JEE Mains (11th)

Sample Paper - I

DURATION : 180 Minutes | **M. MARKS : 300**

ANSWER KEY

PHYSICS

1.	(2)
2.	(4)
3.	(4)
4.	(3)
5.	(4)
6.	(2)
7.	(3)
8.	(3)
9.	(2)
10.	(3)
11.	(2)
12.	(1)
13.	(2)
14.	(3)
15.	(3)
16.	(4)
17.	(3)
18.	(1)
19.	(3)
20.	(1)
21.	(9)
22.	(6)
23.	(70)
24.	(2)
25.	(2)
26.	(4)
27.	(2)
28.	(7)
29.	(3)
30.	(4)

CHEMISTRY

31.	(1)
32.	(3)
33.	(4)
34.	(4)
35.	(2)
36.	(4)
37.	(4)
38.	(3)
39.	(1)
40.	(2)
41.	(3)
42.	(3)
43.	(2)
44.	(2)
45.	(3)
46.	(1)
47.	(4)
48.	(4)
49.	(3)
50.	(2)
51.	(91)
52.	(02)
53.	(06)
54.	(40)
55.	(02)
56.	(03)
57.	(26)
58.	(25)
59.	(06)
60.	(09)

MATHEMATICS

61.	(1)
62.	(3)
63.	(4)
64.	(1)
65.	(3)
66.	(1)
67.	(3)
68.	(3)
69.	(2)
70.	(2)
71.	(3)
72.	(1)
73.	(3)
74.	(1)
75.	(4)
76.	(1)
77.	(1)
78.	(4)
79.	(1)
80.	(2)
81.	(7)
82.	(26)
83.	(8)
84.	(3)
85.	(0)
86.	(1)
87.	(41)
88.	(1)
89.	(33)
90.	(17)

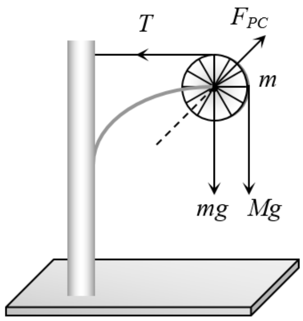
PHYSICS

1. **(2)**

In this case, one 2 kg wt on the left will act as the support for the spring balance. Hence its reading will be 2 kg.

2. **(4)**

Force on the pulley by the clamp



$$F_{pc} = \sqrt{T^2 + [(M+m)g]^2}$$

$$F_{pc} = \sqrt{(Mg)^2 + [(M+m)g]^2}$$

$$F_{pc} = \sqrt{M^2 + (M+m)^2}\,g$$

3. **(4)**

$$R = \frac{u^2 \sin 2\theta}{g} = \frac{2u_x v_y}{g}$$

∴ Range ∝ horizontal initial velocity (u_x)

In path 4 range is maximum so football possess maximum horizontal velocity in this path.

4. **(3)**

$$H_{\max} = \frac{u^2 \sin^2\theta}{2g}$$

According to problem

$$\frac{u_1^2 \sin^2 45°}{2g} = \frac{u_2^2 \sin^2 60°}{2g}$$

$$\Rightarrow \frac{u_1^2}{u_2^2} = \frac{\sin^2 60°}{\sin^2 45°}$$

$$\Rightarrow \frac{u_1}{u_2} = \frac{\sqrt{3}/2}{1/\sqrt{2}} = \sqrt{\frac{3}{2}}.$$

5. **(4)**

$$w = \frac{v_\perp}{r} = 0.7 \text{ rad/s}$$

6. **(2)**

$$T = \frac{2m_1 m_2}{m_1 + m_2} g \text{ and } F = -kx$$

7. **(3)**

W = total area under curved

8. **(3)**

$$\frac{1}{2}mv^2 = \frac{1}{2}kx^2$$

$$x_{\max} = v\sqrt{\frac{m}{k}}$$

Now, $k_i = k_f + u_{sp}$

$$\frac{1}{2}mv^2 = k_f + \frac{1}{2}k\left(\frac{x_{\max}}{2}\right)^2$$

$$k_f = \frac{3mv^2}{8}$$

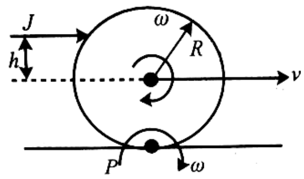
$$\frac{k_i}{k_f} = \frac{\frac{1}{2}mv^2}{\frac{3mv^2}{8}} = \frac{4}{3}$$

$$k_f = \frac{3}{4}k_i$$

then KE = 75%

9. **(2)**

Rolling is rotation about point of contact. Applying-impulse momentum equation about P.



