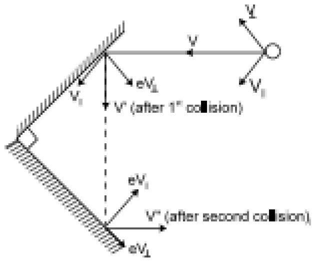
FIITJEE MONTHLY ASSESSMENT TEST

PHYSICS, CHEMISTRY & MATHEMATICS
CMT-2
Batch: CM-1820
QP CODE: 112878
ANSWER KEYS

PHYSICS [PART-I]			CHEMISTRY[PART-II]			MATHEMATICS [PART-III]		
1	C	P110610	1	C	C110603	1	D	M110909
2	C	P110607	2	A	C110602 C110603	2	A	M110923
3	A	P110612	3	A	C110606 C110607	3	C	M110915
4	C	P110604	4	D	C110603	4	D	M110930
5	A	P110612	5	C	C110609	5	B	M110930
6	B	P110604	6	A	C110607	6	A	M110924
7	B	P110612	7	D	C110604	7	A	M110919
8	A	P110612	8	B	C110601	8	A	M110926
9	ACD	P110604 P110608	9	BCD	C110603	9	BCD	M110920
10	ABC	P110612	10	ABC	C110606	10	AB	M110910
11	ABC	P110606 P110609	11	AD	C110601	11	AC	M110905
12	D	P110612	12	AD	C110605	12	CD	M110911
1	(A) → ps (B) → rs (C) → r (D) → pqr	P110606 P110608	1	A → qr B → pst C → qr D → qr	C110603	1	(A) → pr (B) → pq (C) → r (D) → ps	M110920 M110909 M110919 M110920
2	(A) → rs (B) → r (C) → p (D) → pqrs	P110607	2	A → qt B → p C → rs D → rs	C110602 C110603 C110607	2	(A) → prt (B) → prt (C) → pqrs (D) → p	M110921 M110903 M110909 M110902
1	4	P110612	1	4	C110602 C110606	1	5	M110926
2	2	P110606	2	2	C110607	2	4	M110902
3	2	P110612	3	0	C110602	3	3	M110922
4	5	P110613	4	3	C110608	4	9	M110908
5	6	P110606	5	7	C110602	5	5	M110907
6	4	P110604	6	8	C110604	6	8	M110908

HINTS & SOLUTIONS
PHYSICS

1. C



During 1st collision perpendicular component of V, $V_\perp$ becomes e times, while IInd component $V_{||}$ remains unchanged and similarly for second collision. The end result is that both $V_{||}$ and $V_\perp$ becomes e times their initial value and hence V" = – eV (the (–) sign indicates the reversal of direction).

2. C

For first collision v = 10 m/s. $t_1 = \frac{\pi(5)}{10} = \pi/2$ sec.

velocity of sep = e. velocity of opp.

$$v_2 - v_1 = \frac{1}{2}(10)$$

$$v_2 - v_1 = 5 \text{ m/s}$$

for second collision

$$\therefore \quad t_2 = \frac{2\pi(5)}{5} = 2\pi$$

$$\therefore \quad \text{total time} \quad t = t + t_2 = \pi/2 + 2\pi$$

$$t = 2.5\pi$$

3. A

$$\Sigma m \Delta r_{cm} = m_1 \Delta r_1 + m_2 \Delta r_2$$

$$= (m + 2m)(0) = m(x - 4) + 2m(x) \quad \Rightarrow \quad x = \frac{4}{3} \text{ cm.}$$

4. C

Muzzle velocity = $v_{m/g} = v_0$

Along x-direction ;

$v_{m(x)} - v_{g(x)} = v_0 \cos\theta$

By momentum conservation: $(M + m)(0) = m(v_0 \cos\theta - v) - Mv \Rightarrow v = \frac{mv_0 \cos\theta}{(M+m)}$

5. A

Momentum of the system remains conserved as no external force is acting on the system in horizontal direction. $\therefore$ (50 + 100) 10 = 50 × V + 100 × 0 ⇒ V = 30 m/s towards right, as boat is at rest. $V_{P_{boat}}$ = 30 m/s

