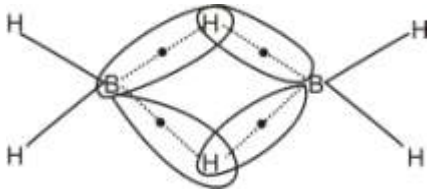
HINTS & SOLUTIONS

CHEMISTRY

Dibrorane str.

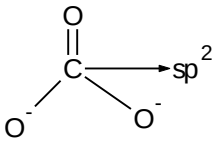
1. **(A)**



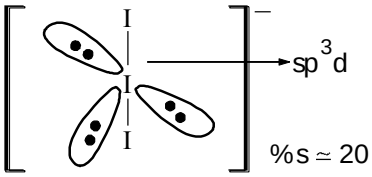
$\rightarrow$ 3C – 2e = 2 bonds

$\rightarrow$ 2C – 2e $\rightarrow$ 4 bonds

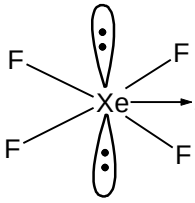
2. **(A)**



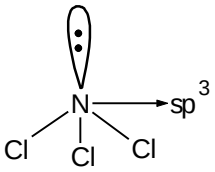
$\rightarrow sp^2$ $\%s \simeq 20$



$\rightarrow sp^3d$ $\%s \simeq 20$



$\rightarrow sp^3d^2$ $\%s \simeq 16.66\%$



$\rightarrow sp^3$ $\%s \simeq 25$

3. **(B)**

4. **(B)**

Let moles of $Na_2CO_3 = x$ & $NaHCO_3 = y$ then

for phenolphthalein indicator

$$x \times \frac{1}{2} + 0 = 5 \times 10^{-3} \times \frac{1}{10}$$

for methyl orange

$$x + y = 15 \times 10^{-3} \times \frac{1}{10}$$

so,

$$x = 5 \times 10^{-4}$$

$$x = \frac{\text{mass of } Na_2CO_3}{106} = 5 \times 10^{-4}$$

Mass of $Na_2CO_3 = 5 \times 10^{-4} \times 106\,g$

$= 5.3 \times 10^{-2}$

$= 0.053\,g$

5. **(A)**

6. (A)

$$E = \omega + KE$$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + KE$$

$$\lambda = \frac{h}{\sqrt{2m\,KE}} \Rightarrow \lambda = \frac{h}{\sqrt{2m \times hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]}}$$

$$\lambda = \sqrt{\frac{h\lambda\lambda 0}{2mc(\lambda_0 - \lambda)}}$$

Assertion & Reason

7. (C)

8. (A)

9. (C)

Para # 1 (Q. 10 to 12)

10. (C)

11. (D)

12. (D)

<u>Para # 2 (Q. 13 to 15)</u>

$$CO + Cl_2 \rightleftharpoons COCl_2$$

$t = 0$	342mm	351.4 mm	0
$t = t$	$342mm - x$	$351.4mm - x$	x

$$P_{equilibrium} = (342mm - x) + (351.4mm - x) + x$$
$$439.5mm = 693.4 - x$$
$$x = 253.9mm$$

13. (C)

x = 253.9 nm

14. (C)

$$k_P = \frac{P_{COCl_2}}{P_{CO}\,P_{Cl_2}} = 22.5\ atm^{-1}$$

15. (B)

k_P remains constant it will only depends on temperatures.

