SOLUTIONS

WEEKLY TEST-2

GZRS-1902

(JEE ADVANCED PATTERN)

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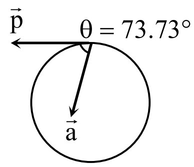
PHYSICS

1. **(B)**

Angle between $\vec{a}$ and $\vec{p}$ is :



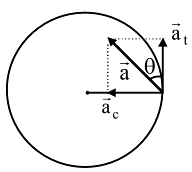
$\theta = \cos^{-1} \frac{\vec{a}.\vec{p}}{|\vec{a}||\vec{p}|}$

$= \cos^{-1} \left\{\frac{32-18}{\sqrt{(16+9)}\sqrt{(64+36)}}\right\}$

$= \cos^{-1} \left(\frac{14}{50}\right)$

Clearly both are not perpendicular, hence accelerated circular motion

2. **(C)**



$\tan\theta = \frac{a_c}{a_t}$

$\therefore \quad \frac{a_c}{a_t} = \tan 30° = \frac{1}{\sqrt{3}}$

3. **(D)**

$\frac{\Delta V}{V} \times 100 = 3\left(\frac{\Delta \ell}{\ell} \times 100\right)$

4. **(B)**

Work done depends upon frame of reference.

5. $a = -s$, $\quad v\frac{dv}{ds} = -s$, $\int_{v_0}^{0} vdv = -\int_{0}^{s} sds$, $\frac{v_0^2}{2} = \frac{s^2}{2} \Rightarrow s = v_0$

$\therefore$ **(B)**

6. Time to cross river (t) = $\frac{AB}{v_{mr}\sin\theta} = \frac{0.4}{5\sin\theta}$

$BC = (v_{mr}\cos\theta + v_r)t$

$\Rightarrow \quad 0.4 = (5\cos\theta + 1)\times\frac{0.4}{5\sin\theta} \quad \Rightarrow \quad 5\sin\theta - 5\cos\theta = 1$

$\Rightarrow \quad 25\sin^2\theta + 25\cos^2\theta - 50\sin\theta\cos\theta = 1 \quad \Rightarrow 25\sin 2\theta = 24$

$\Rightarrow \quad \sin 2\theta = \frac{24}{25} \quad \Rightarrow \quad \theta = 53°$

$\therefore$ **(C)**

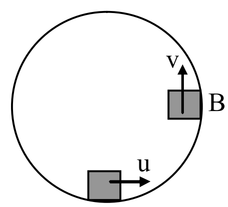
7. **(B)**

8. **(A)**

$u^2 = 5gR$

$\therefore v^2 = u^2 - 2gR$

$= 5gR - 2gR = 3gR$



Tangential acceleration at B is

$a_t = g$ (downwards)

Centripetal acceleration at B is

$a_C = \frac{v^2}{R} = 3g$

$\therefore$ Total acceleration will be

$a = \sqrt{a_C^2 + a_t^2} = g\sqrt{10}$

9. **(B)**

As $W = \Delta K$

Force is along negative x-axis and displacement is along + x-axis

$\therefore \quad W$ = negative

Hence

ΔK = negative

10. (B)

Take the mass m as a point mass. At the instant when the pendulum collides with the nail, m has a velocity v = $\sqrt{2g\ell}$. The angular momentum of the mass with respect to the point at which the nail locates is conserved during the collision. Then the velocity of the mass is still **v** at the instant after the collision and the motion thereafter is such that the mass is constrained to rotate around the nail. Under the critical condition that the mass can just swing completely round in a circle, the gravitational force when the mass is at the top of the circle. Let the velocity of the mass at this instant be $\mathbf{v_1}$, and we have

$$\frac{mv_1^2}{\ell - d} = mg,$$

or $v_1^2 = (\ell - d)g$

The energy equation

$$\frac{mv^2}{2} = \frac{mv_1^2}{2} + 2mg(\ell - d),$$

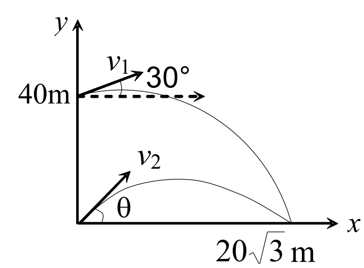
or $2g\ell = (\ell - d)g + 4(\ell - d)g$

then gives the minimum distance as

$$d = \frac{3\ell}{5}$$

11. (D)