6. **B**

$$\frac{v}{2} = \sqrt{\frac{k}{2m}}\sqrt{\left(\frac{2mg}{k}\right)^2 - \left(\frac{mg}{k}\right)^2} \; ; \qquad v = \sqrt{\frac{2k}{m}}\sqrt{\frac{3m^2g^2}{k^2}} \quad = \sqrt{\frac{6mg^2}{k}}$$

7. **B**

Work done by spring on the block of mass m_1 = W_1 = change in kinetic energy

$$= \frac{1}{2}m_1v_1^2 - \frac{1}{2}m_1(0)^2 = \frac{1}{2}m_1v_1^2$$

$$W_2 = \frac{1}{2}m_2v_2^2$$

$$\frac{W_1}{W_2} = \frac{\frac{1}{2}m_1v_1^2}{\frac{1}{2}m_2v_2^2}$$

from conservation of momentum

$$m_1v_1 = m_2v_2$$

$$\therefore \quad \frac{W_1}{W_2} = \frac{v_1}{v_2} = \frac{m_2}{m_1}$$

8. **A**

9. **ACD**

10. **ABC**

It can be shown that

$K_0 = K_{cm} + \frac{1}{2}MV_{cm}^2$ where M is the total mass of the system and V_{cm} is velocity of centre of mass with respect to ground.

Due to internal changes K_{cm} can change but V_{cm} will remain same. Hence only K_{CM} portion of kinetic energy can be transformed to some other form of energy. Thus D is the wrong statement.

11. **ABC**

Coefficient of restitution

$$e = \frac{u_1 - u_2}{v_2 - v_1} \Rightarrow v_2 = v_1 + u_1 \begin{bmatrix} e = 1 \\ u_2 = 0 \end{bmatrix} \quad \text{.......... (1)}$$

Momentum Conservation

$mu_1 + 2m(0) = mv_1 + 2mv_2$ ....(2)

solving (1) and (2)

$$v_1 = \frac{-u_1}{3}, \; v_2 = \frac{2u_1}{3}$$

(A) $|v_1| = \frac{|u_1|}{3}$

(B) $\Delta k_1 = \frac{1}{2}m\left(v_1^2 - u_1^2\right) = \frac{1}{2}mu_1^2\left(\frac{8}{9}\right)$

(C) $\Delta k_2 = \frac{1}{2}(2m)\left(v_2^2 - u_2^2\right) = \frac{1}{2}(2m)\left[\frac{4u_1^2}{9}\right]u_1^2\left(\frac{8}{9}\right)$

$\Delta k_1 + \Delta k_2 \neq 0$

12. **D**

Momentum of (m + M) system is conserved in x-direction

$mv_1 - Mv_2 = 0$ ………….(1)

Energy conservation from A to B

$$\frac{1}{2}mv_1^2 + \frac{1}{2}Mv_2^2 - mgr = 0 + 0 \text{ ……………(2)}$$

Solving (1) and (2)

$$v_2 = \frac{m}{M}\sqrt{\frac{2gr}{\left(1+\frac{m}{M}\right)}}$$

$$v_1 = \sqrt{\frac{2gR}{\left(1+\frac{m}{M}\right)}}$$

If block of mass M will be at rest, then only work done by normal on 'm' will be zero.

1. (A) → ps, (B) → rs, (C) → r, (D) → pqr

In elastic collision, kinetic energy is always lost. In elastic collision, kinetic energy remains constant.

If total work done is zero, then kinetic energy will remain constant. If non-consecutive forces are not present, then kinetic energy may decrease, increase or remain constant, depending upon other forces.

2. **(A) → rs**

$8u_1 + 2(-3) = 8v_1 + 2v_2$

$$\frac{v_2 - v_1}{u_1 - (-3)} = e = 0.5$$

Solving, we get $v_1 = \frac{7u_1 - 9}{10}$, $v_2 = \frac{12u_1 + 6}{10}$

v_2 is always positive.

