MOTION IIT-JEE

(Where Faith Counts the Success)

# TARGET IIT-JEE

## HINT & SOLUTIONS

### ANSWER KEY WITH SOLUTION

### PAPER-I CLASS XI (DATE 26-01-10)

## MATHEMATICS

*SECTION - I*

**1.** B **2.** C **3.** C **4.** A **5.** A **6.** D **7.** A **8.** C

*SECTION - II*

**1.** A,C,D **2.** A,B,C,D **3.** A, D **4.** A, B, C, D

*SECTION - III*

**1.** B **2.** D **3.** A **4.** B **5.** C **6.** A

*SECTION - IV*

**1.** (A) $\rightarrow$ (R), (B) $\rightarrow$ (S), (C) $\rightarrow$ (P), (D) $\rightarrow$ (Q) **2.** (A) $\rightarrow$ (P, S) ; (B) $\rightarrow$ (P, R); (C) $\rightarrow$ (P); (D) $\rightarrow$ (P)

## PHYSICS

*SECTION - I*

**1.** D **2.** C **3.** D **4.** A **5.** B **6.** C **7.** D **8.** C

SECTION - II

**1.** A,C **2.** B,C **3.** A,C **4.** A,B,C

SECTION - III

**1.** D **2.** D **3.** A **4.** C **5.** C **6.** B

*SECTION - IV*

**1.** A $\rightarrow$ T ; B $\rightarrow$ R, ; C $\rightarrow$ P,S ; D $\rightarrow$ Q,R,T **2.** A $\rightarrow$ P,Q,S ; B $\rightarrow$ R, ; C $\rightarrow$ P,Q ; D $\rightarrow$ P,Q

## CHEMISTRY

*SECTION - I*

**1.** A **2.** C **3.** A **4.** A **5.** A **6.** B **7.** A **8.** A

*SECTION - II*

**1.** B,D **2.** B, C, D **3.** A, B, D **4.** A,B,D

*SECTION - III*

**1.** B **2.** D **3.** A **4.** C **5.** A **6.** B

SECTION - IV

**1.** (A) $\rightarrow$ P,R,S ; (B) $\rightarrow$ P,R,S; (C) $\rightarrow$ P, S; (D) $\rightarrow$ Q, T **2.** (A) $\rightarrow$ R ; (B) $\rightarrow$ Q ; (C) $\rightarrow$ S ; (D) $\rightarrow$ P,T

# SOLUTIONS

## MATHEMATICS

### *SECTION - I*

**1.** **B**

The point B is (2, 1)

image of A(1, 2) in the line x – 2y + 1 = 0 is given by

$$\frac{x-1}{1} = \frac{y-2}{-2} = \frac{4}{5}$$

$\therefore$ coordinates of the point are $\left(\frac{9}{5}, \frac{2}{5}\right)$

Since this point lies on BC.

$\therefore$ equation of BC is 3x – y – 5 = 0

$\therefore$ a + b = 2

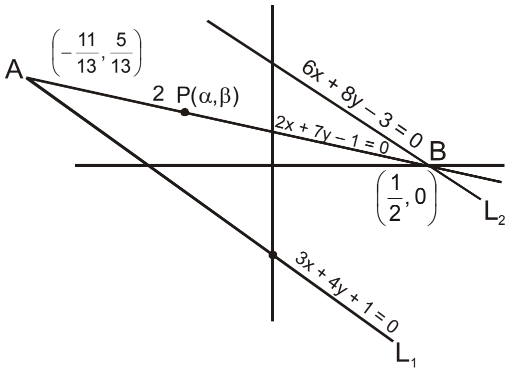
**2.** **C**

Number of quadrilaterals = (total number of quadrilaterals) – (choosing 3 points from m and 1 from remaining points) – (choosing 4 points from m points)

$= {}^{n}C_4 - {}^{m}C_3\,({}^{n-m}C_1) - {}^{m}C_4$

**3.** **C**

AP : PB = 2 : 1




$$\alpha = \frac{2\times\frac{1}{2} + 1\times -\frac{11}{13}}{2+1} = -\frac{2}{39}$$

$$\beta = \frac{2\times 0 + 1\times\frac{5}{13}}{2+1} = \frac{5}{39}$$

$\therefore$ Required line $y - \frac{5}{39} = -\frac{3}{4}\left(x - \frac{2}{39}\right)$

$$9x + 12y - 2 = 0$$

**4.** **A**

For length, number of choices is

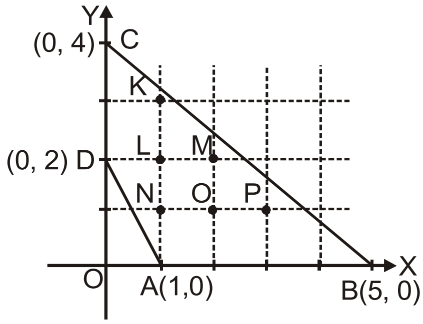
(2m – 1) + (2m – 3) + ........ + 3 + 1 = $m^2$