12. (B)



For stone thrown from top of the tower

$$-40 = (v_1 \sin\theta_1)t - \frac{1}{2}gt^2 \quad \ldots\text{(i)}$$

For stone thrown from bottom of the tower

$$0 = (v_2 \sin\theta_2)t - \frac{1}{2}gt^2 \quad \ldots\text{(ii)}$$

By (i) and (ii)

$$-40 = v_1 \sin\theta_1 t - v_2 \sin\theta_2 t \quad \ldots\text{(iii)}$$

But $t = \dfrac{20\sqrt{3}}{v_1 \cos\theta_1} = \dfrac{20\sqrt{3}}{v_2 \cos\theta_2}$ …(iv)

So, $-40 = (v_1 \sin\theta_1)\left(\dfrac{20\sqrt{3}}{v_1 \cos\theta_1}\right) - (v_2 \sin\theta_2)\left(\dfrac{20\sqrt{3}}{v_2 \cos\theta_2}\right)$

$$-40 = 20\sqrt{3}(\tan\theta_1 - \tan\theta_2)$$

$$\tan\theta_2 - \tan\theta_1 = \frac{2}{\sqrt{3}} \qquad \ldots(v)$$

Given $\theta_1 = 30°$ $\Rightarrow$ $\tan\theta_2 = \frac{2}{\sqrt{3}} + \frac{1}{\sqrt{3}}$

$\Rightarrow$ $\theta_2 = 60°$

Putting $t = \frac{20\sqrt{3}}{v_2\cos\theta_2}$ in equation (ii) $\frac{v_2\sin\theta_2 \times 20\sqrt{3}}{v_2\cos\theta_2} - \frac{1}{2}gt^2 = 0$

$20\sqrt{3}\tan\theta_2 - \frac{1}{2}gt^2 = 0$, $\quad t = \sqrt{\frac{40\times 3}{10}}$ = $2\sqrt{3}$ s

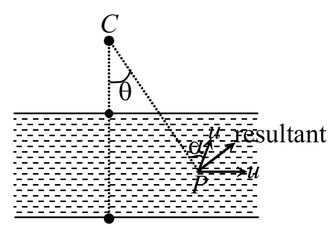
By equation (iv), $v_1 = \frac{20\sqrt{3}}{2\sqrt{3}\times\cos 30°} = \frac{20}{\sqrt{3}}$ m/s

$v_2 = \frac{20\sqrt{3}}{2\sqrt{3}\times\cos 60°}$ = 20 m/s

13. Because resultant velocity is always perpendicular to line joining *C* and boat, so path is circular with center at *C*.

$\therefore$ **(C)**

14. Let any time the velocity of boat with respect to river makes an angle α with *CP*.



Since along *CP*, net velocity is zero

$u\cos\alpha = u\sin\theta$

$\cos\alpha = \sin\theta \Rightarrow \alpha = \frac{\pi}{2} - \theta$

$V_{resultant}$ = $u\sin\alpha + u\cos\theta$

$= u\cos\theta + u\cos\theta = 2u\cos\theta$.

Angular velocity $\omega = \frac{2u\cos\theta}{2d} = \frac{u\cos\theta}{d}$, $\quad \frac{d\theta}{dt} = \frac{u\cos\theta}{d}$

$$\int_0^{\pi/3}\frac{d\theta}{\cos\theta} = \int_0^t \frac{u}{d}dt \Rightarrow t = \frac{d}{u}\ln\left[2+\sqrt{3}\right]$$