For $v_1 > 0$ $u_1 = \frac{9}{7} m/s$

(B) → r

$8u_1 + 2(-3) = 8v_1 + 2v_2$

$$\frac{v_2 - v_1}{u_1 - (-3)} = e = 1$$

For maximum energy to transfer to m_2, $v_1 = 0$

Solving, we get $u_1 = 2$ m/s

(C) → p

For this $v_2 = 0$

(D) → pqrs

Depends upon e.

1. **4**

Momentum of conservation $m_1v_1 - 2mv_2 = 0$

$$\frac{v_1}{v_2} = 2 \quad .... (1)$$

Energy conserved

$$v_r + k_r = v_f + k_f$$

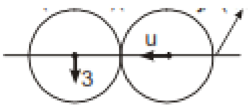
$$0 + 0 = -2mgl + \frac{1}{2}mv_1^2 + \frac{1}{2}(2m)(v_2)^2 \text{ ......(2)}$$

Solving (1) and (2)

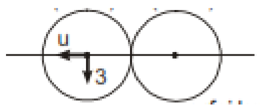
$$v_1 = \sqrt{\frac{8gl}{3}}$$

2. **2**

The line of impact for duration of collision is parallel to x-axis.
The situation of striker and coin just before the collision is given as

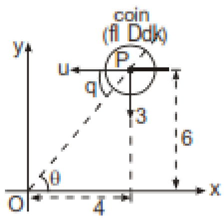


Before Collision



After Collision

Because masses of coin and striker are same, their components of velocities along line of impact shall exchange. Hence the striker comes to rest and the x-y component of velocities of coin are u and 3 m/s as shown in figure.



For coin to enter hole,

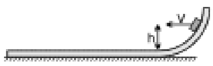
its velocity must be along PO $\quad \therefore \tan\theta = \frac{6}{4} = \frac{3}{u}$

u = 2, v = 0

u + v = 2

3. **2**

Let v be the final speed of block when it is at maximum height h. At that instant the speed of circular track shall also be v.



From conservation of momentum

$$m\sqrt{2gR} = (m + 2m)\,v \qquad ....(1)$$

From conservation of energy

$$\frac{1}{2}m(2gR) = \frac{1}{2}(m + 2m)v^2 + 2mgh \qquad ....(2)$$

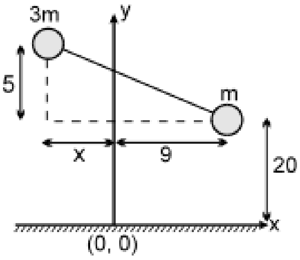
solving (1) and (2) we get

$$h = \frac{R}{3} = \frac{nR}{6}$$

n = 2

4. **5**

The external force on two body system acts along y-axis. The initial momentum of the two body system is zero. Hence the C.M. of two body system always moves along y-axis



$\because$ centre of mass of two body system lies along y-axis, the x-coordinate of centre of mass of two body system is $x_{cm} = 0$

$\therefore$ $3m\,x = m\,9 \Rightarrow x = 3$

$\therefore$ Length of string is $\sqrt{5^2 + (9+3)^2} = 13$ cm.

L = 13 = 2n + 1

n = 5

5. **6**

Solve in the reference frame fixed to the wall.

Before collision, velocity of ball = 3v towards it.

$\therefore$ After elastic collision of ball = 3v away from it

Time of flight = $\sqrt{\frac{2h}{g}}$

$\therefore$ distance between wall and ball = $3v.\sqrt{\frac{2h}{g}}$.

$$3v\sqrt{\frac{2h}{g}} = v\sqrt{\frac{3nh}{g}}$$

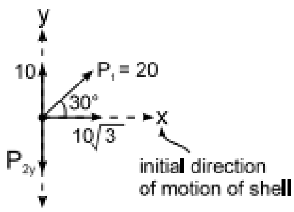
n = 6

6. **4**

As shown in figure the component of momentum of one shell along initial direction and perpendicular to initial direction are $P_{1X} = 10\sqrt{3}$ Ns and P_{1y} = 10Ns.

For momentum of the system to be zero in y-direction P_{2y} must be 10 Ns. 2nd part of shell may or may not have momentum in x-direction

$\therefore$ P_{2min} = 10 Ns.



P = 10 = 2n + 2

n = 4.