Matrix – Match

1. A - s, B - p, C - r, D - q,t

2. A – p, q, r; B – p,q,s; C – q, s; D – r

(A) Pressure ↑ so volume decreases, concentration of each species ↑ that's why rate of forward and backward reaction ↑
$R_f = R_b$
$Q = K_{eq}$

(B) volume ↓ so concentration increases that's why rate of forward and backward reaction ↑
$Q \neq K_{eq.}$

(C) By the addition of NH_3, $[NH_3]$ ↑ (rate backward ↑
$Q \neq K_{eq}$

(D) Inert gas added at constant volume P_{PCl_5}, P_{PCl_3}, P_{Cl_2} do not change
$(Rate)_f = (Rate)_b$

HITS & SOLUTIONS (MATHS)

1. Taking L.C.M.

$$\left[1-\frac{\sin^2 y}{1+\cos y}\right] + \left[\frac{1+\cos y}{\sin y} - \frac{\sin y}{1-\cos y}\right]$$

$$= \frac{1+\cos y-\sin^2 y}{1+\cos y} + \frac{1-\cos^2 y-\sin^2 y}{\sin y.(1-\cos y)}$$

$$= \frac{\cos y+\cos^2 y}{1+\cos y} + 0 = \cos y$$

Ans.[D]

2. D
Equation of the normal to the parabola $y^2 = 4x$ is
$y = -tx + 2t + t^3$
Therefore, condition for current lines will be

$$\begin{vmatrix} p & 1 & 2p+p^3 \\ q & 1 & 2q+q^3 \\ r & 1 & 2r+r^3 \end{vmatrix} = 0$$

$\Rightarrow$ p + q + r = 0 $\quad (\because p \neq q \neq r)$

$\therefore$ Common root between the given quadratic equation is 1

3. A
4. B
Line $\perp$ to ax + by + c = 0 passing through (2, 0) is bx – ay = 2b
5. C

$$\sqrt{13} = \left|\frac{4-2+c}{\sqrt{5}}\right| \Rightarrow |c+2| = \sqrt{65}$$

$c_1 + 2 = \sqrt{65}$

$c_1 + 2 = -\sqrt{65}$

$c_1 + c_2 = -4$

6. C
Any point on the given parabola is $(t^2, 2t)$. The equation of the tangent at (1,2) is x–y +1 = 0
The image (h,k) of the point $(t^2, 2t)$ in x–y+1 = 0
The image (h,k) of the point $(t^2, 2t)$ in x–y+1 = 0 is given by $\frac{h-t^2}{1} = \frac{k-2t}{-1} = -\frac{2(t^2-2t+1)}{1+1}$
$h = t^2 - t^2 + 2t - 1 = 2t-1$ and $k = 2t + t^2 - 2t + 1 = t^2 + 1$

Eliminating t from h = 2t–1 and k = t^2 + 1,
We get $(h+1)^2 = 4(k-1)$
The required equation of reflection is $(x+1)^2 = 4(y-1)$.

7. B
Obviously family of circles touching a line at a point

8. A
$t_2 = -t_1 - \frac{2}{t_1}$ and $t_4 = -t_3 - \frac{2}{t_3}$

Adding, we get $t_2 + t_4 = -t_1 - t_3 - \frac{2}{t_1} - \frac{2}{t_3}$

$\Rightarrow t_1 + t_2 + t_3 + t_4 = -\frac{2}{t_1} - \frac{2}{t_3}$

$\Rightarrow \frac{1}{t_1} + \frac{1}{t_3} = 0 \Rightarrow t_1 + t_3 = 0$

Now, point of intersection of tangents at A and C will be $(at_1t_3, 4(t_1 + t_3))$. Since $t_1 + t_3 = 0$, This point will lie on X-axis, which is axis of parabola.

9. A
10. B
11. A
12. B
Chord of contact from $p(\alpha,\beta)$
$(\alpha-2)x + (\beta-3)y + 4 - 2\alpha - 3\beta = 0$
Comparing 2x + y = 3
$(\alpha,\beta) \equiv \left(-\frac{5}{2}, \frac{3}{4}\right)$
$\therefore$ circumcirlce $\Rightarrow \left(x+\frac{5}{2}\right)(x-2) + \left(y-\frac{3}{4}\right)(y-3) = 0$
Line $\perp$ to 2x + y = 3 passing through (2, 3) is x – 2y + 4 = 0
$\therefore$ M is point of intersection

