SOLUTIONS

PROGRESS TEST-6

GZR-1901 TO 1907

GZRK-1901 & 1902 & GZBS-1901

(JEE MAIN PATTERN)

Test Date: 16-09-2017

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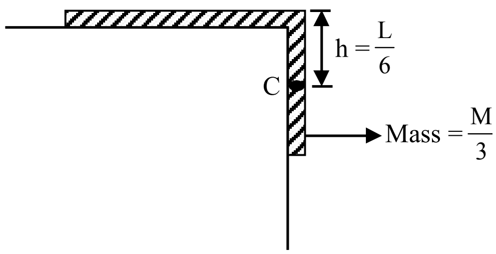
PHYSICS

1. (D)

Mass of hanging portion is $\frac{M}{3}$ (one-third) and centre of mass c, is at a distance h = $\frac{L}{6}$ below the table top.

Therefore, the required work done is,



$$W = mgh = \left(\frac{M}{3}\right)(g)\left(\frac{L}{6}\right) = \frac{MgL}{18}$$

2. (A)

Work = Force × Camponent of displacement along force

3. (D)

Tension acts perpendicular to displacement. Hence no work.

4. (B)

$$x = \frac{t^4}{4},$$

$$\therefore v = \frac{dx}{dt} = t^3$$

$$\therefore a = \frac{dv}{dt} = 3t^2$$

$$\therefore f = ma = 1 \times 3t^2$$

$$\therefore w = \int F.v\,dt = \int_0^1 3t^2 \times t^3\,dt = \frac{1}{2} J$$

5. (C)

$$w = Fs\cos\theta \Rightarrow 25 = 5 \times 10 \times \cos\theta \Rightarrow \theta = 60^\circ$$

6. (D)

$$K = \frac{p^2}{2m}$$

$$\therefore \frac{K'}{K} = \frac{(1.5)^2}{1} \Rightarrow K' = 125\%$$

7. (B)

$\vec{s} = \hat{i} + \hat{j}$

$\therefore\ w = \vec{F}.\vec{s} = 8J$

From work – energy theorem

$8 = \frac{1}{2} \times 1 \times \left(v^2 - 2^2\right) \Rightarrow v = 4.5\ m/s$

8. (A)

For tangential forcé W.D. against gravity as well as friction is independent from path followed.

9. (B)

Clearly $mgh \times 2 = Mg(H-h) \Rightarrow h = \frac{H}{3}$

& $v = \sqrt{2g\left(H - \frac{H}{3}\right)} = 2\sqrt{\frac{2H}{3}}$

10. (B)

$v = \frac{dt}{dt} = 2t + 2,$ $\therefore\ v_i = 6\,m/s$ $v_f = 10\,m/s$

$\therefore w = \frac{1}{2}m\left(v_f^2 - v_i^2\right) = 64\,J$

11. (D)

$a = \frac{v-0}{t_1}$ $\therefore\ F = \frac{mv}{t_1}$ Also $s = 0 + \frac{1}{2}\left(\frac{v}{t_1}\right)t^2$

$\therefore w = \frac{mv}{t_1} \times \frac{1}{2} \cdot \frac{v}{t_1} \cdot t^2 = \frac{1}{2}\frac{mv^2}{t_1^2} \times t^2$

12. (A)

Displacement = Area = 50 m (using similar angle trianyle)

Force = mass × acceleration = mass × slope = 6 N

$\therefore\ w = 6 \times 50 = 300\,J$

13. (B)

$\vec{F} = 30\left(\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}\right) = 10\sqrt{3}\ \left(\hat{i} + \hat{j} + \hat{k}\right)$

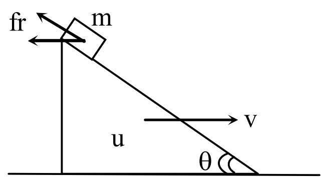
$\vec{S} = \vec{r}_2 - \vec{r}_1 = \hat{i} + 2\hat{k}$

$\therefore w = \vec{F}.\vec{s} = 10\sqrt{3}(1+2) = 30\sqrt{3}\ J$

14. (D)

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

15. (B)



f_r = mg sinθ

Work done by fr = – mg sinθ cosθ vt

$= -\ \frac{mg\sin 2\theta}{2}(v \times t)$

16. (B)