CHEMISTRY

1. **C**

E_a of 2nd step is more than that of the 3rd step so $K_1 < K_2$.

Since $\sum H_R > \sum H_P$, $\Delta H = -ve$.

2. A

$$K = \frac{0.693}{69.3} = 10^{-2} \min^{-1}$$

$$A = \frac{K}{e^{-Ea/RT}} = \frac{10^{-2}}{10^{-10}} = 10^{8} \min^{-1}$$

3. **A**

4. **D**

$$\frac{kcat}{k} = \frac{e^{-(E_a - x)/RT}}{e^{-E_a/RT}}$$

$$= \frac{e^{-E_a/RT}.e^{x/RT}}{e^{-E_a/RT}}$$

$$= e^{x/RT} = e^{\frac{19147}{8314}} = e^{2.3}$$

=10

5. **C**

$$Eavg = \frac{k_1}{k_1 + k_2} * E_{a_1} + \frac{k_2}{k_1 + k_2} * E_{a_2}$$

$$= \frac{4}{5} \times 100 + \frac{1}{5} \times 60$$

= 80 + 12 = 92

6. **A**

From graph

$$kt = \frac{1}{a} - \frac{1}{a_0} \qquad k = \tan\theta = 10^{-2}$$

$$\frac{1}{a} = kt + \frac{1}{a_0} \qquad \frac{1}{a_0} = 0.1 \text{ or } a_0 = 10$$

$$r = k[A]^2 = 10^{-2} * (5)^2 = 0.25$$

7. **D**

$${}^{20}_{11}Na \rightarrow {}^{20}_{10}Na + {}^{0}_{+1}\beta$$

$${}^{24}_{11}Na \rightarrow {}^{24}_{12}Mg + {}^{0}_{-1}\beta$$

8. **B**

$$-\frac{d[RX]}{dt} = K_2[RX][OH^-] + K_1[RX]$$

9. **BCD**

10. **ABC**

11. **AD**

12. **AD**

1. **A → qr** **B → pst** **C → qr** **D → qr**

2. **A → qt** **B → p** **C → rs** **D → rs**

1. **4**

2. **2**

$t_{1/2} \propto \frac{1}{[R]_0^{n-1}}$ where n = order of reaction

When n = 2 (second order), $t_{1/2} \propto \frac{1}{[R]_0}$

3. **0**

For zero order

$K = \frac{[A]_0 - [A]}{t}$

At $t = 10\,\text{min}, K = \frac{200-150}{10} = \frac{50}{10} = 5$

$t = 20\,\text{min}, K = \frac{100}{20} = 5$

$t = 30\,\text{min}, K = \frac{150}{30} = 5$

$\because$ K is constant $\therefore$ it is zero order reaction.

4. **3**

$r = K[NO]^m[H_2]^n$

$K = [1.5\times10^4]^m[4\times10^3]^n = 4.4\times10^4$ …1

$K = [1.5\times10^4]^m[2\times10^3]^n = 2.2\times10^4$ …2

$K = [0.5\times10^4]^m[2\times10^3]^n = 0.24\times10^4$ …3

By 1/2 and 2/3, we get n = 1 and m = 2

Over all order of reaction = 1 + 2 = 3

5. **7**

It is zero order reaction

$[H^+] = \frac{3\times10^{-6}}{0.05}\times1000 = 0.06M$

Time taken = $\frac{moles\,used}{rate\,\text{constant}}$

Now $K = \frac{0.06}{6\times10^{-9}} = 1\times10^7$

$\therefore$ x = 7

6. **8**

MATHEMATICS

1. D

Let DC = CB = BA = AD = k

$\therefore$ Coordinates of B are (k, k),

Which lie on $y = \lambda\sqrt{x}$

$\therefore$ $k = \lambda\sqrt{k}$

$\therefore$ $k = \lambda^2$, BC = k = λ^2

Also, let CG = GF = FE = EC = k_1

$\therefore$ Coordinates of F are $\left(\lambda^2 + k_1, k_1\right)$,

Which lie on $y = \lambda\sqrt{x}$

Then $k_1 = \lambda\sqrt{\left(\lambda^2 + k_1\right)}$

$\Rightarrow$ $k_1^2 = \lambda^4 + \lambda^2 k_1$

or $k_1^2 - \lambda^2 k_1 - \lambda^4 = 0$

$\therefore$ $k_1 = \dfrac{\lambda^2 \pm \sqrt{\left(\lambda^4 + 4\lambda^4\right)}}{2}$ $[\because k_1 > 0]$