$\therefore$ **(B)**

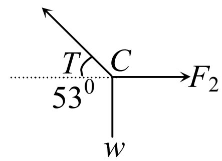
15. **(A)**

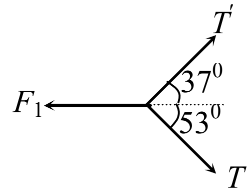
16. **(A)**

17. **(B)**

18. **(A)**

$$T=\frac{w}{\sin\left(180-53^0\right)}=\frac{5w}{4}$$





$$F_2=T\sin\left(180-37^0\right)=\frac{3w}{4}$$

and $F_1=\dfrac{T}{\sin\left(180-37^0\right)}=\dfrac{5T}{3}=\dfrac{25}{12}w$

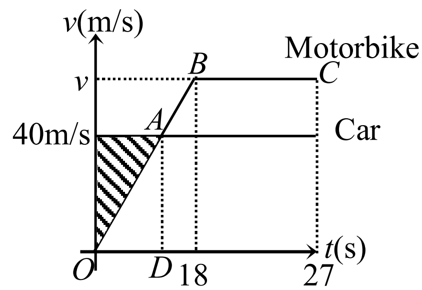
$$\frac{T'}{\sin\left(180^0-53^0\right)}=\frac{F_1}{\sin 90^0}$$

$$\Rightarrow\ T'=\frac{25}{12}w\times\frac{4}{5}=\frac{5w}{3}$$

$\therefore$ **(A)- 2, (B)- 4, (C)- 1, (D)-3**

19. **(A)**

Let maximum speed of motorbike = *v*



$40\times 27=\frac{1}{2}(27+9)v$

v = 60 m/s

So acceleration of motorbike $=\dfrac{60}{18}=\dfrac{10}{3}$

Maximum separation = shaded area

$$=\frac{1}{2}\times 40\times OD=\frac{1}{2}\times 40\times 12=240$$

Separation at $t=18$ $=240-\frac{1}{2}\times 20\times 6=$

$\therefore$ **(A) –2 , (B)- 3, (C)- 4, (D) - 1**

20. **(B)**

If maximum extension is x_m,

By conservation of energy,

$$\frac{1}{2}kx_m^{\ 2}=m_A g x_m$$

$$\frac{1}{2}\times 200\times x_m=10\times 10$$

$\boldsymbol{x_m}$ **= 1 m**

Let extension in spring is x_1 when velocity of m_A is $\sqrt{10/3}$ m/s. The velocity of m_B will also be $\sqrt{\dfrac{10}{3}}$ m/s.

$$\frac{1}{2}m_A v^2 + \frac{1}{2}m_B v^2 + \frac{1}{2}kx_1^2 = m_A g x_1$$

$$\frac{1}{2}\times 10\times \frac{10}{3} + \frac{1}{2}\times 5\times \frac{10}{3} + \frac{1}{2}\times 200 x_1^{\;2} = 10\times 10\times x_1$$

$$25 + 100 x_1^{\;2} = 100 x_1$$

$$4x_1^{\;2} - 4x_1 + 1 = 0$$

$$(2x_1 - 1)^2 = 0$$

$$\boldsymbol{x_1 = \frac{1}{2} = 0.5\ \text{m}}$$

If acceleration of m_A and m_B is a

$$T - kx_1 = m_B a$$

$$T - 200\times 0.5 = 5a$$

$$T = 5a + 100 \qquad \ldots\text{(i)}$$

$$m_A g - T = m_A a$$

$$10\times 10 - T = 10a$$

$$T = 100 - 10a \qquad \ldots\text{(ii)}$$

(i) and (ii) $\Rightarrow$ $5a + 100 = 100 - 10a$

***a* = 0**

When acceleration m_B is 4 m/s^2, the acceleration of m_A will also be 4 m/s^2

$$T - kx = m_B a$$

$$T - 200x = 20 \qquad \ldots\text{(i)}$$

$$m_A g - T = m_A a$$

$$100 - T = 40 \qquad \ldots\text{(ii)}$$

(i) + (ii) $\Rightarrow$ 100 – 200 x = 60

$$x = \frac{40}{200} = \frac{1}{5}\ \text{m}$$

$$U = \frac{1}{2}kx^2 = \frac{1}{2}\times 200\times \frac{1}{25} = 4\ \text{J}$$

$\therefore$ **(A) – 4, (B) – 1 , (C) – 3 ,(D) – 5**

CHEMISTRY

21. (B)