Clearly $\frac{\sqrt{3}}{2}v = 10 \times \frac{1}{2} \Rightarrow v = \frac{10}{\sqrt{3}}$

$$\therefore\ w = \frac{5\sqrt{3} - \frac{5}{\sqrt{2}}}{2} = \frac{5}{\sqrt{3}}\ \text{rad/sec}$$

17. (C)

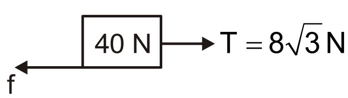
$$t = \frac{\sqrt{\left(50\sin 30^\circ\right)^2 + 2\times 10\times 70} + 50\sin 30^\circ}{10} = 7\,\text{sec}$$

18. (C)

Component of velocity in vertical should be same.

19. (D)

From f.b.d.



$$\mu = \frac{8\sqrt{3}}{40} \simeq 0.35$$

20. (A)

Resolve the applied force and get normal reaction and limiting friction

21. (C)

$a = g\sin g\ 45^\circ + \mu g\cos 45^\circ$

22. (A)

$$\mu \times \frac{mv^2}{R} = mg \Rightarrow v = \sqrt{\frac{gR}{\mu}}$$

23. (C)

Common acceleration $a = \frac{KA}{2m}$

$\therefore f_r = ma = \frac{KA}{2}$

24. (C)

Clearly $\mu = \tan\theta = \frac{3}{4}$

25. (C)

Use homogenity of dimensión and use

$\mu \rightarrow$ Dimension less quantity

$\lambda \rightarrow$ meter

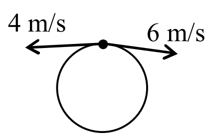
26. (B)

$t = \frac{d}{v}$ is possible only when swimmer moves across the river. But there will be drifting in this case.

27. (B)

$F = m\sqrt{a_t^2 + a_r^2}$

28. (B)



$\therefore S_1 + S_2 = 2\pi r$

$\therefore 4t + 6t = 2\pi r = t = \frac{2\pi r}{10} = \frac{2 \times 3.14 \times 4}{10} = 2.5$ s

29. (C)

$v\frac{dv}{dx} = 2x + 1$

$vdv = (2x + 1)\,dx$

$\int_0^v v\,dv = \int_0^x (2x+1)\,dx \qquad \Rightarrow \frac{v^2}{2} = x^2 + x$

30. (C)

$N = mg\cos\theta$

$kx = N\sin\theta$

$\quad = mg\cos\theta \times \sin\theta$

$x = \frac{mg\sin^2\theta}{2k}$

CHEMISTRY

31. (B)

Root mean square speed = V

$$\sqrt{\frac{3RT}{M}} = V$$

Then $\frac{3RT}{M} = V^2$

$$\frac{\frac{\cancel{3R}\,T_1}{\cancel{M}}}{\frac{\cancel{3R}T_2}{\cancel{M}}} = \frac{V^2}{x^2}$$

$$\frac{140}{560} = \left(\frac{v}{x}\right)^2$$

$$\frac{v}{x} = \sqrt{\frac{1}{4}}$$

x = 2V

32. (C)

33. (B)

$T_1 < T_2 < T_3$

34. (B)

$$V_{t^0} = V_0 + \frac{t\,V_0}{273}$$

$$V_{40^o} = V_0 + \frac{40\ \ V_o}{273}$$

$$V_{41^o} = V_0 + \frac{41\ \ V_o}{273}$$

$$V_{41^o} - V_{40^o} = \frac{V_0}{273}$$

35. (C)

$$\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

for b = 0,

$$PV_m + \frac{a}{V_m} = RT$$

$PV_m = RT - \frac{a}{V_m}$

From graph,

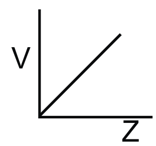
$\text{Slope} = -a = \frac{21.6 - 20.1}{2 - 3}$

$\therefore$ a = 1.5

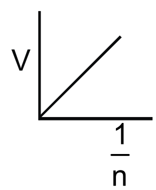
36. (D)

$V_n = 2.18 \times 10^8 \times \frac{Z}{n}\ \text{cm/sec}$

$V_n \propto Z; \quad V_n = KZ$



$V_n = K.\frac{1}{n}$



37. (D)

$E \alpha \frac{1}{\lambda}$

λ highest than E is minimum

$E_5 - E_4 < E_5 - E_3 < E_5 - E_2 < E_5 - E_1$

38. (C)

Higher (n + l) means higher energy.