Similarly for breadth number of choices is

(2n – 1) + 2n – 3) + .......... + 3 + 1 = $n^2$

Hence, required number of choices is $m^2n^2$

**5.** **A**




six point K,L,M,N,O,P

**6.** **D**

Bell A ring after 2, 4, 6, 8, .............. 480 min.

Bell B ring after 5, 10, 15, 20, ............ 480 min.

Bell C ring after 6, 12, 18, 24, ............ 480 min.

Bell D ring after 8, 16, 24, 32, ............. 480 min.

Now LCM of 2, 5, 6, 8 = 120

So bells ring simultaneously after 120, 240, 360, 480 min.

No. of times = 4

**7.** **A**

ar(quad. ABDC) = ar($\Delta$ABC) + ar($\Delta$CBD) =

$$\frac{1}{2}\begin{vmatrix} 2 & 1 & 1 \\ 8 & 1 & 1 \\ 4 & 3 & 1 \end{vmatrix} + \frac{1}{2}\begin{vmatrix} 4 & 3 & 1 \\ 8 & 1 & 1 \\ 6 & 6 & 1 \end{vmatrix} = 14 \text{ sq.units}$$

**8.** **C**

Solving $y = m_r x$ and x + y = 1, we get $x = \frac{1}{1+m_r}$,

$y = \frac{m_r}{1+m_r}$. Thus, the points of intersection of the three lines on the transversal are

$$\left(\frac{1}{1+m_1}, \frac{m_1}{1+m_1}\right), \left(\frac{1}{1+m_2}, \frac{m_2}{1+m_2}\right) \text{ and } \left(\frac{1}{1+m_3}, \frac{m_3}{1+m_3}\right)$$

By hypothesis,

$$\left(\frac{1}{1+m_1} - \frac{1}{1+m_2}\right)^2 + \left(\frac{m_1}{1+m_1} - \frac{m_2}{1+m_2}\right)^2$$

$$= \left(\frac{1}{1+m_2} - \frac{1}{1+m_3}\right)^2 + \left(\frac{m_2}{1+m_2} - \frac{m_3}{1+m_3}\right)^2$$

$$\Rightarrow \quad \frac{m_2 - m_1}{1+m_1} = \frac{m_3 - m_2}{1+m_3} \text{ or } \frac{1+m_2}{1+m_1} - 1$$

$$= 1 - \frac{1+m_2}{1+m_3}$$

$\Rightarrow \quad \frac{1+m_2}{1+m_1} + \frac{1+m_2}{1+m_3} = 2$

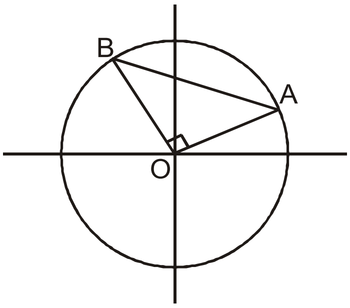
$\Rightarrow \quad 1 + m_1,\ 1 + m_2,\ 1 + m_3$ are in HP.

### *SECTION - II*

**1.** **A, C, D**

$|\beta - \alpha| = 90^\circ$

$\left|\frac{\beta - \alpha}{2}\right| = 45^\circ$




**2.** **A, B, C, D**

$\because$ Given lines are perpendicular and intersect at $\left(\frac{6}{5}, \frac{13}{5}\right)$

Equations of angle bisectors of the given lines are

$x + 3y = 0$ and $3x - y = 1$

Third side (Let BC) will be parallel to these bisectors.