Let dibasic acid is H_2A

Silver salt : Ag_2A

$$\underset{0.90\,g}{Ag_2A} \longrightarrow \underset{0.54\,g}{Ag}$$

By POAC of Ag

$$2 \times \frac{0.90}{(216 + M_{A^{2-}})} = \frac{0.54}{108}$$

$$(216 + M_{A^{2-}}) = 360$$

$$M_{A^{2-}} = 360 - 216 = 144$$

Mol. wt H_2A = 2 + 144 = 146

22. (C)

Law of multiple proportion is defined for different compounds having same constituent elements.

23. (A)

$$P_{N_2} + 10\,\text{cm of Hg} + \frac{380.8}{13.6} = 76$$

or, $P_{N_2} = 38\,\text{cm of Hg} = \frac{1}{2}\text{atm}$

Now, PV = nRT for N_2

$$\frac{1}{2} \times 1 = n \times \frac{1}{12} \times 360$$

or, $n = \frac{1}{60}$ mole

mass of nitrogen $= \frac{1}{60} \times 28 = \frac{14}{30}\,g$

$$\% = \frac{14}{30 \times 1.4} \times 100 = 33.33\%$$

24. (D)

$V_c = 3b$

or, 3 = 3b or b=1 litre/mol

Now, $b = 4 \times \frac{4}{3}\pi r^3 N_A$

or, $\sqrt[3]{\frac{1000 \times 3}{16\pi N_A}} = r$

or, $r = \left(\frac{3000}{16\pi N_A}\right)^{1/3}$ cm

25. (D)

At same T, K.E. is equal and P.E. of gas > P.E. of liq.

26. (C)

27. (C)

28. (A)

29. (D)

In (A) and (B) use (z / e) concept for isoelectronic specie.

In (C) size of neutral atom is greater than its cation.

In (D) Se^{2-} and As^{3-} related with 4th period, while Ba^{2+} and Cs^{+} related with 6th period. (These are not isoelectronic species)

30. (C)

Due to diagonal relationship radius of Li^{+} is close to Mg^{2+} ion

31. (B)

Difference in vertical height = 5 cm.

32. (D)

Vertical difference of height is 5 cm.

Now,

$\rho_1 h_1 = \rho_2 h_2$

$5 \times \rho_{Hg} = \frac{\rho_{Hg}}{2} \times h_2$

or, h_2 = 10 cm

$l = \frac{10}{\sin 30^o} = 20\text{cm}$

33. (C)

34. (A)

35. (C)

O^{-} ion will resist the addition of another electron due to inter-electronic repulsion.

36. (D)

B < S < P < F (Data base)

37. (D)

(A) — (R); (B) — (S); (C) — (P); (D) — (Q)

38. (C)

(A) — (R); (B) — (Q); (C) — (P); (D) — (S)

39. (A)

(A) — (Q); (B) — (R); (C) — (S); (D) — (P)

40. (C)

(A) — (R); (B) — (S); (C) — (Q); (D) — (P)

MATHEMATICS

41. (A)

Let P is (h, k) then | h – 2| + | k – 3| = 1

$\Rightarrow |x-2|+|y-3|=1$

which is a square having centre at (2, 3).

42. (A)

$3^x = 4^{x-1} \Rightarrow \quad \log_2 3^x = (x-1)\log_2 4 = 2(x-1)$

or $x\log_2 3 = 2x-2$

or $x = \dfrac{2}{2-\log_2 3}$

Rearranging, we get

$$x = \frac{2}{2-\frac{1}{\log_2 2}} = \frac{\frac{1}{\log_4 3}}{\frac{1}{\log_4 3}-1} = \frac{1}{1-\log_4 3}.$$

43. (B)

Let α, β are the roots of given equation

$$\alpha+\beta = \frac{4+\sqrt{5}}{5+\sqrt{2}}, \alpha\beta = \frac{8+2\sqrt{5}}{5+\sqrt{2}}$$

$$H = \frac{2\alpha\beta}{\alpha+\beta} = \frac{2(8+2\sqrt{5})}{(4+\sqrt{5})} = 4$$