39. (A)

$0.5 = \frac{0.4 \times V \times 2 + 50 \times 0.3}{50 + V}$

V = 33.33 ml

40. (D)

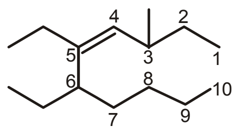
Let the water added is V ml

16 × 0.5 = (16 + v) × 0.2

40 = 16 + V

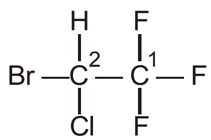
V = 24 ml.

41. (B)

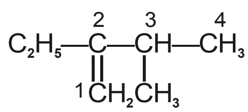


5, 6-Diethyl-3-methyldec-4-ene

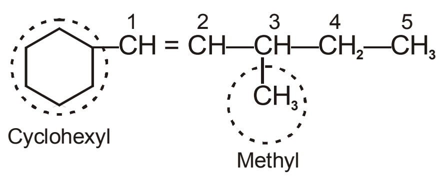
42. (C)



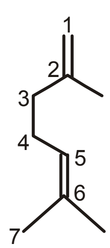
43. (B)



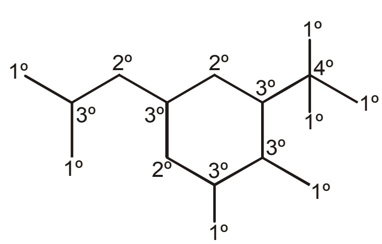
44. (A)



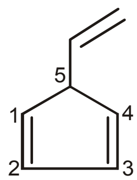
45. (C)



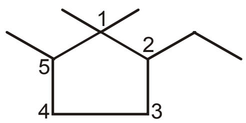
46. (C)



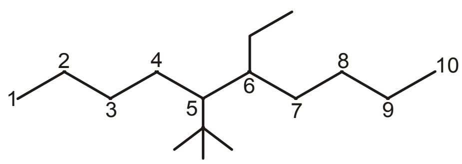
47. (A)



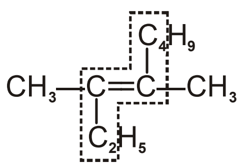
48. (C)



49. (B)



50. (C)



51. (B)

$A + A \rightarrow A^- + A^+$ 4eV

I.P. – E.A. = 4eV ....(i)

$A^- \rightarrow A^+$

$IP + EA = 10eV$ ....(ii)

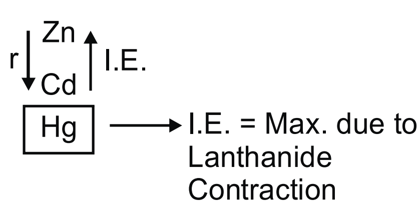
From (i) and (ii)

IP = 7eV

EA = 3eV

52. (C)

53. (D)



I.E. = Hg > Zn > Cd

54. (D)

Ge

Sn, Pb } (Exception) Lanthanide Contraction

$I.E_1$ = Ge > Pb > Sn

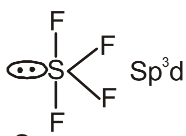
55. (C)

56. (A)

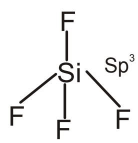
57. (B)

58. (B)

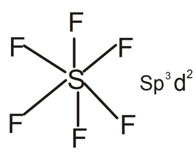
(A)



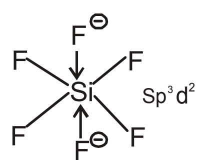
Sea saw



(B)

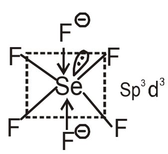


octahedral



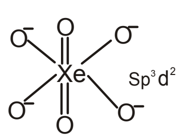
octahedral

(C)

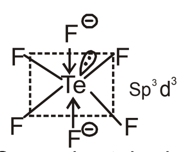


Capped octahedral

(D)



octahedral

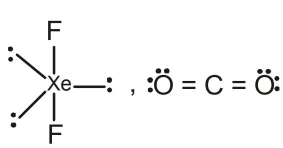


Capped octahedral

59. (A)

