_3\right|^2$
$\Rightarrow z_1\bar{z}_2 + \bar{z}_1 z_2 = 0$
$\Rightarrow z_1\bar{z}_2$ is purely imaginary
$\Rightarrow \quad \frac{z_1}{z_2}$ is purely imaginary
$\Rightarrow \quad \left|\arg\left(\frac{z_1}{z_2}\right)\right| = \frac{\pi}{2}$

(46) **Answer :** 15
Hint:
There will be three cases
Case I: 4 Different letter
Case II: 2 Alike, 2 different
Case III: 2 Alike, 2 Alike
Solution:
There will be three cases
Case I: 4 Different letter
Case II: 2 Alike, 2 different
Case III: 2 Alike, 2 Alike

Case I: 4 Different words
= ${}^8C_4(4!) = 1680$
Case II: 2 Different and 2 Alike
= ${}^4C_1 \cdot {}^7C_2 \times \frac{4!}{2!}$
= 1008
Case III: 2 Alike and 2 Alike
= ${}^4C_2 \times \frac{4!}{2!2!}$
= 6(6)
= 36
Total number of words = 36 + 1680 + 1008
= 2724

(47) **Answer :** 4
Hint:

$\sin 2\theta = \frac{2\tan\theta}{1+\tan^2\theta}$

Solution:

$5 \cdot \frac{2\tan\beta}{1+\tan^2\beta} = 3 \cdot \frac{2\tan\alpha}{1+\tan^2\alpha}$

$\therefore \quad \frac{5\tan\beta}{1+\tan^2\beta} = \frac{3\tan\alpha}{1+\tan^2\alpha}$

substituting $\tan\beta = 3\tan\alpha$

$\frac{5\cdot 3\tan\alpha}{1+9\tan^2\alpha} = \frac{3\tan\alpha}{1+\tan^2\alpha}$

$5+5\tan^2\alpha = 1+9\tan^2\alpha$

$4\tan^2\alpha = 4 \Rightarrow \tan\alpha = 1$

$\therefore \quad \tan\beta = 3$

$\therefore \quad \tan\alpha + \tan\beta = 4$

Section-IV

(48) Answer : (A)

Hint:

$\alpha^2 - 3\alpha + 4 = 0$, $\beta^2 - 3\beta + 4 = 0$

Solution:

$\alpha + \beta = 3$, $\alpha\beta = 4$

$\alpha^2 - 3\alpha + 4 = 0$, $\beta^2 - 3\beta + 4 = 0$

$\Rightarrow \alpha^2 + \beta^2 = 3(\alpha + \beta) - 8 = 1$

$\alpha^3 - 3\alpha^2 + 4\alpha = 0$, $\beta^3 - 3\beta^2 + 4\beta = 0$

$\Rightarrow \alpha^3 + \beta^3 = 3(\alpha^2 + \beta^2) - 4(\alpha + \beta) = -9$

$\alpha^4 - 3\alpha^3 + 4\alpha^2 = 0$, $\beta^4 - 3\beta^3 + 4\beta^2 = 0$

$\Rightarrow \alpha^4 + \beta^4 = 3(\alpha^3 + \beta^3) - 4(\alpha^2 + \beta^2) = -31$

$\alpha^5 - 3\alpha^4 + 4\alpha^3 = 0$, $\beta^5 - 3\beta^4 + 4\beta^3 = 0$

$\Rightarrow \alpha^5 + \beta^5 = 3(\alpha^4 + \beta^4) - 4(\alpha^3 + \beta^3) = -57$

(49) Answer : (A)

Hint:

Trigonometric ratio

Solution:

$1 + \sin x \geq 0$

$1 + \cos x \geq 0$

$\Rightarrow (1 + \sin x)(1 + \cos x) \geq 0$

(R) $\frac{4\left(2\sin 50^\circ \cdot \sin 40^\circ\right)\sin 10^\circ}{\sin 10^\circ \cdot \cos 10^\circ} = \frac{4\left(\cos 10^\circ - \cos 90^\circ\right)\sin 10^\circ}{\sin 10^\circ \cdot \cos 10^\circ} = 4$