44. (D)

$$(\alpha\beta\gamma)^{\frac{1}{3}} \ge \frac{\alpha+\beta+\gamma}{3} \Rightarrow \alpha=\beta=\gamma$$

Again $\alpha+6\beta+5\gamma=12 \Rightarrow \alpha=\beta=\gamma=1$

$$\Rightarrow \alpha^5+\beta^3+\gamma^9=3$$

45. (B)

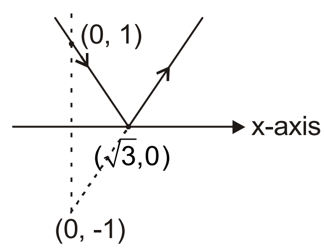
$$\frac{\sqrt{\left(\sin\frac{x}{2}+\cos\frac{x}{2}\right)^2}+\sqrt{\left(\sin\frac{x}{2}-\cos\frac{x}{2}\right)^2}}{\sqrt{\left(\sin\frac{x}{2}+\cos\frac{x}{2}\right)^2}-\sqrt{\left(\sin\frac{x}{2}-\cos\frac{x}{2}\right)^2}}=\frac{\sin\frac{x}{2}+\cos\frac{x}{2}+\sin\frac{x}{2}-\cos\frac{x}{2}}{\sin\frac{x}{2}+\cos\frac{x}{2}-\sin\frac{x}{2}+\cos\frac{x}{2}}=\tan\frac{x}{2}$$

46. (A)

$$x+\sqrt{3}y=\sqrt{3}$$

$$(y+1)=\frac{1}{\sqrt{3}}x$$

$$\sqrt{3}y=x-\sqrt{3}$$



47. (A)

The lines represented by the given equation will be coincident if $h^2 - ab = 0$.

Here, a = 2, b = k, h = 4.

Substituting the values, we get $(4)^2 - 2k = 0 \Rightarrow k = 8$.

48. (D)

$$4\sin\left(1+\frac{\pi}{6}\right)\cos\left(1+\frac{\pi}{3}\right) \quad =2\left[\sin\left(2+\frac{\pi}{2}\right)+\sin\left(-\frac{\pi}{6}\right)\right]$$

49. (C)

Taking logarithm, $\left(\frac{3}{4}y^2+y-\frac{5}{4}\right)y=\frac{1}{2}$ where $y=\log_2 x \Rightarrow \log_2 x = 1, -\frac{1}{3}, -2$

$$\Rightarrow x = 2, \sqrt[3]{\frac{1}{2}}, \frac{1}{4}$$

50. (A)

$$t_{r+1}=\frac{a_{2n+1-r}-a_{r+1}}{a_{2n+1-r}+a_{r+1}}, r=0,1,2,....n-1. =\frac{a_1+(2n-r)d-\{a_1+rd\}}{a_1+(2n-r)d+\{a_1+rd\}}. =\frac{(n-r)d}{a_1+nd}$$

$$\therefore \text{ The sum is } S_n=\sum_{r=0}^{n-1}t_{r+1}=\sum_{r=0}^{n-1}\frac{(n-r)d}{a_1+nd}$$

$$=\left[\frac{n+(n-1)+(n-2)+....+1}{a_1+nd}\right]d=\frac{n(n+1)d}{2a_{n+1}}=\frac{n(n+1)}{2}\times\frac{a_2-a_1}{a_{n+1}}$$

51. (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 through (–1, 1) and $\left(-\frac{2}{5},-\frac{2}{5}\right)$.