Let AD = a $\Rightarrow$ AB = $a\sqrt{2}$

$\because$ Area of $\Delta$ABC = 10

$\Rightarrow \quad \frac{1}{2}(a\sqrt{2})^2 = 10$

$\Rightarrow \quad a = \sqrt{10}$

let the equation of BC is $x + 3y = k$

$\therefore \quad \left|\frac{\frac{6}{5} + \frac{39}{5} - k}{\sqrt{1+9}}\right| = \sqrt{10} \Rightarrow k = -1, 19$

Thus equation of BC is $x + 3y + 1 = 0$ or $x + 3y - 19 = 0$

If the equation of BC is $3x - y = k_1$

$\therefore \quad \left|\frac{\frac{18}{5} - \frac{13}{5} - k_1}{\sqrt{10}}\right| = \sqrt{10} \Rightarrow k_1 = -9, 11$

Hence equation of BC is $3x - y + 9 = 0$ or $3x - y - 11 = 0$

**3.** **A, D**

Number of selections of 7 digits out of the digit 1, 2, 3, ........., 9 = $^9C_7$

Number of digits out of these 7 selected digits excluding. the greatest digit = 6

having 3 digits = $\frac{6!}{3!\,3!\,2!} = {}^6C_3 \times \frac{1}{2!}$

But the 3 digits on one side can go on the other side

$\therefore$ Required number of ways = $^9C_7 \cdot {}^6C_3 \cdot \frac{1}{2!} \cdot 2! = {}^9C_7 \cdot {}^6C_3 = {}^9C_2 \cdot {}^6C_3$

**4.** **A, B, C, D**

Let the slope of u = 0 be m then the slope of v = 0 is $\frac{9m}{2}$

$\therefore \quad \frac{7}{9} = \left|\frac{m - \frac{9m}{2}}{1 + m.\frac{9m}{2}}\right| = \left|\frac{-7m}{2+9m^2}\right|$

i.e. $\quad 9m^2 - 9m + 2 = 0$

or $\quad 9m^2 + 9m + 2 = 0$

$m = \frac{9 \pm \sqrt{81-72}}{18} = \frac{9 \pm 3}{18} = \frac{2}{3}, \frac{1}{3}$ or

$m = \frac{-9 \pm 3}{18} = -\frac{2}{3}, -\frac{1}{3}$

### *SECTION - III*

**1.** **B**

$N = 2^\alpha \cdot 3^\beta \cdot 5^\gamma \cdot 7^\delta$

$\alpha$ can take the value 0 ; $\beta$ can take the values 0, 1 ; $\gamma$ can take the values 0, 1, 2 and $\delta$ can take the values 0, 1

$\therefore$ Number of odd proper divisors = 11

**2.** **D**

$N = 2^\alpha \cdot 3^\beta \cdot 5^\gamma \cdot 7^\delta$

$\alpha$ can take the value 1, 2, 3, ; $\beta$ can take the values 0 ; $\gamma$ can take the values 0, 1, 2 and $\delta$ can take the values 0, 1

$\therefore$ Number of even proper divisors = 18

**3.** **A**

Required sum = $(2^0 + 2^1 + 2^2 + 2^3)(3^0 + 3^1)(5^0 + 5^1 + 5^2) = 1860$

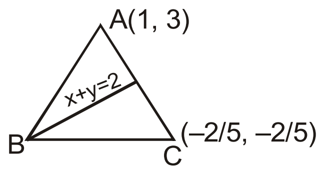
**4.** **B**

Image of A(1, 3) in line x + y = 2 is $\left(1 - \frac{2(2)}{2}, 3 - \frac{2(2)}{2}\right) \equiv (-1, 1)$

So line BC passes thorugh (–1, 1) and $\left(-\frac{2}{5}, -\frac{2}{5}\right)$

Equation of line BC is $y - 1 = \frac{-2/5 - 1}{-2/5 + 1}(x + 1) \Rightarrow$

$7x + 3y + 4 = 0$



**5.** **C**

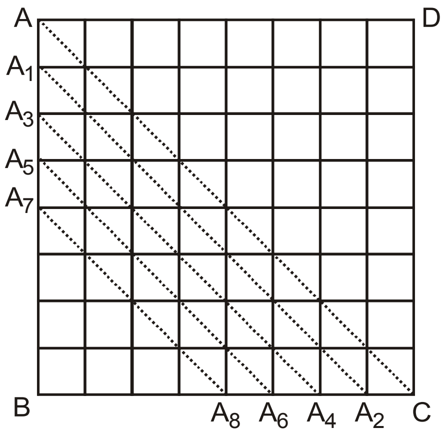
Vertex B is point of intersection of 7x + 3y + 4 = 0 and x + y = 2 i.e. B = (–5/2, 9/2)