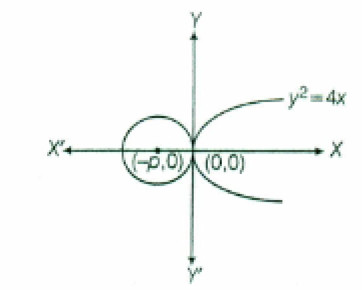
or $\dfrac{k_1}{\lambda^2} = \dfrac{1+\sqrt{5}}{2}$

or $\dfrac{FG}{BC} = \dfrac{\sqrt{5}+1}{2}$

2. A

It is clear from figure

- p < 0 or p > 0



3. C

Let $A \equiv (\alpha, \beta)$

The equation of normal at (at^2, 2at)

$$Y + tx = 2at + at^3 \qquad \ldots(i)$$

(α, β) lie on Eq. (i), then

$$at^3(2a - \alpha)t - \beta = 0 \qquad \ldots(ii)$$

Let t_1, t_2 and t_3 be the roots of Eq. (ii), then

$$at^3 + (2a - \alpha)t - \beta = a(t - t_1)(t - t_2)(t - t_3) \qquad \ldots(iii)$$

Let $P \equiv \left(at_1^2, 2at_1\right), Q \equiv \left(at_2^2, 2at_2\right), R \equiv \left(at_3^2, 2at_3\right)$

Since, the focus is S (a, 0)

$\therefore$ $SP = a\left(1 + t_1^2\right), SQ = a\left(1 + t_2^2\right)$

and $SR = a\left(1 + t_3^2\right)$

on putting $t = i = \sqrt{-1}$ in Eq. (iii), we get

$-ai + (2a - \alpha)i - \beta$

$$a(i-t_1)(i-t_2)(i-t_3)$$

or $|(a-\alpha)i-\beta| = a|i-t_1||i-t_2|i-t_3|$

$\Rightarrow \quad \sqrt{(a-\alpha)^2+\beta^2}$

$$= a\sqrt{(1+t_1^2)}\sqrt{(1+t_2^2)}\sqrt{(1+t_3^2)}$$

or $= a\left((a-\alpha)^2+\beta^2\right) = a(1+t_1^2) \ .a(1+t_2^2) \ .a(1+t_3^2)$

$$a(SA)^2 = SP.\ SQ.\ SR$$

or $\quad SP.\ SQ.\ SR = a(SA)^2$

4. D

On solving

$x^2+y^2=a^2$ and $y^2=4(x+4)$

$\Rightarrow \quad x^2+4(x+4)=a^2$

Or $\quad x^2+4x+16-a^2=0$

If the circle and parabola touch each other, then

$D=0 \Rightarrow 16-4.1.(16-a^2)=0$

$\Rightarrow \quad a^2=12$ or $a=2\sqrt{3}$

5. B

6. A

7. A

Let a point on $y^2=8x$ be $(2t^2,4t)$.

$x^2+y^2-2x-4y=0$

$\Rightarrow 4t^4+16t^2-4t^2-16t=0 \Rightarrow t=0,\ 1$

$\therefore \quad P\equiv(0,0)$ and $Q(2,4)$

And $S\equiv(2,0)$, $\quad \therefore$ Area $\Delta(PQS)=4$

8. A

Focus of the parabola is, $S\equiv\left(\frac{1}{2},\frac{1}{2}\right)$ which will be a fixed point ($\therefore$ 'O' is on directrix and axis passes through O(0, 0) and L. R. is Line joining (1, 0) and (0, 1)) locus is a point (i.e. a point circle)

