PART (A) : PHYSICS

ANSWER KEY

1.	(C)	2.	(B)	3.	(D)	4.	(B)	5.	(C)
6.	(C)	7.	(A)	8.	(C)	9.	(B)	10.	(A)
11.	(B)	12.	(C)	13.	(D)	14.	(B)	15.	(A)
16.	(C)	17.	(D)	18.	(D)	19.	(B)	20.	(B)
21.	(4)	22.	(4)	23.	(1)	24.	(5)	25.	(4)
26.	(1)	27.	(7)	28.	(2)	29.	(5)	30.	(3)

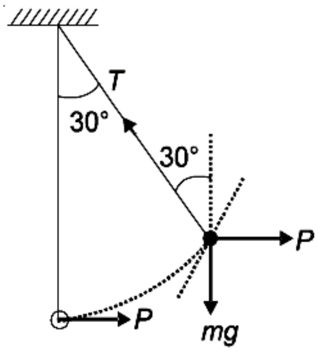
SOLUTIONS

1. (C)

$F = T + mg\sin\theta$

$F = 2mg + mg\sin\theta$

2. (B)



Tension $= T$

$P = T\sin\theta$ ......(i)

$mg = T\cos\theta$ .....(ii)

Divide (i)by(ii), $\frac{P}{mg} = \tan\theta \quad P = mg\tan\theta$

Suppose the bob swings through arc length x and it becomes $x + dx$ when the angular displacement increases from θ to $\theta + d\theta, x = l\theta, dx = ld\theta$

Work done by force P is $W = \int \vec{P}.d\vec{x}$

$$= \int P\cos\theta\, dx$$

$$= \int_0^{30^\circ} P\cos\theta\, l d\theta$$

$$= \left|P\sin\theta l\right|_0^{30} = \frac{Pl}{2}$$

3. (D)

$$\frac{1}{2}mv^2 = 12\times\frac{3}{4} = 9$$

$$\Rightarrow v = 3m/s$$

4. (B)

$$W = \frac{1}{2}mv_f^2 - \frac{1}{2}mv^2 \Rightarrow v_f = \sqrt{\frac{2W}{m} + v^2}$$

5. (C)

$$\frac{1}{2}kx^2 = \frac{1}{2}m\left(v^2 - \frac{v^2}{4}\right)$$

$$\therefore\ k = \frac{3mv^2}{4x^2} = \frac{6mv^2}{8x^2}$$

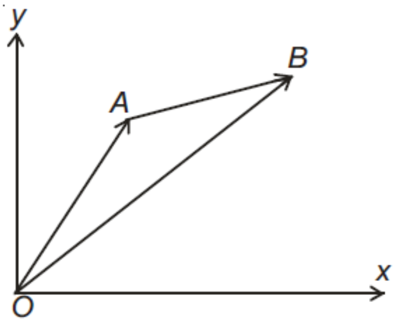
6. (C)

Acceleration $= \frac{v^2}{r}$ towards centre

$$\therefore |\vec{a}| = \frac{4^2}{2} = \frac{16}{2} = 8 \text{ towards centre}$$

$$\text{i.e., } \vec{a} = 8\left(-\hat{j}\right)$$

7. (A)



$$m_A = 2kg$$

$$m_B = 5kg$$

$$\overline{OA} = 2\hat{i} + 3\hat{j}, \overline{AB} = 5\hat{i} + 8\hat{j}$$

$$\overline{OB} = \overline{OA} + \overline{AB}$$

$$= 7\hat{i} + 11\hat{j}$$

$$\vec{r}_{cm} = \frac{m_A\vec{r}_{OA} + m_B\vec{r}_{OB}}{m_A + m_B} = \frac{39\hat{i} + 61\hat{j}}{7}$$

$$\therefore \text{ co-ordinate of centre of mass } = \left(\frac{39}{7}, \frac{61}{7}\right)$$

8. (C)

$$x_{cm} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2} = \frac{m.(0) + m\left(\frac{\ell}{2}\right)}{2m} = \frac{\ell}{4}$$