**6.** **A**

Line AB is $y - 3 = \frac{3 - 9/2}{1 + 5/2}(x - 1) \Rightarrow 3x + 7y = 24$

***SECTION - IV***

**1.** **(A) → (R), (B) → (S), (C) → (P), (D) → (Q)**




(A) Total ways = $2\,({}^8C_3) + 4({}^7C_3 + {}^6C_3 + {}^5C_3 + {}^4C_3 + {}^3C_3)$
= 2 × 56 + 4 (35 + 20 + 10 + 4 + 1) = 112 + 280 = 392

(B) L – 2 ; I – 2 ; O – 2 ; H – 1 ; D – 1 ; V – 1 ; E – 1

| Category | Selection | No. of 3 letter words |
|---|---|---|
| (i) 2 alike and 1 different letters | ${}^3C_1.{}^6C_1=18$ | 18×3=54 |
| (ii) All three different letters | ${}^7C_3= 35$ | 35×3!=210 |
| | | Total = 264 |

(C) S = {1,2,3,4,5,6,7,8,9,10,11}

Any five elements can be selected in ${}^{11}C_5 = 462$ ways

Now number of ways in which five elements from the set S can be selected so that no two of them are consecutive is ${}^7C_5 = 21$ | × | × | × | × | × | × |(7 gaps)

∴ Required number of ways = ${}^{11}C_5 - {}^7C_5 = 462 - 21 = 441$

(D) A′s = 2 ; B′s = 4 ; C′s = 2

Total words formed = ...(1)

Let ABBC = ′x′

Number of ways in which × ABBC can be arranged

$= \frac{5!}{2!} = 60$ but this includes × ABBC and ABBC ×.

But the word ABBCABBC is counted twice in 60 hence it should be 59

Hence required number of ways = 420 – 59 = 361

**2.** **(A) → (P, S) ; (B) → (P, R); (C) → (P); (D) → (P)**

(A) Lines are concurrent $\Rightarrow \begin{vmatrix} 1 & -2 & -6 \\ 3 & 1 & -4 \\ \lambda & 4 & \lambda^2 \end{vmatrix} = 0$

$\Rightarrow \lambda^2 + 2\lambda - 8 = 0 \qquad \Rightarrow \lambda = 2, -4$

(B) points are collinear $\Rightarrow \begin{vmatrix} \lambda+1 & 1 & 1 \\ 2\lambda+1 & 3 & 1 \\ 2\lambda+2 & 2\lambda & 1 \end{vmatrix} = 0$

$\Rightarrow 2\lambda^2 - 3\lambda - 2 = 0 \quad \Rightarrow \quad \lambda = 2, -1/2$

(C) points of intersection of x – y + 1 = 0 and 3x + y – 5 = 0 is (1, 2),
it will satisfy $x + y - 1 - \lambda = 0 \Rightarrow \lambda = 2$

$\frac{8!}{4!\,2!\,2!} = 420$

(D) midpoint of (1, –2) and (3, 4) will satisfy $y - x - 1 + \lambda = 0 \Rightarrow \lambda = 2$

## *SECTION - I*

1. **D**
2. **C**

Rate of cooling $\left(-\frac{dT}{dt}\right) \propto$ emissivity (e)

From the graph, $\left(-\frac{dT}{dt}\right)_y > \left(-\frac{dT}{dt}\right)_x \quad \therefore e_y > e_x$

Further emissivity (e) $\propto$ absorptive power (a)

(good absorbers are good emitters also)

$\therefore A_x > A_y$

Hence the correct answer is (C).
Note : Emissivity is a pure ratio (dimensionless) while the emissive power has unit J/s or watt.

3. **D**

$Pt = \frac{1}{2}mv^2$

v is doubled $\Rightarrow$ t is 4 times.

4. **A**

V = constant

Thus $\frac{dv}{dt} = a_t = 0$

$\Rightarrow \quad a_c = \frac{v^2}{R}$

$\Rightarrow \quad \vec{a}_{net} = \vec{a}_c + \vec{a}_t = \vec{a}_c$

$\vec{a} = -2\hat{i} - 2\hat{j}$

Ist quadrant

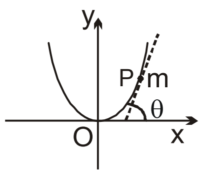
5. **B**

The net force on the stick must be zero for it to be in equilibrium.