$J(R+h) = I_P\omega$ ...(i)

and $J = mv$ ...(ii)

As sphere rolls $v = \omega R$, and

$$I = \frac{2}{5}mR^2 + mR^2 = \frac{7}{5}mR^2$$

After solving, we get $\frac{h}{R} = \frac{2}{5}$

10. **(3)**

Let k = force constant of the spring.

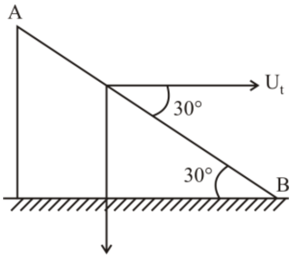
Potential energy of the spring after the first stretching = $E_1 = \frac{1}{2}kx^2$

Potential energy of the spring after the second stretching $= E_2 = \frac{1}{2}k(2x)^2$.

$W_1 = E_1$, $W_2 = E_2 - E_1$

11. **(2)**

Velocity component along AB should remain unchanged.



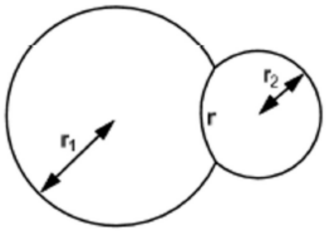
$\therefore$ 3 sin 30° = v_f cos 30°

or v_f = 3 tan 30° = $\sqrt{3}$ m/s

12. **(1)**

As the cork moves up, the force due to buoyancy remains constant. As its speed increases, the retarding force due to viscosity increases, being proportional to the speed. Thus, the acceleration gradually decreases. The acceleration is variable, and hence the relation between velocity and time is not linear.

13. **(2)**



Let p_0 = atmospheric pressure,

p_1 and p_2 = pressures insides the two bubbles.

$$p_1 - p_0 = \frac{4S}{r_1}, \quad p_2 - p_0 = \frac{4S}{r_2}$$

or $p_2 - p_1 = \frac{4S}{r_2} - \frac{4S}{r_1}$ = pressure difference across the common surface.

Let r = radius of curvature of the common surface.

$\therefore \quad p_2 - p_1 = \frac{4S}{r}$.

$\therefore \quad \frac{4S}{r} = \frac{4S}{r_2} - \frac{4S}{r_1}$.

14. **(3)**

$$P + \rho g h + \frac{1}{2}\rho v^2 = c$$

$$P_0 + \rho g h + 2\rho g \frac{h}{2} + 0 + 0$$

$$= \frac{1}{2} 2\rho v_2^2 + P_0 + 0$$

$$2\rho g h = \rho v_2^2$$

$$v_1 = \sqrt{2gh}$$

$$\frac{v_1}{v_2} = \frac{\sqrt{gh}}{\sqrt{2} \times \sqrt{gh}} = \frac{1}{\sqrt{2}}$$

15. **(3)**

Energy radiated per second by the sun,

$$E = \sigma T^4 4\pi R^2$$

This energy falls uniformly on the inner surface of spheres centred around the sun.

If r is the distance of the earth from the sun, then energy falling per second on unit area of the sphere of radius r is,

$$\frac{4\pi R^2 \sigma T^4}{4\pi r^2} = \frac{\sigma R^2 T^4}{r^2}$$

The radiant power incident on the earth is given by:

$$Q = \pi r_0^2 \times \frac{\sigma R^2 T^4}{r^2} = \frac{\pi r_0^2 R^2 \sigma T^4}{r^2}$$

16. **(4)**

According to Wien's law,

$$\lambda_m \propto \frac{1}{T}$$

and from the figure

$$(\lambda_m)_1 < (\lambda_m)_3 < (\lambda_m)_2$$

Therefore, $T_1 > T_3 > T_2$

17. **(3)**

$$V = V_0(1 + \gamma\Delta\theta)$$

or $L^3 = L_0(1+\alpha_1\Delta\theta)L_0^2(1+\alpha_2\Delta\theta)^2$

$$= L_0^3(1+\alpha_1\Delta\theta)(1+\alpha_2\Delta\theta)^2$$

Since, $L_0^3 = V_0$, hence

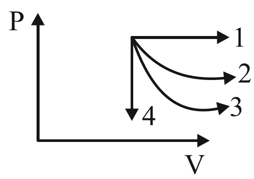
$$1 + \gamma\Delta\theta = (1+\alpha_1\Delta\theta)(1+\alpha_2\Delta\theta)^2$$