Equation of line BC is $y-1=\frac{-2/5-1}{-2/5+1}(x+1) \Rightarrow 7x+3y+4=0$

52. (C)

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

53. (C)

$$\sin\frac{9\pi}{14}\sin\frac{11\pi}{14}\sin\frac{13\pi}{14}=\sin\frac{5\pi}{14}\sin\frac{3\pi}{14}.\sin\frac{\pi}{14}$$

$$=\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\frac{3\pi}{7}=-\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}=-\frac{\sin\frac{8\pi}{7}}{8\sin\frac{\pi}{7}}=\frac{1}{8}$$

54. (B)

$$\cos 2^3\frac{\pi}{10}\cos 2^4\frac{\pi}{10}.\cos 2^5\frac{\pi}{10}...\cos 2^{10}\frac{\pi}{10}$$

$$=\frac{\sin 2^{11}\frac{\pi}{10}}{256\sin 2^3\frac{\pi}{10}}=\frac{1}{256}\left[\frac{1}{256}\cdot\frac{\sin\left(2^8\cdot\frac{8\pi}{10}\right)}{\sin\left(\frac{8\pi}{10}\right)}\right]$$

$$=\frac{\sin\left(256\pi+\frac{8\pi}{10}\right)}{256\cdot\sin\left(\frac{8\pi}{10}\right)}=\frac{\sin\frac{8\pi}{10}}{\sin\frac{8\pi}{10}}\cdot\frac{1}{256}=\frac{1}{256}.$$

55. (C)

$$\frac{x-2}{3} = \frac{y-3}{-4} = -15\ \frac{6-12+1}{25} = 3$$

$\therefore$ x = 11, y = – 9 $\therefore$ α = 2

56. (D)

$$\frac{x-1}{-5} = \frac{y-1}{12} = 26\ \frac{-5+12+6}{169} = 2$$

x = – 9, y = 25 $\therefore$ β = 16

57. (A)

(P) $a=\frac{p}{2}\{2a_1+(p-1)d\}$,

$b=\frac{q}{2}\{2a_1+(q-1)d\}$,

$c=\frac{r}{2}\{2a_1+(r-1)d\}$

$\therefore \sum\frac{a}{p}(q-r)=0$

(Q) $R = ak^{r-1}$

$R^{s-t} = a^{s-t}\,k^{(s-t)(r-1)}$

$S^{t-r} = a^{t-r}\,k^{(s-1)(t-r)}$

$T^{r-s} = a^{r-s}\,k^{(t-1)(r-s)}$

$\therefore$ $R^{s-t}\,S^{t-r}\,T^{r-s} = 1$.

(R) $x^{y-z}.y^{z-x}\,z^{x-y} = (AR^{m-1})^{(n-p)d}\,(AR^{n-1})^{(p-m)d}\,(AR^{p-1})^{(m-n)d} = 1$

(S) $\Sigma\, a(b-c)\log a = \frac{1}{abc}\sum\left(\frac{1}{c}-\frac{1}{b}\right)\log a = \frac{1}{abc}\sum(r-q)d(\log A+(p-1)\log R) = 0$

58. (B)

(P) Reduce the expression in the form of $l\cos\theta+m\sin\theta$ whose maximum is $\sqrt{l^2+m^2}$

(Q) $\cos 2\alpha + \cos 2\beta = 2\cos(\alpha+\beta)\cdot\cos(\alpha-\beta)$

$\Rightarrow$ max. $(\cos 2\alpha + \cos 2\beta) = 2\,|\cos(\alpha+\beta)|$

(R) $\sin 2\alpha + \sin 2\beta = 2\sin(\alpha+\beta)\cos(\alpha-\beta)$

$\therefore$ maximum value $= 2\,|\cos(\alpha-\beta)|$

(S) $\theta \in \left(0, \frac{\pi}{2}\right)$

$\tan\theta + \cot\theta \geq 2$

$\tan\theta + \cot\theta - 2\cos 2(\alpha+\beta) \geq 2 - 2\cos 2(\alpha+\beta) \geq 4\sin^2(\alpha+\beta)$

59. (C)

(P) Let P be the point (α, β), then $\alpha^2 + \beta^2 + 2\alpha + 2\beta = 0$ mid point of OP is $\left(\frac{\alpha}{2}, \frac{\beta}{2}\right)$.