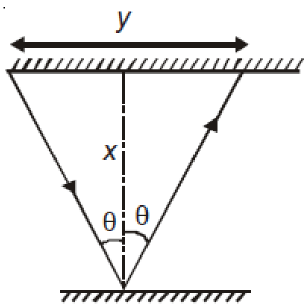
$$y_{cm} = \frac{m_1y_1 + m_2y_2}{m_1 + m_2} = \frac{m.\left(\frac{\ell}{2}\right) + m(\ell)}{2m} = \frac{3\ell}{4}$$

9. (B)

$$V_{cm} = \frac{m_1V_1 + m_2V_2}{m_1 + m_2} = \frac{2\times25 - 2\times5}{2+2} = 10m/s$$

10. (A)

Let the angle of incident is θ then from figure we can see that



$$\tan\theta = \frac{4}{2x}$$

So as x decreases then y will also decrease.

11. (B)

$$\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$$

$$\frac{n^2a}{V^2} = P$$

$$\Rightarrow a = \frac{PV^2}{n^2}$$

$\therefore$ Dimension of a $= \left[ML^5T^{-2}mol^{-2}\right]$

12. (C)

$$x = \frac{V_0}{\alpha}\left(1 - e^{-\alpha t}\right)$$

$$[\alpha] = T^{-1}$$

$$\frac{V_0}{\alpha} = [L]$$

$\Rightarrow V_0 = \left[LT^{-1}\right]$

13. (D)

$v \rightarrow \left[T^{-1}\right]$

Also, $\sqrt{\frac{F}{ML}} \rightarrow \left[T^{-1}\right]$

14. (B)

Decrease in potential energy of 1 kg = increase in kinetic energy of both

$\therefore \quad 1\times10\times1 = \frac{1}{2}(4+1)v^2$

$v = 2\ \text{m/s}$

15. (A)

$t = px^2 + qx$

$\frac{1}{v} = \frac{dt}{dx} = 2px + q$

$\Rightarrow v = \frac{1}{2px+q}$

Also acceleration $a = \frac{dv}{dt} = \frac{-1\times2p}{(2px+q)^2}\times\frac{dx}{dt}$

$a = -2pv^2 \times v$

$\therefore a \propto v^3$

16. (C)

Using $y = ut + \frac{1}{2}gt^2$,

$t_1t_2 = \frac{2h}{g} \Rightarrow h = \frac{t_1t_2g}{2} = \frac{6\times2\times10}{2} = 60m$

$\vec{s} = \vec{u}t + \frac{1}{2}\vec{a}t^2 \Rightarrow -60 = u\times6 - \frac{1}{2}\times10\times6^2 \Rightarrow u = 20m/s$

17. (D)

Let $|\vec{A}| = (P+Q)$

$|\vec{B}| = (P-Q)$

Given $|\vec{A}+\vec{B}| = \sqrt{P^2+Q^2}$

$\Rightarrow \sqrt{P^2+Q^2} = \sqrt{|\vec{A}|^2 + |\vec{B}|^2 + 2|\vec{A}||\vec{B}|\cos\theta}$

$$\Rightarrow \cos\theta = \frac{P^2 + Q^2}{2\left(Q^2 - P^2\right)}$$

18. (D)

If $\vec{A}$ and $\vec{B}$ are two vectors, then

$$\left|\left|\vec{A}\right| - \left|\vec{B}\right|\right| \le \left|\vec{A} + \vec{B}\right| \le \left|\vec{A}\right| + \left|\vec{B}\right|$$

19. (B)

$$v_{y_1} = v_{y_2}$$

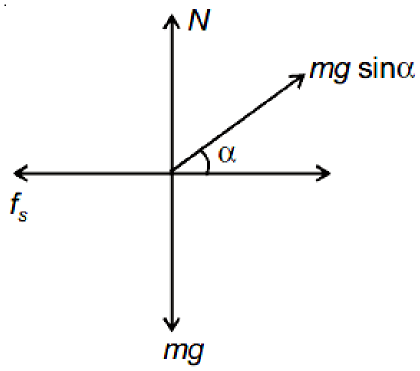
$$\Rightarrow v_1 \sin 30 = v_2$$

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

$$\frac{v_1}{v_2} = 2$$

20. (B)