$$\cong (1+\alpha_1\Delta\theta)(1+2\alpha_2\Delta\theta)$$

$$\cong 1 + \alpha_1\Delta\theta + 2\alpha_2\Delta\theta$$

$$\therefore \gamma = \alpha_1 + 2\alpha_2.$$

18. **(1)**



1 $\rightarrow$ isobaric

2 $\rightarrow$ isothermal

3 $\rightarrow$ adiabatic

4 $\rightarrow$ isochoric

Work done = Area

19. **(3)**

For free expansion

W = 0

ϕ = 0

then $d\phi$ = dU + dW

dU = 0

T = constant

PV = P′V′

P × 5 = 11P′

P′ = $\frac{5P}{11}$

20. **(2)**

$2A = 0.06$

$A = 0.03$

$\lambda = \frac{300}{245}, k = \frac{2\pi}{300} \times 245 = 5.1$

$\omega = 1540$

So, option (2) matches.

21. **(9)**

$A \to B \to C$

$W_{ABC} = W_{AB} + W_{BC}$

$(400 - 200) \times 10^{-6} \times 10 \times 10^3 = 2$ J

$(\Delta\Delta)_{AC} = Q_{ABC} - W_{ABC} = 8 - 2 = 6$ J

$W_{AC} = \frac{1}{2} \times 10 \times 10^3 \times 200 \times 10^{-6} = 1$ J

$W_{AC} = 1 + 2 = 3$

$Q_{AC} = W_{AC} + \Delta U = 9$ J

22. **(6)**

The excess of pressure above atmospheric pressure, due to surface tension in a bubble $\Delta p = \frac{4T}{r}$

The surrounding pressure for 1st bubble

$P_A = P_0 + \frac{4T}{r_A} = 8 + \frac{4 \times 0.04}{0.02} = 16\,\text{N/m}^2$

Similarly, for 2nd bubble

Using, $PV = nRT$

$(16)\frac{4}{3}\pi(0.02)^3 = n_A RT$ ...(i)

$(12)\left(\frac{4}{3}\pi(0.04)^3\right) = n_B RT$ ...(ii)

Dividing eq. (ii) with eq. (i) we get,

$\frac{n_B}{n_B} = 6$

23. **(70)**

According to Boyle's law

$(P_1V_1)_{\text{bottom}} = (P_2V_2)_{\text{top}}$

$(10 + h) \times \frac{4}{3}\pi r_1^3 = 10 \times \frac{4}{3}\pi r_2^3$

but $r_2 = 2r_1$

$\therefore (10 + h)r_1^3 = 10 \times 8r_1^3 \Rightarrow 10 + h = 80$

$\therefore h = 70$ m

24. **(2)**

$P = P_0 e^{-\alpha t^2}$

The power of exponent is dimensionless,

$\alpha t^2 = [M^0L^0T^0]$

$\alpha = [T^{-2}]$

25. **(2)**

26. **(4)**

$0.5 \times g - N = 0.5 \times 2$

$N = 5 - 1 = 4$

27. **(2)**

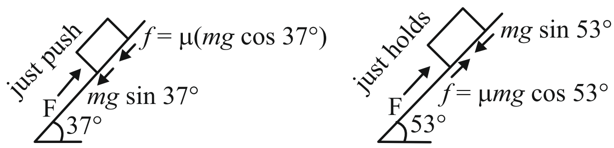
$a_1 = \frac{F - f_1}{m_1} = \frac{F - \mu m_1 g}{m_1} = 10\text{ m/s}^2$

$a_2 = \frac{-F + \mu m_2 g}{m_2} = -1\text{ m/s}^2$

$\therefore s = \frac{1}{2}a_{\text{real}}t^2$

$22 = \frac{1}{2}[10 - (-1)]t^2 \Rightarrow t = 2$ sec

28. **(7)**



$F = mg[\sin 37° + \mu \cos 37°]$

and $F = mg[\sin 53° - \mu \cos 53°]$

Equating both we obtain $\mu = \frac{1}{7}$

$\therefore \frac{1}{\mu} = 7$.

29. **(3)**

As sphere rolls, the lowest point of the sphere should have the same acceleration as the plank.