$\therefore$ Locus of $\left(\frac{\alpha}{2}, \frac{\beta}{2}\right)$ is $4x^2 + 4y^2 + 4x + 4y = 0$

i.e., $x^2 + y^2 + x + y = 0$ $\therefore$ $2g = 1, 2f = 1$ $\therefore$ $g + f = 1$

(Q) Centres of the circle are (1, 2), (5, -6).

Equation of $C_1 C_2$ is $y - 2 = -\frac{8}{4}(x - 1)$

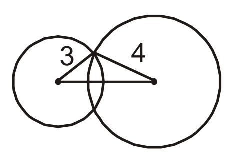
i.e., $2x + y - 4 = 0$

Equation of radical axis is $8x - 16y - 56 = 0$

i.e., $x - 2y - 7 = 0$

Points of intersection is (3, –2).

(R) Let length of common chord be 2a, then



$\sqrt{9 - a^2} + \sqrt{16 - a^2} = 5 \Rightarrow \sqrt{16 - a^2} = 5 - \sqrt{9 - a^2}$

$16 - a^2 = 25 + 9 - a^2 + 10\sqrt{9 - a^2}$

$\sqrt{9 - a^2} = 18 \Rightarrow 100(9 - a^2) = 324$

i.e., $100a^2 = 576$

$\therefore$ $a = \sqrt{\frac{576}{100}} = \frac{24}{10}$ $\therefore$ $2a = \frac{24}{5} = \frac{k}{5} \Rightarrow k = 24$

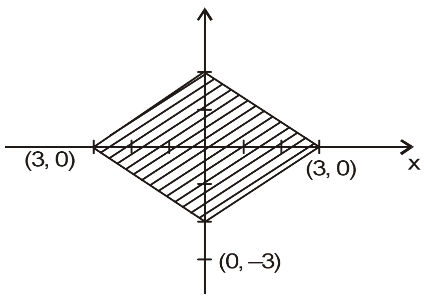
(S) Equation of common chord is 6x + 4y + p + q = 0 common chord pass through centre (–2, –6) of circle $x^2 + y^2 + 4x + 12y + p = 0$

$\therefore$ p + q = 36

60. (C)

(P)

$\therefore$ $2|x| + 3y \le 6$ will represent the shaded region as shown in figure.



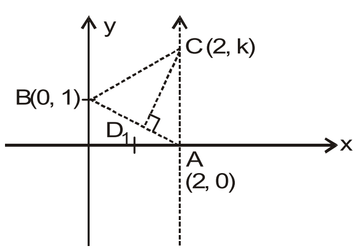
$\therefore$ required area = $4 \times \frac{1}{2} \times 3 \times 2$.

= 12 sq. units.

(Q)

$\therefore$ D $\left(1, \frac{1}{2}\right)$

$\therefore$ CD is perpendicular AB. $\Rightarrow \frac{k - \frac{1}{2}}{2 - 1} = 2$.



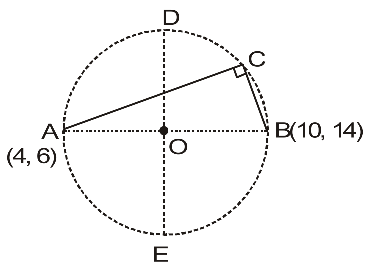
$\Rightarrow$ $k = \frac{5}{2}$.

$\therefore$ slope of BC = $\frac{3}{4}$

$\therefore$ 4m = 3.

(R)

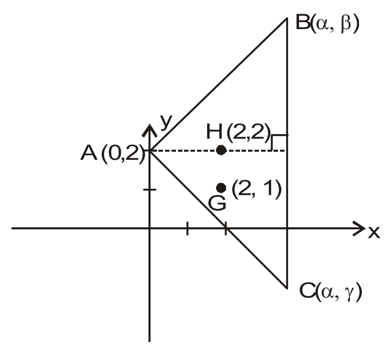
$\therefore$ Area of triangle ABC = 20 square units



$\therefore$ C can not be at D and E.

$\therefore$ four positions are possible two above AB and two below AB.

(S)



$\therefore \quad \frac{\alpha+\alpha+0}{3} = 2$

$\alpha = 3$.

$\therefore$ x- coordinate of B = 3.