FBD of $m(\text{w.r.t.}2m)$



For no sliding,

$$(mg\sin\alpha)\cos\alpha \le f_s^{max}$$

$$(mg\sin\alpha)\cos\alpha \le (\mu)\left(mg - mg\sin^2\alpha\right)$$

$$mg\sin\alpha\cos\alpha \le \mu\, mg\cos^2\alpha$$

$$\sin\alpha \le \mu\cos\alpha$$

$$\tan\alpha \le \mu$$

$$\alpha \le \tan^{-1}(\mu)$$

21. (4)

$$16t = 8$$

$$t = \frac{1}{2}$$

At $t=\frac{1}{2}$ $P=2$

So, $F_{av}=\frac{2}{1/2}=4$

22. (4)

For maximum,

$m_2g = Mg\sin 37^\circ + \mu Mg\cos 37^\circ$

For minimum,

$m_1g = Mg\sin 37^\circ - \mu Mg\cos 37^\circ$

So, $(m_2 - m_1)g = 2\mu Mg\cos 37^\circ$

$(m_2 - m_1) = 2\times\frac{1}{2}\times 5\times\frac{4}{5} = 4kg$

23. (1)

$\frac{1}{2}kd^2 = \mu mgd$

$d = \frac{2\mu mg}{k} = \frac{2\times 0.5\times 4\times 10}{50} = 0.8m$

So, answer is 1m.

24. (5)

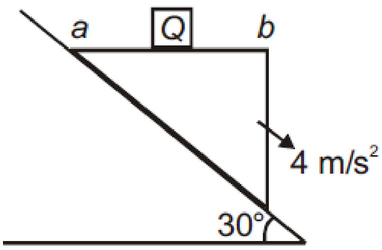
$a_{cm} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2 g$

$a_{cm} = \left(\frac{3-1}{3+1}\right)^2 g$

$a_{cm} = \frac{g}{4} = 2.5\,m/s^2$

$\therefore x = 5$

25. (4)



$a_Q = a_P\ \sin 30^\circ = 4\times\frac{1}{2} = 2m/s^2$

$Mg - N = ma_Q$

$\Rightarrow N = mg - m a_Q$

$= 0.5 \times 10 - 0.5 \times 2 = 5 - 1 = 4N$

26. (1)

$v = \dfrac{p^b d^c}{l^a}$

Equating dimension of both side

$\left[M^0 L^0 T^{-1}\right] = \left[ML^{-1}T^{-2}\right]^b \left[ML^{-3}\right]^c \left[L^{-a}\right]$

$0 = b + c$

$0 = -b - 3c - a$

$-1 = -2b$

Solving these,

$c = -\dfrac{1}{2}$

$a = -\dfrac{1}{2} + \dfrac{3}{2} = 1$

$b = \dfrac{1}{2}$

$a + b + c = 1$

27. (7)

$F = \dfrac{mv^2}{r}$

For maximum error,

$\dfrac{\Delta F}{F} \times 100 = \left(\dfrac{\Delta m}{m} + \dfrac{2\Delta v}{v} + \dfrac{\Delta r}{r}\right) \times 100$

$= \left(\dfrac{0.1}{4} + 2 \times \dfrac{0.1}{10} + \dfrac{0.2}{8}\right) \times 100$

$= \dfrac{10}{4} + \dfrac{20}{10} + \dfrac{20}{8}$

$= 2.5 + 2 + 2.5 = 7\%$

28. (2)

$a = \dfrac{vdv}{dx} = \left(x^2 + x\right)\left(2x + 1\right) = 30$

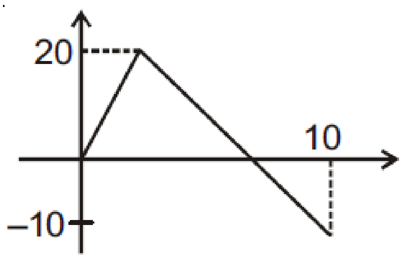
$\Rightarrow x = 2m$

29. (5)