Hence, $a_1 = \alpha R - a_2$

$2 = 2\alpha - 4 \Rightarrow \alpha = 3\text{ rad/s}^2$

30. **(4)**

Share force = F sin θ

Share stress = $\frac{\text{Shear Force}}{\text{Surface Area}} = \frac{F\sin\theta}{A/\cos\theta}$

Shear stress will be max for θ = 45°

CHEMISTRY

31. **(1)**

$$M_{NaCl} = \frac{n_{NaCl}}{V_{sol}\text{ in L}}$$
$$= \frac{5.85/58.5}{500/1000}$$
$$= \frac{5.85}{58.5}\times\frac{1000}{500}$$
$$= 0.2$$
$$= \frac{1}{5}\text{ M}$$

32. **(3)**

Molecule	**Shape**
CH_4	Tetrahedral
SF_4	See-saw
XeF_4	Square planar
ClF_3	T-shape

33. **(4)**
Critical temperature $\propto$ Intermolecular forces of attraction
In NH_3 molecule there is hydrogen bonding (strongest intermolecular forces of attraction), hence NH_3 will have maximum critical temperature.

34. **(4)**
$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g);\quad K_c = x$$
On reverting this equation:
$$2NO(g) \rightleftharpoons N_2(g) + O_2(g);\quad K_c = \frac{1}{x}$$
Now multiplying this equation by $\frac{1}{2}$, we get the desired equation.
$$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g);\quad K_c = \frac{1}{\sqrt{x}}$$

35. **(2)**
Electromeric effect is a temporary effect since it occurs only in presence of an attacking reagent.

36. **(4)**

Metals		**Flame colour**
(1) Calcium	:	(p) Brick red
(2) Strontium	:	(q) Crimson
(3) Barium	:	(r) Apple green
(4) Magnesium	:	(s) No colour

37. **(4)**
Wurtz reaction is used for the preparation of symmetrical alkanes like $CH_3 – CH_3$, $CH_3 – CH_2 – CH_2 – CH_3$ etc.
Hence CH_4, $CH \equiv CH$ and C_6H_6 cannot be prepared by Wurtz reaction.

38. **(3)**
Maximum prescribed limit of Cd in drinking water is 0.005 ppm or 0.005 mg/dm^3
(1 ppm = 1 mg/dm^3)

39. **(1)**
Electronegativity order of group-13 elements is:

B	>	Al	<	Ga	<	In	<	Tl
(2.5)		(1.5)		(1.6)		(1.7)		(1.8)

40. **(2)**
In aqueous medium, basic strength order of methyl amines is:
$2^o > 1^o > 3^o > NH_3$

41. **(3)**
The correct relation between pH and pOH is given by the following expression:
$pH + pOH = pK_w$
For neutral water at 25°C $[H_3O^+] = [OH^-] = 10^{-7}$ M

42. **(3)**
$[1\,\text{Å} = 10^{-8}\text{ cm}]$
$$\text{Wave number } (\bar{v}) = \frac{1}{\lambda}$$
$$= \frac{1}{5000\,\text{Å}}$$
$$= \frac{1}{5\times10^3\,\text{Å}}$$
$$= \frac{1}{5\times10^3\times10^{-8}\text{cm}}$$
$$= \frac{1}{5\times10^{-5}\text{cm}}$$
$$= 0.2\times10^5\text{ cm}^{-1}$$
$$= 2\times10^4\text{ cm}^{-1}$$

43. **(2)**
Be has higher ionization enthalpy than B due to its more stable electronic configuration (Be = $1s^2\,2s^2$)
Thus, correct order of ionization enthalpy is:
Be > B > Li

44. **(2)**
Energy of a subshell $\propto$ (n + *l*) value
When (n + *l*) values are same then,
Energy of a subshell $\propto$ n value

Subshell	**(n + *l*)**
5d subshell	5 + 2 = 7
4f subshell	4 + 3 = 7
6p subshell	6 + 1 = 7
7s subshell	7 + 0 = 7

45. **(3)**

$$1D = 3.33564 \times 10^{-30}\ C\,m$$

46. **(1)**

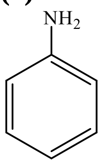
Work (w) is a path function physical quantity since it depends upon path followed.

U, H and G are state functions since they depend upon initial and final states of the system.

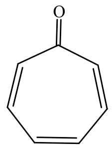
47. **(4)**

K, Rb and Cs forms stable superoxide (because lager anions are satisfied by larger cations).