(S) Use Numerator $\left(\sin^2 t + \cos^2 t\right)^2 - 2\sin^2 t\cos^2 t - 1 = -2\sin^2 t\cos^2 t$ Denominator $\left(\sin^2 t + \cos^2 t\right)^3 - 3\sin^2 t\cos^2 t - 1 = -3\sin^2 t\cos^2 t]$

(50) Answer : (B)

Hint:

Here $A = \{2, 3\}$ and $B = \{-3, -2, -1, 0, 1, 2, 3\}$

Solution:

Here $A = \{2, 3\}$ and $B = \{-3, -2, -1, 0, 1, 2, 3\}$

And $A \cup B = B$

$A \cap B = \{2, 3\}$

$B - A = \{-3, -2, -1, 0, 1\}$

Number of subsets of $A \cup B = 2^7 = 128$

$n(P(A \cap B)) = 2^2 = 4$

(51) Answer : (A)

Hint:

Replacement property

Solution:

(P) $f(2-x) = \frac{5^{2-x}}{5^{2-x}+5} = \frac{5}{5+5^x}$

So $f(x) + f(2-x) = 1$

$\sum_{r=1}^{39} f\left(\frac{r}{20}\right) = \sum_{r=1}^{19}\left(f\left(\frac{r}{20}\right)+f\left(2-\frac{r}{20}\right)\right)+f(1)$

$= 19+\frac{1}{2}=\frac{39}{2}$

(Q) $f(x)=\frac{2e^{2x}}{e^{2x}+e}$ and $f(1-x)=\frac{2e^{2-2x}}{e^{2-2x}+e^{1}}$

$\therefore\ \frac{f(x)+f(1-x)}{2}=1$ i.e. $f(x)+f(1-x)=2$

$\therefore f\left(\frac{1}{100}\right)+f\left(\frac{2}{100}\right)+\ldots.+f\left(\frac{99}{100}\right) = \sum_{x=1}^{49} f\left(\frac{x}{100}\right)+f\left(1-\frac{x}{100}\right)+f\left(\frac{1}{2}\right)$

$=49\times 2+1=99$

(R) $f(x)=\frac{42^{x}+16}{2.2^{2x}+16.2^{x}+32}$

$f(x)=\frac{2(2^{x}+4)}{2^{2x}+8.2^{x}+16}$

$f(x)=\frac{2}{2^{x}+4}$

$f(4-x)=\frac{2^{x}}{2(2^{x}+4)}$

$f(x)+f(4-x)=\frac{1}{2}$

So, $f\left(\frac{1}{15}\right)+f\left(\frac{59}{15}\right)=\frac{1}{2}$

Similarly $=f\left(\frac{29}{15}\right)+f\left(\frac{31}{15}\right)=\frac{1}{2}$

$f\left(\frac{30}{15}\right)=f(2)=\frac{2}{2^{2}+4}=\frac{2}{8}=\frac{1}{4}$

$\Rightarrow 8\left(29\times\frac{1}{2}+\frac{1}{4}\right)=118$

(S) $f(x)=\frac{2^{x}}{2^{x}+\sqrt{2}}$ $f(x)+f(1-x)=\frac{2^{x}}{2^{x}+\sqrt{2}}+\frac{2^{1-x}}{2^{1-x}+\sqrt{2}}$

$=\frac{2^{x}}{2^{x}+\sqrt{2}}+\frac{2}{2+\sqrt{2}2^{x}}=\frac{2^{x}+\sqrt{2}}{2^{x}+\sqrt{2}}=1$

Now, $\sum_{k=1}^{81} f\left(\frac{k}{82}\right)=f\left(\frac{1}{82}\right)+f\left(\frac{2}{82}\right)+\ldots\ldots+f\left(\frac{81}{82}\right)$

$=f\left(\frac{1}{82}\right)+f\left(\frac{1}{82}\right)+\ldots\ldots.+f\left(1-\frac{2}{82}\right)+f\left(1-\frac{1}{82}\right)$ $\left[f\left(\frac{1}{82}\right)+f\left(1-\frac{1}{82}\right)\right]+\left[f\left(\frac{2}{82}\right)+f\left(1-\frac{2}{82}\right)\right]+\ldots.40$ cases $+f\left(\frac{41}{82}\right)$

$(1+1+\ldots..+1)40$ times $+\frac{2^{1/2}}{2^{1/2}+2^{1/2}}$

$40+\frac{1}{2}=\frac{81}{2}$