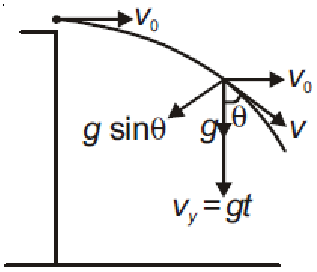
Total distance travelled is $20 + 20 + 10 = 50$

Time $= 10s$

Average speed $= \dfrac{50}{10} = 5 m/s$



30. (3)



$$R = \frac{v^2}{g\sin\theta}$$

$$\sin\theta = \frac{v_0}{v}$$

$$\sin\theta \propto \frac{1}{v}$$

$$R \propto v^3$$

PART (B) : CHEMISTRY

ANSWER KEY

31.	(C)	32.	(D)	33.	(D)	34.	(D)	35.	(D)
36.	(D)	37.	(D)	38.	(D)	39.	(B)	40.	(C)
41.	(A)	42.	(A)	43.	(C)	44.	(C)	45.	(A)
46.	(A)	47.	(C)	48.	(C)	49.	(B)	50.	(B)
51.	(3)	52.	(3)	53.	(9)	54.	(4)	55.	(6)
56.	(6)	57.	(9)	58.	(7)	59.	(1)	60.	(4)

SOLUTIONS

31. (C)

32. (D)

33. (D)

34. (D)

35. (D)

36. (D)

37. (D)

38. (D)

39. (B)

40. (C)

41. (A)

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Mass = density × volume

Density = 0.93 g/cc

Mass of 1 cc of solution = 0.93 × 1 = 0.93 g

The solution contains 18.6% ammonia by weight.

So, 1 cc of solution = 18.6% of 0.93 g ammonia

$$= \frac{18.6 \times 0.93}{100} = 0.173\,\text{g/cm}^3$$

Hence, the correct option is (A).

42. (A)
According to the reaction:
$Ca^{2+} + 2C_8H_7SO_3Na \rightarrow Ca(C_8H_7SO_3)_2 + 2Na^+$
2 mole of the resin requires 1 mole of Ca^{2+} ions.
(2×206 g) of the resin requires 1 mole of Ca^{2+} ions.
So, 1 g of the resin requires
$= \frac{1}{2\times 206} \times 1 = 0.00243$ mole of Ca^{2+} ions.

43. (C)

44. (C)

45. (A)

46. (A)
Maximum polarization is brought about by a cation of high charge.
According to Fajan's rule, polarisation of anion is influenced by charge and size of cation. More is the charge on cation, more is polarisation of anion.
The correct option is (A).

47. (C)
(A) Be_2 : Valence electrons = 4
$(\sigma 2s)^2(\sigma^* 2s)^2$
(B) B_2 : Valence electrons = 6
$(\sigma 2s)^2(\sigma * 2s)^2(\sigma 2p_z)^2$
(C) C_2 : Valence electrons = 8
$(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2p_z)^2(\pi 2p_x)^1(\pi 2p_y)^1$
(D) N_2 : Valence electrons = 10
$(\sigma 2s)^2(\sigma * 2s)^2(\sigma 2p_z)^2(\pi 2p_x)^2(\pi 2p_y)^2$
C_2 has two unpaired electrons, thus its paramagnetic.

48. (C)
Let x be that volume of the cylinder.
Initially at lower end -
P = 76 cm of Hg + 76 cm of air = 152 cm
T = 300 K
$V = \frac{x}{2}$
Finally at lower end-
P = 57 cm of hg + 76 cm of air = 133 cm

$T = ?$

$V = \frac{5x}{8}$

Therefore, for an ideal gas $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$$\frac{152 \times \frac{x}{2}}{300} = \frac{133 \times \frac{5}{8}x}{T}$$

$$\Rightarrow T = \frac{133 \times 5 \times 2 \times 300}{152 \times 8}$$

$$\Rightarrow T = 328.12\ K$$

49. (B)

0.1 g of CO_2 = $\frac{0.1}{44}$ moles of CO_2 occupies 0.32 L.