BeF_3^- $\langle Sp^2 \rangle$

60. (B)



MATHEMATICS

61. (A)

$$x = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + ...\text{to } \infty$$

$$= \left(\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + ...\text{to } \infty\right) - \left(\frac{1}{2^4} + \frac{1}{4^4} + ...\text{to } \infty\right)$$

$$= \frac{\pi^4}{90} - \frac{1}{16}\left(\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + ...\text{to } \infty\right) = \frac{\pi^4}{90} - \frac{1}{16}.\frac{\pi^4}{90} = \frac{\pi^4}{96}$$

62. (A)

63. (B)

Here $2\sin\frac{\alpha+\beta}{2}.\cos\frac{\alpha-\beta}{2} = a, 2\sin\frac{\alpha+\beta}{2}.\sin\frac{\beta-\alpha}{2} = b$

Now, divide and get the value

64. (B)

$\sin n\theta = b_0 + b_1\sin\theta + b_2\sin^2\theta + ...$

This is possible when n is an odd integer.

Put $\theta = 0$ to get b_0. After differentiating w.r.t. θ, put $\theta = 0$ to get b_1.

65. (A)

66. (A)

As the points are in order, the are

$$= \left|\frac{1}{2}\left\{\begin{vmatrix}4 & 1\\3 & 6\end{vmatrix} + \begin{vmatrix}3 & 6\\-5 & 1\end{vmatrix} + \begin{vmatrix}-5 & 1\\-3 & -3\end{vmatrix} + \begin{vmatrix}-3 & -3\\-3 & 0\end{vmatrix}\begin{vmatrix}-3 & 0\\4 & 1\end{vmatrix}\right\}\right| = 30 \text{ unit}^2$$

67. (A)

68. (D)

$\tan(180° - \theta) = \text{slope of } AB = -3$

$\therefore \quad \tan\theta = 3$

$\therefore \quad \frac{OC}{AC} = \tan\theta, \frac{OC}{BC} = \cot\theta$

$\Rightarrow \quad \frac{BC}{AC} = \frac{\tan\theta}{\cot\theta} = \tan^2\theta = 9$

69. (D)

$$|x|\left(\frac{1+|x|}{x^2+x+1}\right)\le 0 \quad \Rightarrow x=0$$

70. (C)

71. (C)

For internal point p(2, 8) 4 + 64 – 4 + 32 – p < 0 $\Rightarrow$ p > 96 and x intercept = $2\sqrt{1+p}$ therefore 1 + p > 0

$\Rightarrow$ p > – 1 and y intercept = $2\sqrt{4+p}$ $\Rightarrow$ p > – 4

Combining the above conditions on p we get p > 96 i.e. $p\in(96,\infty)$

72. (A)

Let d be the distance between the centres of two circles of radii r_1 and r_2.

These circle intersect at two distinct points if $|r_1 - r_2| < d < r_1 + r_2$

Here, the radii of the two circles are r and 3 and distance between the centres is 5.

centres is 5.

Thus, $|r - 3| < 5 < r + 3 \Rightarrow -2 < r < 8$ and $r > 2 \Rightarrow 2 < r < 8$.

73. (C)

The cosine formula applied to triangle Q_1OQ_2 gives $\cos\angle Q_2OQ_1 = \dfrac{OQ_1^2 + OQ_2^2 - Q_1Q_2^2}{2\cdot OQ_1\cdot OQ_2}$

$$= \frac{(x_1-0)^2+(y_1-0)^2+(x_2-0)^2+(y_2-0)^2-[(x_1-x_2)^2+(y_1-y_2)^2]}{2\cdot OQ_1\cdot OQ_2} = \frac{2\,(x_1x_2)+2(y_1y_2)}{2\cdot OQ_1\cdot OQ_2}$$

$$\therefore \quad OQ_1\cdot OQ_2 \cos\angle Q_1OQ_2 = x_1x_2 + y_1y_2$$

74. (A)

75. (D)

The equation of the common chord of the circles $x^2 + y^2 - 4x - 4y = 0$ and $x^2 + y^2 = 16$ is x + y = 4 which meets the circle $x^2 + y^2 = 16$ at points A(4, 0) and B(0, 4). Obviously OA $\perp$ OB. Hence the common chord AB makes a right angle at the centre of the circle $x^2 + y^2 = 16$.