6. **C**

$x^2 = 4ay$

Differentiating w.r.t x, we get




$\frac{dy}{dx} = \frac{x}{2a}$

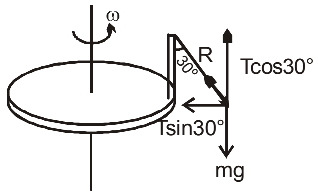
$\therefore$ At (2a, a), $\frac{dy}{dx} = 1$

$\Rightarrow$ hence $\theta = 45°$

the component of weight along tangential direction is mg sin $\theta$.

hence tangential acceleration is g sin $\theta = \frac{g}{\sqrt{2}}$

7. **D**




The bob of the pendulum moves in a circle of radius

(R + Rsin 30°) = $\frac{3R}{2}$

Force equations :

$T \sin 30° = m\left(\frac{3R}{2}\right)\omega^2$

$T \cos 30° = mg$

$\Rightarrow \tan 30° = \frac{3}{2}\frac{\omega^2 R}{g} = \frac{1}{\sqrt{3}} \Rightarrow \omega = \sqrt{\frac{2g}{3\sqrt{3}R}}$

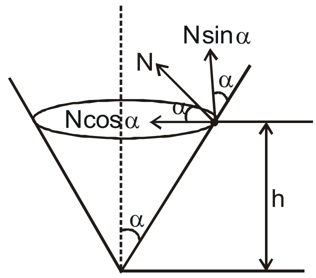
8. **C**

## SECTION - II

1. **A,C**

As N sin $\alpha$ = mg

N cos $\alpha$ = m $\omega^2$ r




$\tan\alpha = \frac{g}{\omega^2 r}$

$\therefore \; T^2 \propto \tan\alpha$

$\therefore$ when $\alpha$ increases T also increases

Also $T^2 \propto r\tan\alpha$

but $r = h\tan\alpha$

$\therefore \; T^2 \propto h\tan^2\alpha$

for constant $\alpha$

$T^2 \propto h$

Thus when h increases T also increases

2. **B,C**

3. **A,C**

4. **A,B,C**

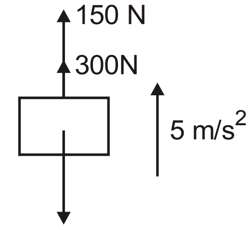
## SECTION - III

1. **D**

FBD of block in ground frame :

applying N.L. 150 + 300 – 10 M = 5M

$\Rightarrow 15\,M = 450 \Rightarrow M = \frac{450}{15}$




$\Rightarrow$ M = 30 kg Ans.

Normal on block is the reading of weighing machine i.e. 150 N.

**2.** **D**

300 + N = 300 $\Rightarrow$ N = 0

So block will lose the contact with weighing machine thus reading of weighing machine will be zero.

T = 30 kgf So reading of spring balance will be 30 kg.

**3.** **A**

$$a = \frac{600 - 300}{30} \Rightarrow a = \frac{300}{30} = 10 m/s^2$$

**4.** **C**

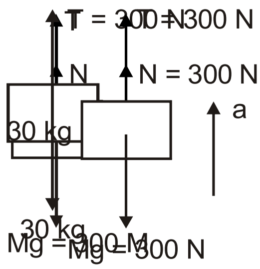
**5.** **C**

**6.** **B**

***SECTION - IV***

**1.** A $\rightarrow$ T ; B $\rightarrow$ R, ; C $\rightarrow$ P,S ; D $\rightarrow$ Q,R,T

**2.** A $\rightarrow$ P,Q,S ; B $\rightarrow$ R, ; C $\rightarrow$ P,Q ; D $\rightarrow$ P,Q



*SECTION - I*

**1.** **A**

**2.** **C**

**3.** **A**

+M of –OH > +M of $–OCH_3$

**4.** A

**Case-I**

$$C_2H_5OH + CH_3COOH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

Mole before reaction: 1, 1, 0, 0

Mole at equilibrium: 1 – x, 1 – x, x, x

$\because \quad x = \frac{2}{3}$

$\therefore$ Mole at equilibrium $\left(1-\frac{2}{3}\right)$ $\left(1-\frac{2}{3}\right)$ $\frac{2}{3}$ $\frac{2}{3}$

$$\therefore \quad K_c = \frac{\frac{2}{3}\times\frac{2}{3}}{\frac{1}{3}\times\frac{1}{3}} = 4$$