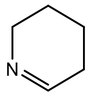
48. **(4)**



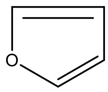
Homocyclic



Homocyclic



Heterocyclic



Heterocyclic

49. **(3)**

Molar mass of butane (C_4H_{10}) = 58 g/mol

$\because$ 58 g butane gives heat energy = 2658 kJ

$\therefore$ 5.8 g butane will give heat energy = 265.8 kJ

50. **(2)**

For n = 4, possible values of l = 0, 1, 2 and 3

For n = 2, possible values of l = 0 and 1

Thus (1), (3) and (4) are incorrect and correct option is (2)

(2) n = 4 l = 3 m = –2 $s = -\frac{1}{2}$

51. **(91)**

$$\text{Strength of } H_2O_2 = \frac{68}{22.4} \times \text{Vol. strength of } H_2O_2 \text{ g/L}$$

$$= \frac{68}{22.4} \times 30 \text{ g/L}$$

$$= 91.07 \text{ g/L}$$

$$= 91 \text{ g/L}$$

52. **(02)**

Lactic acid $\Rightarrow$ $CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - COOH$

In lactic acid two functional groups (–OH and –COOH) are present

53. **(06)**

$$O_2 = \sigma 1s^2\ \sigma^*1s^2\ \sigma 2s^2\ \sigma^*2s^2\ \sigma 2p_z^2$$

$$\pi 2p_x^2 = \pi 2p_y^2\ \pi^*2p_x^1 = \pi^*2p_y^1$$

Thus, total number of electrons present in antibonding molecular orbitals of O_2 = 6

54. **(40)**

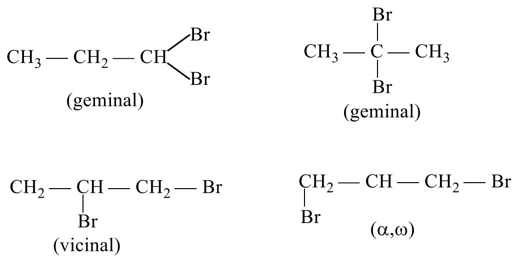
$$\%\ Br = \frac{80}{188} \times \frac{w_{AgBr}}{w_{compound}} \times 100$$

$$= \frac{80}{188} \times \frac{0.188}{0.2} \times 100$$

$$= 40\ \%$$

55. **(02)**

Isomers of $C_3H_6Br_2$ are as follows:



56. **(03)**

One π bond consumes 1 mole of O_3.

There are three π bonds in benzene hence 3 moles of O_3 will be required during the reductive ozonolysis of benzene.

57. **(26)**

Most electronegative element is F (Z = 9)

Most negative electron gain enthalpy element is Cl (Z = 17)

Sum of their atomic numbers = 9 + 17 = 26

58. **(25)**

The element of 4th period which shows highest oxidation state (+7) is Mn with Z = 25

[Atomic number (Z) = No. of protons]

59. **(06)**

In diborane molecule;

No. of planar atoms = 6

No. of non-planar atoms = 2

60. **(09)**

He^+ ion is a single electron species.

For single electron species, energy of all the orbitals of a particular shell is the same.

The energy order for the orbitals of He^+ is:

1s < 2s = 2p < 3s = 3p = 3d < …….

Thus, total degenerate orbitals in 3rd shell of He^+ ion = 1 + 3 + 5 = 9

61. **(1)**

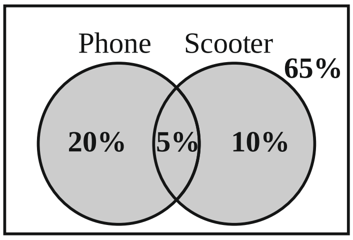
$$y = \log_{10} x + \log_x 10 + \log_x x + \log_{10} 10$$

$$= \log_{10} x + \frac{\log_e 10}{\log_e x} + 1 + 1$$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{x}\log_{10} e - \frac{\log_e 10}{x(\log_e x)^2}$$

62. **(3)**

Let the total population of town be x.



$$\therefore \frac{25x}{100} + \frac{15x}{100} - 1500 + \frac{65x}{100} = x$$

$$\Rightarrow \frac{105x}{100} - x = 1500$$

$$\Rightarrow \frac{5x}{100} = 1500 \quad \Rightarrow x = 30{,}000$$

63. **(4)**

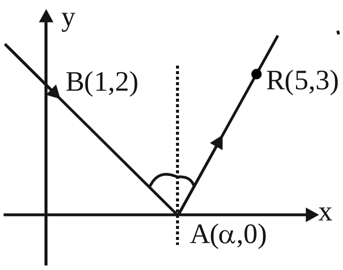
The number of ways of arranging 8 men =7!