13. (D)
14. (A)
15. (D)
The equations of the bisectors are givne by x.y = 0 and x + y + 2 = 0
There bisectors intersect at the point P(-1, -1).
Focus S, is the foot of parallel from P to MN, where [M(1, 1), N(0, -2)]
i.e. point of intersection of lines, MN (3x – y – 2 = 0) and PS (x + 3y + 4 = 0)
$\therefore$ Focus is $\left(\frac{1}{5}, \frac{-7}{5}\right)$, $MS = \sqrt{\frac{2}{5}}, NS = 4\sqrt{\frac{2}{5}}$

Length of latus rectum = $2\left[\frac{2\left(\sqrt{\frac{2}{5}}\right)\left(4.\sqrt{\frac{2}{5}}\right)}{\sqrt{\frac{2}{5}} + 4\sqrt{\frac{2}{5}}}\right]$

$= \frac{16\sqrt{2}}{5^{3/2}}$

Circle passing through PMN is
$(x-0).(x-1) + (y-1)(y+2) = 0 \Rightarrow x^2 + y^2 - x + y - 2 = 0$
$\therefore$ Equation of tangent at (-1, -1), which is also the equation of directrix, is 3x + y + 4 = 0

1. A- R, B- Q, C- PS, D- ST
(a) $K = mh - m^2 \Rightarrow m^2 - hm + K = 0$
$\Rightarrow m_1 + m_2 = h$ and $m_1m_2 = k$
If tangents intersect axes at concyclic points, then
$m_1m_2 = 1 \Rightarrow K = 1$ $\therefore$ Locus of P is y = 1
(b) $y^2 - 4y - 2x = 0 \Rightarrow (y-2)^2 = 2(x+2)$

It's directrix is x + 2 = $-\frac{2}{4} \Rightarrow 2x+5=0$

(c) Any point on the parabola is P(t^2, 2t). The circumcentre Q(h, k) of ΔPAB is mid-point of P(t^2, 2t) and the centre C(-3, 2) of the circle. Hence,

$$h=\frac{t^2-3}{2}, \text{ and } k=t+1$$

Elimination t, we get $(k - 1)^2 = 2h + 3$

$\therefore$ Locus of P(h, k) is - $(y-1)^2 = 2x+3 = 2\left(x+\frac{3}{2}\right)$

Which is a parabola, whose tangent at the vertex is $x+\frac{3}{2} = 0$

Also, a tangent to parabola with slope 1 is

$$y-1=1\left(x+\frac{3}{2}\right)+\frac{1}{2} \Rightarrow y-1=x+2 \Rightarrow y=x+3$$

A tangent to parabola with slope – 1 is $y-1=-1\left(x+\frac{3}{2}\right)+\frac{\frac{1}{2}}{-1}$

$\Rightarrow y-1=-x-2 \Rightarrow y=-x-1$

(d) A tangent to parabola $y^2 = 12x$ is $y=mx+\frac{2}{m}$, which is tangent to circle

$2(x^2+y^2)=9 \Rightarrow x^2+y^2=\frac{9}{2}$ if

$\Rightarrow \left(\frac{3}{m}\right)^2 = \frac{9}{2}(1+m^2) \Rightarrow m^4+m^2-2=0 \Rightarrow m \pm 1$

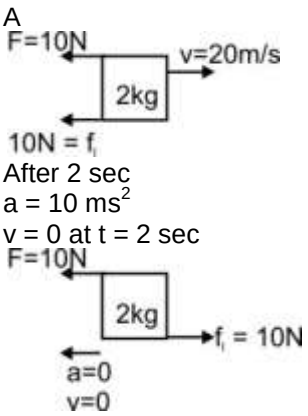
$\therefore$ The equation of two common tangents are $y=x+3$ or $y=-x-3$

2. A- R; B- P ; C- S; D- Q

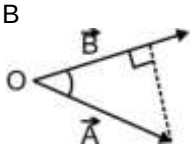
Lines passing through points of intersection of lines $(2x-3y)+\lambda(4x-5y-2)=0$