Hence (D) is the correct answer.

76. (D)

It can be seen that the given points P(p, q), $C\left(\frac{p}{2},\frac{q}{2}\right)$ and the origin are collinear which implies that line OP where O is the origin is a diameter of the given circle. Therefore, equation of the given circle is

$x(x - p) + y(y - q) = 0$

i.e. $x^2 + y^2 - px - qy = 0$.......(1)

Let M(a, 0) be the mid-point of a chord AP (see fig.). Then, we have

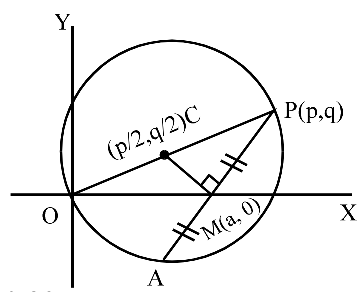
$CM \perp AP$

i.e. slope of CM × slope of AP = – 1 $\Rightarrow \dfrac{\frac{q}{2}}{\frac{p}{2} - a} \times \dfrac{q}{p - a} = -1$

i.e. $q^2 + (p - 2a)(p - a) = 0$

i.e. $2a^2 - 3pa + p^2 + q^2 = 0$ .... (2)

Equation (2) which is a quadratic equation in a shows that there will be two real and distinct values of a if the discriminant is > 0



i.e. if $(3p)^2 - 4 \times 2(p^2 + q^2) > 0$

i.e. if $p^2 > 8q^2$

which is the desired result.

Aliter. Equation of the given circle is

$x^2 + y^2 - px - qy = 0$....... (1)

Equation of any line through P(p, q) can be written as

$y - q = m(x - p)$ (where m is a variable)

i.e. $x = \dfrac{y + (mp - q)}{m}$ .... (2)

putting the value of x from equation (2) in equation (1) will give the ordinate of the intersection points of the line and the given circle as

$$\left\{\frac{y + (mp - q)}{m}\right\}^2 + y^2 - p\left\{\frac{y + (mp - q)}{m}\right\} - qy = 0$$

i.e. $\{y + (mp - q)\}^2 + m^2y^2 - mp\{y + (mp - q)\} - m^2qy = 0$

i.e. $(1 + m^2)y^2 + \{2(mp - q) - mp - m^2q\}y + (mp - q)^2 - mp(mp - q) = 0$

i.e. $(1 + m^2)y^2 + (pm - 2q - qm^2)y - q(mp - q) = 0$ ....(3)

The above equation gives the Y coordinates of the intersection points of the chord and the given circle. According to the given condition, the mid-point of this intercept lies on the X-axis, therefore we have sum of the roots of equation (3) = 0

i.e. $pm - 2q - qm^2 = 0$

i.e. $qm^2 - pm + 2q = 0$.......(4)

The above equation shows that there will be two real and distinct values of m if $p^2 > 8q^2$ which is the desired result.

77. (A)

Homogenize the equation $3x^2+4xy-4x(2x+y)+(2x+y)^2=0$, now, coefficient of x^2 + coefficient of y^2 = 0

Thus angle between lines is $\frac{\pi}{2}$

78. (A)

$S=1+\frac{2}{3}+\frac{6}{3^2}+\frac{10}{3^3}+\frac{14}{3^4}.......\infty$ .... (i)

$\frac{1}{3}S=\frac{1}{3}+\frac{2}{3^2}+\frac{6}{3^3}..........\infty$ ....(ii)

from equation (i) and (ii)

$$S\left(1-\frac{1}{3}\right)=1+\frac{1}{3}+\frac{4}{3^2}+\frac{4}{3^3}......\infty$$

$$S\left(\frac{2}{3}\right)=\frac{4}{3}+\frac{4}{9}\left(1+\frac{1}{3}+\frac{1}{3^2}......\infty\right)$$

$$S\left(\frac{2}{3}\right)=2, \Rightarrow S=3$$

79. (B)

$$a=1+10+10^2+...+10^{54}$$

$$=\frac{10^{55}-1}{10-1}=\frac{10^{55}-1}{10^5-1}\times\frac{10^5-1}{10-1}=bc$$

80. (A)