The number of ways of arranging 4 women such that no two women can sit together = ${}^8P_4$

$\therefore$ Required number of ways =7!${}^8P_4$

64. **(1)**

Let, the coordinates of point A is $(\alpha, 0)$



If AR makes an angle θ with +ve x-axis, then AB makes $(\pi - \theta)$, therefore

$-m_{AB} = m_{AR}$

$$-\left(\frac{0-2}{\alpha-1}\right) = \left(\frac{0-3}{\alpha-5}\right)$$

$$\Rightarrow 2(\alpha-5) = -3(\alpha-1) \Rightarrow \alpha = \frac{13}{5}$$

$$\therefore A \text{ is } \left(\frac{13}{5}, 0\right)$$

65. **(3)**

We have, $|z-4| < |z-2|$

$$\Rightarrow |(x-4)+iy| < |(x-2)+iy|$$

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

$$\Rightarrow x^2 - 8x + 16 + y^2 < x^2 - 4x + 4 + y^2$$

$$\Rightarrow 8x - 4x > 16 - 4$$

$$\Rightarrow 4x > 12 \quad \Rightarrow x > 3$$

66. **(1)**

We have,

$$x^2 + 2\sqrt{3}xy + 3y^2 - 3x - 3\sqrt{3}y - 4 = 0$$

Now, $d = 2\sqrt{\dfrac{g^2 - ac}{a(a+b)}}$ ......(i)

Here, $a = 1$, $b = 3$, $c = -4$ and $g = -\dfrac{3}{2}$

Putting all the values in Eq. (i), we get

$$d = 2\sqrt{\frac{\frac{9}{4}+4}{1(1+3)}} = 2\sqrt{\frac{\frac{25}{4}}{4}} = 2 \times \frac{5}{4}$$

$$\therefore d = \frac{5}{2}$$

67. **(3)**

Consider $x^2 - 47x + k = 0$

For real roots, $47^2 - 4k \geq 0$

$\Rightarrow k \leq 552$ $(\because k$ is an integer)

$\therefore k = 1, 2, 3\ldots, 552$

Product of real roots

$= 1 \times 2 \times 3 \times 4 \times \ldots\ldots \times 552 = 552!$

68. **(3)**

$$\frac{2-|x|}{3-|x|} - 1 \geq 0 \quad \Rightarrow \frac{2-|x|-3+|x|}{3-|x|} \geq 0$$

$\Rightarrow 3 - |x| < 0 \quad \Rightarrow |x| > 3$

$\Rightarrow x \in (-\infty, -3) \cup (3, \infty)$

69. **(2)**

A (Atmost one is an ace) = 1 – P(both are ace)

$$= 1 - \frac{{}^4C_2}{{}^{52}C_2} = \frac{220}{221}$$

70. **(2)**

$$iz^2 = \bar{z}^2 + z$$

Let $z = x + iy$ then $i(x^2 - y^2 + 2ixy)$

$= (x^2 - y^2 - 2ixy) + (x + iy)$

So $-2xy = x^2 - y^2 + x$ & $x^2 - y^2 = -2xy + y$

$\Rightarrow y = -x$

Hence $\arg(z) = -\dfrac{\pi}{4}$

71. **(3)**

$$\frac{1-\sin x+\sin^2 x-\ldots\ldots \text{ upto} \infty \text{ terms}}{1+\sin x+\sin^2 x+\ldots\ldots \text{ upto} \infty \text{ terms}}=\frac{1-\cos 2x}{1+\cos 2x}$$