$\frac{0.2}{M}$ moles of X occupies 0.44 L

PV = nRT

$V \propto n$ ....[At constant T and P]

$$\frac{V_{(CO_2)}}{V_X} = \frac{n_{CO_2}}{n_X} \Rightarrow \frac{0.32}{0.44} = \frac{0.1 \times M}{44 \times 0.2}$$

$$\Rightarrow M = 64$$

& Molar mass of SO_2 = 32 + 32 = 64

50. (B)

Let the volume of NH_3 be x ml, then the volume of H_2 would be (50 – x) ml.
On sparking,

$$NH_3(g) \longrightarrow \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

Since 40 ml of O_2 is added and sparked, it must have reacted with H_2 to form liquid water.
Since 6 ml contraction in volume is there with alkaline pyrogallol as it is known to absorb O_2, so 34 ml is the volume of O_2 used up.

$\therefore$ Total volume of H_2 would be 68 ml. ($\because 2H_2 + O_2 \longrightarrow 2H_2O$)

$\therefore$ $(50 - x) + \frac{3}{2}x = 68,\ 50 + \frac{x}{2} = 68,\ x = 36\ ml$

$\therefore$ % volume of NH_3 in the original mixture

$$= \frac{36}{50} \times 100 = 72\%$$

51. (3)

52. (3)

53. (9)

54. (4)

55. (6)

56. (6)

57. (9)

Given: $\frac{\ell \times m}{n} = 0$ (For Al)

To find : maximum no. of electrons

$\frac{\ell \times m}{n} = 0 \Rightarrow$ This means $\ell = 0$ or m = 0 electrons.

Al = $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^1$

For n = 1, where n = shell no.

ℓ	m_e	
		$\ell =$ angular momentum quantum no.
0	0	$m_e =$ magnetic quantum no.

For n = 2

ℓ	m_e
0	0
1	−1, 0, +1

For n = 3

ℓ	m_e
0	0
1	−1, 0, +1
2	−2, −1, 0, +1, +2

Total no. of electrons with $\ell = 0$ or $m = 0$

$\Rightarrow 2 + 3 + 4 = 9$

Hence maximum no. of electrons = 9

58. (7)

59. (1)

60. (4)

PART (C) : MATHEMATICS

ANSWER KEY

61.	(C)	62.	(C)	63.	(B)	64.	(A)	65.	(C)
66.	(D)	67.	(A)	68.	(B)	69.	(B)	70.	(A)
71.	(A)	72.	(B)	73.	(D)	74.	(A)	75.	(A)
76.	(A)	77.	(B)	78.	(B)	79.	(C)	80.	(B)
81.	(22)	82.	(2)	83.	(2)	84.	(6)	85.	(1002)
86.	(1)	87.	(2)	88.	(8)	89.	(21)	90.	(48)

SOLUTIONS

61. (C)

$\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$

let $f(a)=(3-a)^2-2(1-2a)$

$f(a)=a^2-2a+7$

$f(a)=(a-1)^2+6$

$f(a)_{min}=6$

62. (C)

Let the common difference is 'd'

$a_1+a_7+a_{16}=40$

$\Rightarrow a_1+a_1+6d+a_1+15d=40$

$\Rightarrow 3a_1+21d=40$

$\Rightarrow a_1+7d=\frac{40}{3}$

$S_{15}=\frac{15}{2}[2a_1+14d]$

$=15(a_1+7d)$

$=15\left(\frac{40}{3}\right)$

= 200

63. (B)

Let the centroid of ΔPQR is (h, k) & P is (α,β), then

$\frac{\alpha+1+3}{3}=h$ and $\frac{\beta+4-2}{3}=k$

$\alpha=(3h-4)$ $\quad$ $\beta=(3k-2)$

Point $P(\alpha,\beta)$ lies on line $2x-3y+4=0$

$\therefore 2(3h-4)-3(3k-2)+4=0$

$\Rightarrow$ locus is $6x-9y+2=0$

64. **(A)**

$$2\sin\frac{\pi}{2^{10}}\cos\frac{\pi}{2^{10}}...\cos\frac{\pi}{2^2}$$

$$2\times\frac{\sin\left(2^9\times\frac{\pi}{2^{10}}\right)}{2^9\times\sin\left(\frac{\pi}{2^{10}}\right)}\times\sin\left(\frac{\pi}{2^{10}}\right)=\frac{1}{256}$$