PHYSICS

1. A



2. B



Component of $\vec{A}$ along $\vec{B}$ is $=|\vec{A}|\cos\theta$

Where $\vec{A}.\vec{B}=|\vec{A}||\vec{B}|\cos\theta$

$$\therefore |\vec{A}|\cos\theta = \frac{\vec{A}.\vec{B}}{|\vec{B}|} = \frac{8-2-2}{\sqrt{4+1+4}} = \frac{4}{3}$$

3. A

v = 2x

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

$$\int_2^x \frac{dx}{x} = 2\int_0^t dt$$

$$\ln\frac{x}{2} = 2t$$

$$v = 4e^{2t}$$

$$\therefore v = 4e^4 \text{ at } t = 2$$

4. D

v = mx + c

A = mv $\Rightarrow a = m[mx+c] \Rightarrow a = m^2x + mc$

5. B

$D = \frac{g}{2}\times 3^2$ also $D = \frac{gt^2}{2} - \frac{g}{2}(t-1)^2$

Solving we get t = 5 sec.

6. B

By WET

$$-f_\ell x - \frac{3}{5}mgx = 0 - \frac{1}{2}m\times 10^2$$

$$-\mu mg\cos 37x - \frac{mgx}{2}\left(\frac{3}{5}\right) = -\frac{m}{2}\times 100 = 50$$

10x = 50

Therefore x = 5

7. Assertion is false but reason is true.

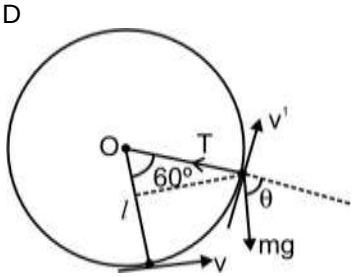
8. B

9. Assertion is false but reason is true.

10. B

11. A

12. D

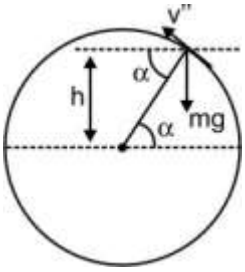


By coe

$$\frac{1}{2}mv^2 = \frac{1}{2}mv'^2 + mg\ell(1-\cos\theta)$$

$$v' = \sqrt{6}$$

$$T - mg\cos\theta = \frac{mv'^2}{\ell} \Rightarrow T = \frac{35}{2}N$$



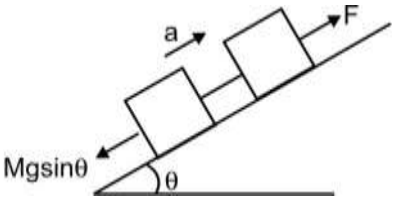
By coe

$$\frac{1}{2}mv^2 = \frac{1}{2}mv''^2 + mg\ell(1+\sin\alpha)$$

And $mg\sin\alpha = \frac{mv''^2}{\ell}$

Solving we get $\sin\alpha = \frac{2}{3} \therefore h = \ell\sin\alpha = \frac{40}{3}$ cm

13. C
14. A
15. D



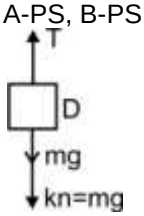
$F - Mg\sin\theta = Ma$

$120 - 12 \times 10 \times \frac{3}{5} = 12 \times a$

$a = 4\ m/s^2$

Matrix Matching :

1. A-PS, B-PS, C-R, D-R



$\therefore T = 2mg$ at equilibra

When spring is cut equation becomes

T – mg = ma

$2mg - mg = ma \Rightarrow a = g$

2. A-R, B-R, C-QR, D-PQR

Let f_{AB}, f_{BC} and f_c be limiting frictions

Then f_{AB} = 8N, f_{BC} = 15N, f_C = 10N

So when F > 10N C will move for motion between B and C F > 20