$$\Rightarrow \frac{1-\sin x}{1+\sin x}=\frac{2\sin^2 x}{2\cos^2 x}$$

$$\Rightarrow \frac{2}{2\sin x}=\frac{1}{\cos^2 x-\sin^2 x}$$

$\Rightarrow$ $1 - 2\sin^2 x = \sin x$

$\Rightarrow$ $2\sin^2 x + \sin x - 1 = 0$

$\Rightarrow$ $\sin x = \frac{1}{2}$ or $\sin x = -1$,

$\Rightarrow$ $\sin x = \frac{1}{2}$ since $\sin x \neq -1$

$$\Rightarrow x = n\pi + (-1)^n \frac{\pi}{6}.$$

72. **(1)**

We know that $a + x = 4$

Or $2 + x = 4$

Or $x = 2$

Putting $x = 2$ in $y^2 = 8x$, we get

$y^2 = 8 \times 2 = 16$

$y = \pm 4$

$\therefore (x, y) = (2, \pm 4)$

73. **(3)**

$t_n = S_n - S_{n-1}$

$$t_n=\frac{n(n+1)(n+2)}{6}-\frac{(n-1)n(n+1)}{6}$$

$$t_n=\frac{n(n+1)}{6}[n+2-n+1]=\frac{n(n+1)}{2}$$

$$\sum_{n=1}^{\infty}\frac{2}{n(n+1)} = 2\left[\left(1-\frac{1}{2}\right)+\left(\frac{1}{2}-\frac{1}{3}\right)+\ldots\ldots\right]=2$$

74. **(1)**

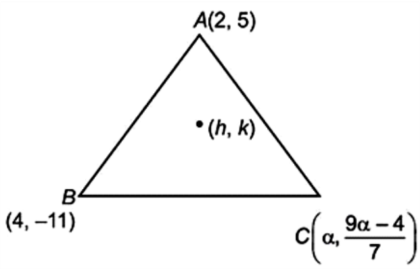
$$\sum_{i=1}^{9} x_i = 9+5(9)=54 \quad \Rightarrow \frac{1}{9}\sum_{i=1}^{9} x_i = 6$$

Also, $\sum_{i=1}^{9}(x_1)^2 + 25(9) - 2(5)(54) = 45$

$$\frac{1}{9}\sum_{i=1}^{9}(x_i)^2 = 40$$

$$SD=\sqrt{\frac{1}{9}\sum_{i=1}^{9}x_i^2-\left(\frac{1}{9}\sum_{i=1}^{9}x_i\right)^2}=2$$

75. **(4)**



$3h = 6 + \alpha$

$$3k=\frac{9\alpha-4}{7}-6$$

$21k = 9\alpha - 46 \quad \Rightarrow \quad 21k + 46 = 9(3h - 6)$

$\therefore 27x - 21y = 100$

76. **(1)**

We have, $9e^2 - 18e + 5 = 0$

$$\Rightarrow (3e-1)(3e-5)=0 \Rightarrow e=\frac{5}{3} \quad [\because e>1]$$

$\therefore 3e - 1 \neq 0$

The coordinate of a focus and the equation of the corresponding directrix are $(5, 0)$ and $x = \frac{9}{5}$ respectively.

$\therefore ae = 5$ and $\frac{a}{e}=\frac{9}{5}$

$$\Rightarrow ae\times\frac{a}{e}=5\times\frac{9}{5}\Rightarrow a^2=9\Rightarrow a=3$$

$$\therefore b^2=a^2(e^2-1)\Rightarrow b^2=9\left(\frac{25}{9}-1\right)=16$$

Hence, $a^2 - b^2 = 9 - 16 = -7$

77. **(1)**

$x = {}^{2020}C_0 - {}^{2020}C_1 + {}^{2020}C_2 - {}^{2020}C_3 + \ldots + {}^{2020}C_{1010}$

$x = {}^{2020}C_{2020} - {}^{2020}C_{2019} + {}^{2020}C_{2018} \ldots + {}^{2020}C_{2010}$

$\Rightarrow 2x = 0 + {}^{2020}C_{1010}$

$\Rightarrow x = \frac{1}{2}\ {}^{2020}C_{1010}$

78. **(4)**

$f(x)=\sqrt{\log_{10}\left(\frac{3-x}{x}\right)}$ is defined for

$$\log_{10}\left(\frac{3-x}{x}\right)\geq 0$$

$$\Rightarrow \frac{3-x}{x}\geq 10^0=1\Rightarrow x\in\left(0,\frac{3}{2}\right] \ldots\ldots(i)$$

For $f(x)=\log_a x$ is defined for $(x>0, a>0, a\neq 1)$

$\log_{10}\left(\frac{3-x}{x}\right)$ is defined for

$$\frac{3-x}{x}>0\Rightarrow 0<x<3 \quad \ldots\ldots.(ii)$$

From (i) and (ii), we get of f is $x\in\left(0,\frac{3}{2}\right]$

79. **(1)**

Here, $B = \{x : x^2 - x + 2 > 0\} = R$

Since, $x^2 - x + 2$

$$=x^2-x+\frac{1}{4}+\frac{7}{4}=\left(x-\frac{1}{2}\right)^2+\frac{7}{4}\geq\frac{7}{4}\Bigg]$$