$$\left(x-\frac{1}{2}\right)^2+\left(y-\frac{1}{2}\right)^2=0$$

$\Rightarrow 4x^2+4y^2-4x-4y+2=0 \quad \Rightarrow 2x^2+2y^2-2x-2y+1=0$

9. BCD

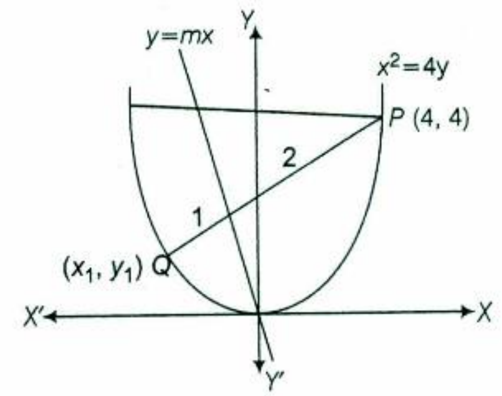
Let point of intersection of the line y = mx with the chord be $(\lambda, m\lambda)$, then

$$\lambda \frac{1.4+2.x_1}{1+2} \qquad \Rightarrow x_1 = \frac{3\lambda-4}{2}$$

and

$$m\lambda = \frac{1.4+2.y_1}{1+2} \qquad \Rightarrow y_1 = \frac{3m\lambda-4}{2}$$

$Q(x_1, y_1)$ lies on the parabola $x^2 = 4y$, then



$$\left(\frac{3\lambda-4}{2}\right)^2 = 4\left(\frac{3m\lambda-4}{2}\right)$$

$$\Rightarrow \qquad 9\lambda^2 - 24\lambda(1+m) + 48 = 0$$

For two distinct chords D > 0

$\Rightarrow (24)^2 (1+m)^2 - 4\cdot 9\cdot 48 > 0$

or $\qquad (1+m)^2 > 3$

$\Rightarrow \qquad 1+m < -\sqrt{3}$

or $\qquad 1+m > \sqrt{3}$

$\therefore \qquad m < -\sqrt{3}-1$

Or $\qquad m > \sqrt{3}-1$

Hence, $m \in \left(-\infty, -\sqrt{3}-1\right) \cup \left(\sqrt{3}-1, \infty\right)$

10. AB

11. AC

12. CD

1. (A) →pr (B) →pq (C) →r (D) →ps

(A) Points (1, 2) and)-1, 1) satisfy both the curves.

(B) Equation of tangent at $(t^2, 2t)$ on $y^2=4x$ is

$$ty = x + t^2$$

It passes through the point (2, 3), then

$$3t = 2 + t^2$$

$\Rightarrow \qquad t^2 - 3t + 2 = 0$

or $\qquad (t-1)(t-2) = 0$

or $\qquad$ t = 1 or 2

the point of contact is (1, 2) or (4, 4)

(C) Let $P\left(\sqrt{5}\cos\theta, \sqrt{5}\sin\theta\right)$ then the chord of contact of the parabola $y^2 = 4x$ w.r.t. P is

$$y \cdot \sqrt{5}\sin\theta = 2\left(x + \sqrt{5}\cos\theta\right)$$

or $$y = \frac{2x}{\sqrt{5}\sin\theta} + 2\cot\theta$$

on comparing with y = 2(x-2), then

$$\sqrt{5}\sin\theta = 1 \text{ and } \cot\theta = -2$$

or $$\sqrt{5}\sin\theta = 1 \text{ and } \sqrt{5}\cot\theta = -2$$

Hence, coordinates of P are (-2, 1)

(D) Let coordinates of Q be (t^2, 2t)

Now, the area of ΔOPQ is

$$\frac{1}{2}\left|\begin{vmatrix} t^2 & 2t \\ 4 & -4 \end{vmatrix}\right| = 6 \qquad \text{[given]}$$