65. **(C)**

$$\frac{a}{1-r}=3 \qquad ......(1)$$

$$\frac{a^3}{1-r^3}=\frac{27}{19}\Rightarrow\frac{27(1-r)^3}{1-r^3}=\frac{27}{19}$$

$$\Rightarrow 6r^2-13r+6=0$$

$$\Rightarrow r=\frac{2}{3}\text{ as }|r|<1$$

66. **(D)**

$$\frac{17-\beta}{-8}\times\frac{2}{3}=-1$$

$$\beta=5$$

67. **(A)**

Given P≡ (α, β).

Given line is $\frac{x}{a}+\frac{y}{b}=1$. . . . . . (1)

If line (1) cuts x and y axes at A and B respectively, then A≡ (a, 0) and B ≡ (0, b). Also the area of $\Delta OAB = s$

i.e. $(1/2)ab = s \Rightarrow ab = 2s$.

Since line (1) passes through P(α, β),

$\frac{\alpha}{a}+\frac{\beta}{b}=1 \Rightarrow \frac{\alpha}{a}+\frac{a\beta}{2s}=1 \Rightarrow a^2\beta - 2as + 2\alpha s = 0.$

Since a is real, $4s^2 - 8\alpha\beta s \geq 0 \Rightarrow s \geq 2\alpha\beta$.

Hence the least value of $s = 2\alpha\beta$.

Hence (A) is the correct answer.

Alternative solution:

Since (α, β) lies on the given line, $\frac{\alpha}{a}+\frac{\beta}{b}=1$

$\Rightarrow ab = a\beta + b\alpha \geq 2\sqrt{ab\alpha\beta} \Rightarrow 2s = ab \geq 4\alpha\beta$

$\Rightarrow$ least value of $s = 2\alpha\beta$.

Hence (A) is the correct answer.

68. **(B)**

The lines $x - 2y = 0$ and $x - 2y + k = 0$ are parallel. The distance between these two lines =

$$\left|\frac{k}{\sqrt{1+(-2)^2}}\right|=3 \qquad \Rightarrow k = \pm 3\sqrt{5}.$$

Hence (B) is the correct answer.

69. **(B)**

We can select 2 men from 5 men in ${}^5C_2$ ways, and 3 women from 7 women in ${}^7C_3$ ways. Hence total number of ways is ${}^5C_2 \times {}^7C_3$

Option (B)

70. **(A)**

9(2!)=3.3.2!=3.3!=(4-1)3!=4!-3!

16(3!)=4.4.3!=4.4!=(5-1)4!=5!-4!

25(4!)=5.5.4!=5.5!=(6-1)5!=6!-5!

2601(50!)=51.51.50!=51.51!=(52-51)51!=52!-51!

Sum=52!-3!=52!-6

Option (A)

71. (A)

Starting with M mean you have to arrange AAR which can be done in $\frac{(3)!}{(2)!} = 3$.

72. **(B)**

$|x-1| + |x| + |x+1| \geq 6$, gives four cases

Case I. When $x < -1$ .... (i)

$-(x+1) - x - (x-1) \geq 6$

$\Rightarrow -x - 1 - x - x + 1 \geq 6$

$\Rightarrow -3x \geq 6$ or $x < -1$ ... (ii)

From Eqs. (i) and (ii), $x \leq -2$

Case II. When $-1 \leq x \leq 0$ .... (iii)

$\Rightarrow x + 1 - x - (x-1) \geq 6$

$\Rightarrow 1 - x + 1 \geq 6$ $\Rightarrow x \leq -4$ ..... (iv)

∴ no value of x [From (iii) and (iv)]

Case III. When $0 \leq x \leq 1$ ....(v)