$x = 1 + a + a^2 ....\infty$

$x=\frac{1}{1-a}\Rightarrow 1-a=\frac{1}{x}\Rightarrow a=\frac{x-1}{x}$ ....(i)

$y=1+b+b^2..........\infty$

$y=\frac{1}{1-b}\Rightarrow b=\frac{y-1}{y}$ ....(ii)

Given

$$1+ab+a^2b^2......\infty=\frac{1}{1-ab}$$

$$=\frac{1}{1-\frac{(x-1)(y-1)}{xy}}$$

$$=\frac{xy}{x+y-1}$$

81. (C)

If $a_1, a_2, a_3, \ldots\ldots a_n$ are in H.P.

$\therefore \frac{1}{a_1}, \frac{1}{a_2}, \frac{1}{a_3} \ldots\ldots \frac{1}{a_n}$ are in A.P.

$\therefore \frac{1}{a_2} - \frac{1}{a_1} = d$ where d is common difference of A.P.

$\Rightarrow a_1 - a_2 = a_1 a_2 d$ (i)

$\Rightarrow \frac{1}{a_3} - \frac{1}{a_2} = d \Rightarrow a_2 - a_3 = d a_3 a_2$ (ii)

$\Rightarrow \frac{1}{a_n} - \frac{1}{a_{n-1}} = d \Rightarrow a_{n-1} - a_n = d a_{n-1} a_n$ (iii)

adding all these equation

$$(a_1 - a_2) + (a_2 - a_3) + (a_3 - a_4) + \ldots\ldots + (a_{n-1} - a_n) = d(a_1a_2 + a_2a_3 \ldots\ldots + a_na_{n-1})$$

$$a_1 - a_n = d(a_1a_2 + a_2a_3 \ldots\ldots + a_na_{n-1})$$

$$(n-1)a_1a_nd = d(a_1a_2 + a_2a_3 \ldots\ldots + a_na_{n-1})$$

$$(n-1)a_1a_n = (a_1a_2 + a_2a_3 + a_3a_4 \ldots\ldots + a_na_{n-1})$$

82. (B)

As log2, $\log(2^x - 1)$ and $\log(2^x + 3)$ are in A.P.,

$2\log(2^x - 1) = \log 2 + \log(2^x + 3) \Rightarrow (2^x - 1)^2 = 2(2^x + 3)$

$\Rightarrow 2^{2x} - 4 \times 2^x - 5 = 0 \Rightarrow (2^x - 5)(2^x + 1) = 0$

As 2^x cannot be negative, we get $2^x = 5$ or $x = \log_2 5$.

Hence (B) is the correct answer.

83. (A)

Let T_r be the rth term of the given series. Then,

$$T_r = \frac{2r+1}{1^2+2^2+...+r^2}$$

$$= \frac{6(2r+1)}{(r)(r+1)(2r+1)}$$

$$= 6\left(\frac{1}{r} - \frac{1}{r+1}\right)$$

So, sum is given by

$$\sum_{r=1}^{50} T_r = 6\sum_{r=1}^{50}\left(\frac{1}{r} - \frac{1}{r+1}\right)$$

$$= 6\left[\left(1-\frac{1}{2}\right)+\left(\frac{1}{2}-\frac{1}{3}\right)+\left(\frac{1}{3}-\frac{1}{4}\right)+...+\left(\frac{1}{50}-\frac{1}{51}\right)\right]$$

$$= 6\left[1-\frac{1}{51}\right]$$

$$= \frac{100}{17}$$

84. (D)

$$m_1 + m_2 = \frac{-2h}{b}, m_1 m_2 = \frac{a}{b} \Rightarrow m + 4m = \frac{-10}{1} \Rightarrow m = -2$$

and $m \times 4m = \frac{a}{1} \Rightarrow 4(-2)^2 = a \Rightarrow a = 16$

85. (B)

The given circle $x^2 + y^2 - 4x - 6y - 12 = 0$ has its centre at (2, 3) and radius equal to 5.