$\Rightarrow$ $$2t^2 + 4t = \pm 6$$

or $$t^2 + 2t \pm 3 = 0$$

$\therefore$ $$t^2 + 2t - 3 = 0$$

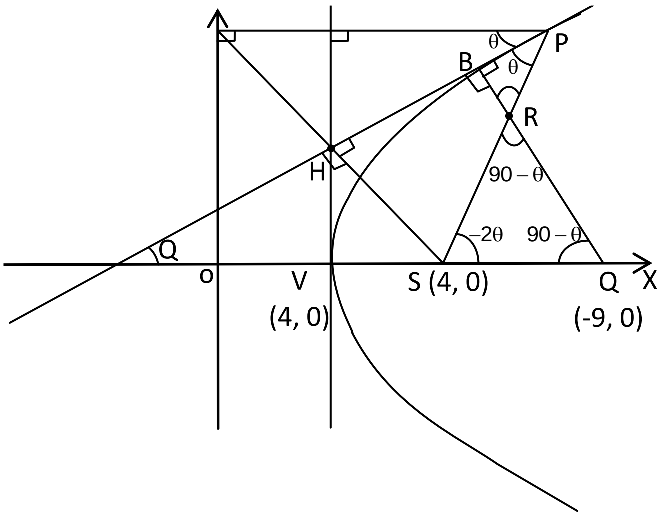
$\Rightarrow$ $$(t+3)(t-1) = 0$$

Then, t = 1 or -3

Hence, the point Q are (1, 2) or (9, -6)

2. **(A) → prt** **(B) → prt** **(C) → pqrs** **(D) → p**

1. **5**



Since tangent bisects
The < 5pm.

So, $\angle SRQ = \angle SQR = \theta$,

$\Rightarrow SQ = SR = 5$

Locus of R is a circle with centre S (4, 0) and radius '5'

$\therefore |\alpha - \beta| = |4 - 0| = 4$

2. **4**

3. 3

Tangent of $y^2 = 12x$ i5,

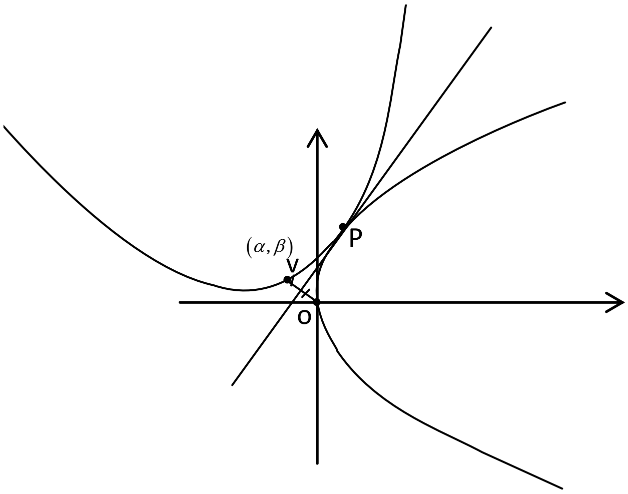
$$y = mx + \frac{3}{m}$$

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

$\Rightarrow$m = (x/y),

$$y\left(-\frac{x}{y}\right)\left(\frac{x^2}{y^2}+1\right) = 6$$

$$\Rightarrow x\left(x^2+y^2\right)+6y^2 = 0$$



4. **9**

$$t_1t_2 = \frac{h}{a}$$

$$t_1 + t_2 = \frac{k}{a}$$

$$\frac{\frac{1}{t_1}-\frac{1}{t_2}}{1+\frac{1}{t_1t_2}} = \sqrt{3}$$

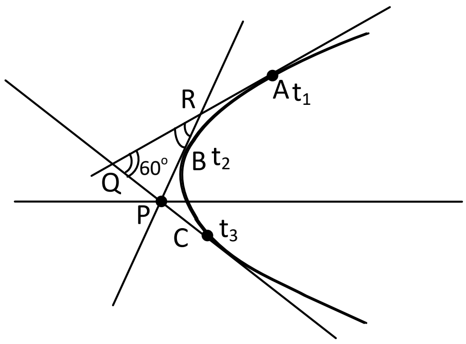
$$\Rightarrow \frac{k^2}{a^2} - \frac{4h}{a} = 3\left(1+\frac{h}{a}\right)^2$$

$$\Rightarrow y^2 - 4ax = 3(x+a)^2$$

$$\Rightarrow 3x^2 + 10ax + 3a^2 = y^2$$

$$\Rightarrow (x+3a)(3x+a) = y^2$$

q = 3, p = 3



5. **5**

6. **8**