$\Rightarrow x + 1 + x - (x-1) \geq 6$

$\Rightarrow x \geq 4$ ... (vi)

No solution, using Eqs. (v) and (vi)

Case IV. When $x > 1$ ... (vii)

$x + 1 + x + x - 1 \geq 6$

$\Rightarrow 3x \geq 6$ or $x \geq 2$ ....(viii)

From Eqs. (vii) and (viii), $x \geq 2$

Thus, from above four cases,

$x \leq -2$ or $x \geq 2$

$\Rightarrow x \in (-\infty, -2] \cup [2, \infty)$

Option (B)

73. **(D)**

Given circle $x^2 + y^2 - 2gx + 6y - 19c = 0$

Passes through (6, 1)

$12g + 19c = 43$ …..(1)

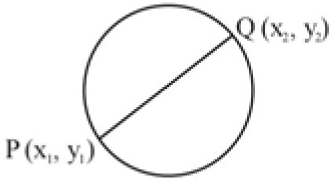
Centre (g, –3) lies on given line

So, $g + 6c = 8$ ….(2)

Solve equation (1) & (2)

c = 1 & g = 2
equation of circle $x^2+y^2-4x+6y-19=0$
Length of intercept on x-axis
$=2\sqrt{g^2-c}=2\sqrt{23}$

74. **(A)**



Equation of circle diameter form
$(x-x_1)(x-x_2)+(y-y_1)(y-y_2)=0$
(Where x_1, x_2 are the roots of $x^2-4x-6=0$ and y_1, y_2 are the root of $y^2+2y-7=0$)
$x^2+y^2-4x+2y-13=0$
Now,
Compare in with the given equation, we get
$a=-2, b=1, c=-13$
Now
$a+b-c=12$

75. **(A)**
Given sinα sinβ – cosα cosβ + 1 = 0
⇒ cos(α + β) = 1
⇒ sin(α + β) = 0
⇒ sinα cosβ + cosα sinβ = 0
⇒ cotα tanβ = -1.
Hence (A) is the correct answer.

76. **(A)**
We have $\frac{\tan 3x - \tan 2x}{1+\tan 3x \tan 2x}=1$
⇒ tan(3x – 2x) = 1 ⇒ tanx = 1
⇒ $\tan x = \tan\frac{\pi}{4}$ ⇒ $x = n\pi + \frac{\pi}{4}$
But for this value of x, tan2x = tan(2nπ + π/2) = ∞ which does not satisfy the given equation as it reduces to indeterminate form.
Hence (A) is the correct answer.

77. **(B)**
a + b + c = 18 ⇒ $2.\frac{a}{2}+3.\frac{b}{3}+4.\frac{c}{4}=18$
$\Rightarrow \left(\left(\frac{a}{2}\right)^2.\left(\frac{b}{3}\right)^3.\left(\frac{c}{4}\right)^4\right)^{1/9} \le \frac{1}{9}\left(2.\frac{a}{2}+3.\frac{b}{3}+4.\frac{c}{4}\right)$
⇒ $a^2 b^3 c^4 \le 2^9.2^2.3^3.4^4$.
Thus the maximum value of $a^2 b^3 c^4 = 2^{19}.3^3$.

Option (B)

78. **(B)**
Let the first five terms of the given G.P. be a_1 , a_2 , a_3 , a_4, a_5 .
Hence $a_3 = 4$. Now $a_1 a_5 = a_2 a_4 = a_3^2$
$\Rightarrow a_1 a_2 a_3 a_4 a_5 = 4^5$.
Hence (B) is the correct answer.