Let (h, k) be the coordinates of the centre of the required circle. Then, the point (h, k) divides the line joining (– 1, – 1) to (2, 3) in the ratio 3 : 2, where 3 is the radius of the required circle. Thus, we have

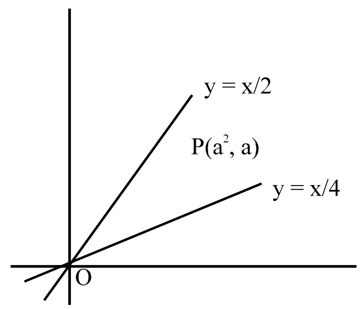
$$h = \frac{3\times 2 + 2(-1)}{3+2} = \frac{4}{5} \text{ and } k = \frac{3\times 3 + 2(-1)}{3+2} = \frac{7}{5}$$

Hence, the equation of the required circle is

$$\left(x - \frac{4}{5}\right)^2 + \left(y - \frac{7}{5}\right)^2 = 3^2 \Rightarrow 5x^2 + 5y^2 - 8x - 14y - 32 = 0.$$

86. (C)

We have $a - \frac{a^2}{4} > 0$ and $a - \frac{a^2}{2} < 0$



$\Rightarrow \left(a - \frac{a^2}{4}\right)\left(a - \frac{a^2}{2}\right) < 0 \Rightarrow a \in (2, 4)$

87. (A)

The equation of the given circle is

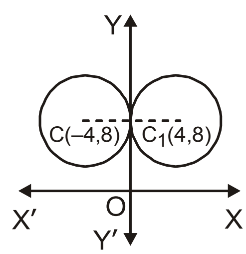
$x^2 + y^2 + 8x - 16y + 64 = 0$

$\Rightarrow (x^2 + 8x + 16) + (y^2 - 16y + 64) = 16$

$\Rightarrow (x + 4)^2 + (y - 8)^2 = 4^2$

$\Rightarrow \{x - (-4)\}^2 + (y - 8)^2 = 4^2.$

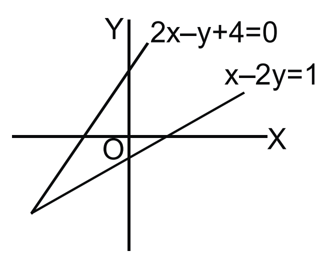
Clearly, its centre is at (–4, 8) and radius = 4.



The image of this circle in the line mirror has its center C_1 (4, 8) and radius 4. So, its equation is $(x - 4)^2 + (y - 8)^2 = 4^2$ or, $x^2 + y^2 - 8x - 16y + 64 = 0$.

88. (B)

Clearly from the figure, the origin is contained in the acute angle. Writing the equations of the lines as $2x - y + 4 = 0$ and $-x + 2y + 1 = 0$, the required bisector is $\frac{2x - y + 4}{\sqrt{5}} = \frac{-x + 2y + 1}{\sqrt{5}}$



89. (C)

As we know that diagonals of a square are perpendicular to each other.

Let the equation of other diagonal is

$x + 7y = k.$

Also, passes through (–4, 5).

$\therefore \quad -4 + 35 = k$

$\Rightarrow \quad k = 31$

$\therefore$ Required equation is $x + 7y - 31 = 0$

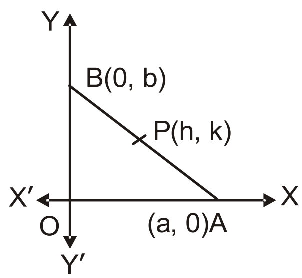
90. (A)

Let the two perpendicular lines be the coordinate axes. Let AB be rod of length l and the coordinates of A and B be (a, 0) and (0, b) respectively.

Let P (h, k) be the mid point of the rod AB in one of the infinte position it attains, then

$$h = \frac{a+0}{2} \text{ and } k = \frac{0+b}{2}$$

$$\Rightarrow h = \frac{a}{2} \text{ and } k = \frac{b}{2} \text{ ... (i)}$$



From ΔOAB, we have

$AB^2 = OA^2 + OB^2$

$\Rightarrow a^2 + b^2 = l^2$

$\Rightarrow (2h)^2 + (2k)^2 = l^2$

$\Rightarrow 4h^2 + 4k^2 = l^2$

$\Rightarrow h^2 + k^2 = \frac{l^2}{4}.$