Note : Volume terms are eliminated

**Case - II**

$$C_2H_5OH + CH_3COOH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

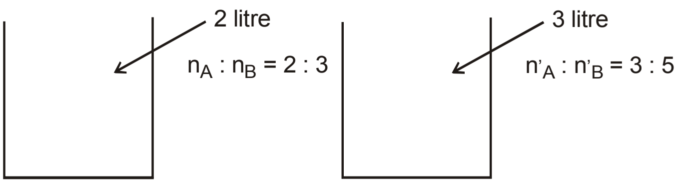
Mole before reaction: 2, 2, 0, 0

Mole at equilibrium: (2 – x), (2 – x), x, x

$\therefore \quad K_C = 4 = \frac{x^2}{(2-x)^2}$ or $\therefore \quad \frac{x}{(2-x)} = 2$

or x = 1.33

**5.** **A**




$\frac{n_A}{n_B} = \frac{2}{3}$ $\qquad$ $\frac{n'_A}{n'_B} = \frac{3}{5}$

$n_A = 2/3\, n_B$ $\qquad$ $n'_A = 3/5\, n'_B$

Put the value of $n_A$, $n_B$, $n'_A$ and $n'_B$ and get

$$\text{mean molar mass} = \frac{(n_A + n'_A)M_A + (n_B + n'_B)M_B}{(n_A + n_B + n'_A + n'_B)}$$

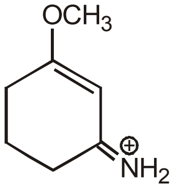
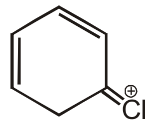
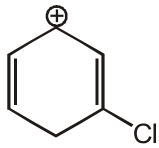
**6.** **B**

**7.** **A**

**8.** **A**

*SECTION - II*

**1.** **B,D**

In (B),  more stable than since +ve charge is located on less electronegative atom (Nitrogen) And in (D),  is more stable than  since octet of all atoms is complete.

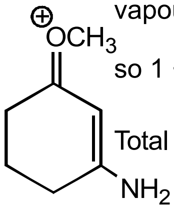


**2.** **B, C, D**

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

t = 0 $\quad$ a $\quad$ 0

t $\quad$ $a(1-\alpha)$ $\quad$ $2a\alpha$




vapour density = $\frac{46}{1+\alpha} = 30.67$

so 1 + α = 1.5 $\qquad$ α = 0.5 = 50%

Total pressure = $\frac{1.5\times1.5\times0.082\times300}{8.2} = 6.75$ atm

so $K_p = \frac{4\alpha^2}{1-\alpha^2}$ P = 9 atm $\quad\Rightarrow$ and for density of mixture = $\frac{138}{8.2}$ gm/L = 16.83 gm/L

**3.** **A, B, D**

Since density of gold decreases after melting therefore it is favourable at low pressure and high temperature.

**4.** **A,B,D**

*SECTION - III*

**1.** **B**

**2.** **D**

Bond order is 1.

**3.** **A**

As size of cation decreases and charge on cation increases, the polarization increases according to Fajan's rule. Hence the covalent character increases.

**4.** **C**

**5.** **A**

**6.** **B**

$$2AB_{3[g]} \rightleftharpoons A_{2[g]} + 3B_{2[g]}$$

| | | |
|---|---|---|
| a | 0 | 0 |
| a – 2x | x | 3x |

$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow \frac{15}{300} = \frac{P_2}{400} \Rightarrow P_2 = 20$ atm

Now $\frac{a+2x}{a} = \frac{30}{20} \Rightarrow 2a + 4x = 3a \Rightarrow x = \frac{1}{4}a$

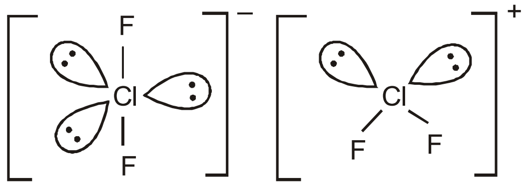
$\therefore$ % of $AB_{3[g]}$ decomposed $= \frac{2x}{a} \times 100 = 50\%$

**SECTION - IV**

**1.** **(A) → P,R,S ; (B) → P,R,S; (C) → P, S; (D) → Q, T**

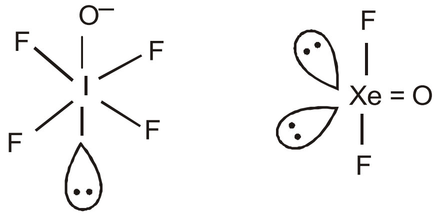
**2.** **(A) → R ; (B) → Q ; (C) → S ; (D) → P,T**

(A)




(B)

(C)




(D)