79. **(C)**
$$\left(x^2+\frac{1}{x^3}\right)^n$$
General term $T_{r+1} = {}^nC_r\left(x^2\right)^{n-r}\left(\frac{1}{x^3}\right)^r$
${}^nC_r.x^{2n-5r}$
For coefficient of x, $2n-5r=1$
Given ${}^nC_r = {}^nC_{23}$
$r = 23$ or $n-r=23$
$\Rightarrow$ $n = 58$ or $n = 38$
Minimum value is n = 38

80. **(B)**
The equation of the line L is x/a + y/b = 1. . . . . . (1)
After the rotation of the axes, the line L has intercepts p and q on the new axes.
In this system equation of the line is x/p + y/q = 1.
Since the origin and the line, both are fixed, the distance between them remains the same.
$$\Rightarrow \left|\frac{-1}{\sqrt{\frac{1}{a^2}+\frac{1}{b^2}}}\right| = \left|\frac{-1}{\sqrt{\frac{1}{p^2}+\frac{1}{q^2}}}\right| \Rightarrow \frac{1}{a^2}+\frac{1}{b^2}=\frac{1}{p^2}+\frac{1}{q^2}.$$
Hence (B) is the correct answer

81. **(22)**
Here we have following cases-
Case (i) – when 4 students are selected then number of ways is 6C4 = 15 ways.
Case (ii) – when 5 students are selected then number of ways is 6C5 = 6 ways.
Case (iii) – when 6 students are selected then number of ways is 6C6 = 1 way.
Then total number of ways is 15 + 6 + 1 = 22 ways.

82. **(2)**
We know that $\cos\frac{5\pi}{8} = \cos\left(\frac{\pi}{2}+\frac{\pi}{8}\right) = -\sin\frac{\pi}{8}$
and $\cos\frac{7\pi}{8} = \cos\left(\frac{\pi}{2}+\frac{3\pi}{8}\right) = -\sin\frac{3\pi}{8}$
$$\Rightarrow \cos^2\frac{\pi}{8}+\cos^2\frac{3\pi}{8}+\cos^2\frac{5\pi}{8}+\cos^2\frac{7\pi}{8}=\cos^2\frac{\pi}{8}+\cos^2\frac{3\pi}{8}+\sin^2\frac{\pi}{8}+\sin^2\frac{3\pi}{8}=2$$

83. **(2)**
Given lines are ax + y + 1 = 0, . . . (1)

x+ by = 0, . . . (2)
ax+ by = 1. . . . (3)
Joint equation of (1) and (2) is (ax + y + 1) (x+ by) = 0
$\Rightarrow ax^2 + by^2 + (ab + 1)\, xy + x + by = 0.$
Making (4) homogeneous with the help of (1) we have
$ax^2 + by^2 + (ab+ 1)\, xy + x(ax + by) + by\,(ax +by) =0.$
Since the angle between these two lines is 90°,
coefficient of x^2 + coeff. of y^2 = 0
$\Rightarrow 2a + b + b^2 = 0$

84. **(6)**
The given function will attain a minimum value at x = 6
Function is symmetric about x = 6 line

85. **(1002)**
$$^{10}C_2 + {}^{10}C_3 + ... + {}^{10}C_8 = \left({}^{10}C_0 + {}^{10}C_1 + {}^{10}C_9 + {}^{10}C_{10}\right) = 1024 - 22 = 1002$$

86. **(1)**
The given equation yields $1 + \log_b\{1 + \log_c(1 + \log_p x)\} = 1$
$\Rightarrow \log_b\{1 + \log_c(1 + \log_p x)\} = 0$
$\Rightarrow 1 + \log_c(1 + \log_p x) = 1$
$\Rightarrow \log_c(1 + \log_p x) = 0 \Rightarrow 1 + \log_p x = 1$
$\Rightarrow \log_p x = 0 \Rightarrow x = 1.$

87. **(2)**
Since $\tan(A + B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B} = 1,$
tanA + tanB + tanA tanB + 1= 1 + 1
or tanA(1+ tanB) + (1+ tanB) = 2
or (1+ tanA) (1+ tanB) = 2.

88. **(8)**
Remainder when 5^{162} divided by 17 is same as when 25/17

89. **(21)**
A ticket will be between two stations so 2 stations from n stations can be selected in $^nC_2$ ways i.e. n(n-1)/2 which is given to us equal to 210 so n(n-1) = 210x2 = 420 or n =21

90. **(48)**
$$\left(1-x^4\right)(1-x)^9 = (1-x)^9 - x^4(1-x)^9$$
Coefficient $x^7 = -{}^9C_7 + {}^9C_3 = 48$