And $A = \{x : x^2 - 4x + 3 \leq 0\}$

$= \{x : (x - 1)(x - 3) \leq 0\} = [1, 3]$

$A \cap B = R \cap [1, 3] = [1, 3]$

80. (2)

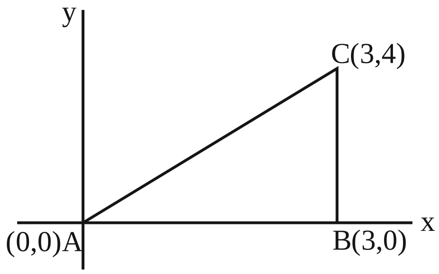
$$\tan(\alpha+\beta)=\frac{\tan\alpha+\tan\beta}{1-\tan\alpha\tan\beta}$$

$$\Rightarrow \tan(\alpha+\beta)=\frac{\frac{1}{1+\frac{1}{2^x}}+\frac{1}{1+2^{x+1}}}{1-\frac{1}{1+\frac{1}{2^x}}\frac{1}{1+2^{x+1}}}$$

$$\Rightarrow \tan(\alpha+\beta)=\frac{2^x+2.2^{x+x}+2^x+1}{1+2^x+2.2^{x+x}+2.2^x-2^x}$$

$$\Rightarrow \tan(\alpha+\beta)=1\Rightarrow \alpha+\beta=\frac{\pi}{4}$$

81. (7)



$AC = 5 = 2ae$

$\Rightarrow 2ae = 5$ ......(i)

Also $AB + BC = 2a$

$\Rightarrow 2a = 7 \Rightarrow a = \frac{7}{2}$

$\therefore\ e=\frac{5}{7}$

$\Rightarrow 1-\frac{b^2}{a^2}=\frac{25}{49} \quad \Rightarrow b=\sqrt{6}$

Length of the latus rectum = $\frac{2b^2}{a}$

$=\frac{2\times 6}{\frac{7}{2}}$ units $\Rightarrow p=7$

82. (26)

$T_{r+1} = {}^nC_r(x^3)^{n-r}\left(\frac{1}{x^4}\right)^r$

$= {}^nC_r\, x^{3n-7r}$

For coefficient of x,

$3n - 7r = 1$ ......(i)

${}^nC_r = {}^nC_{11}$ [given]

$\Rightarrow r = 11$ or $n - r = 11$ ......(ii)

$n = 26$ or $n = 19$ [From (i) and (ii)]

$\Rightarrow$ Largest value of $n = 26$.

83. (8)

Number of four-digit numbers divisible by 5 = 6 + 4 = 10

$\_\ \_\ \_\ \underline{0} \Rightarrow 3! = 6$

$\_\ \_\ \_\ \underline{5} \Rightarrow 3! - 2! = 4$

Total four-digit numbers = 4! – 3! = 18

$\therefore$ Required cases = 18 – 10 = 8

84. (3)

$$\alpha+\beta+\gamma=0,\ \alpha\beta\gamma=\frac{1}{5},\ 5\alpha^3-2\alpha-1=0$$

$$\frac{\alpha^3-3\alpha}{\alpha\beta\gamma}+\frac{\beta^3-3\beta}{\alpha\beta\gamma}+\frac{\gamma^3-3\gamma}{\alpha\beta\gamma}$$

$$\frac{\alpha^3+\beta^3+\gamma^3-3(0)}{\alpha\beta\gamma}=\frac{3\alpha\beta\gamma}{\alpha\beta\gamma}=3$$

85. (0)

$$\frac{1}{\cos 55^\circ}+\frac{1}{\cos 65^\circ}+\frac{\cos 175^\circ}{\cos 55^\circ\cos 65^\circ}$$

$$\frac{\cos(60^\circ+5^\circ)+\cos(60^\circ-5^\circ)-\cos 5^\circ}{\cos 55^\circ\cos 65^\circ}=0$$

86. (1)

$x^2+y^2+(3+\sin\beta)x+(2\cos\alpha)y=0$ ......(i)

$x^2+y^2+(2\cos\alpha)x+2cy=0$ .....(ii)

Since both the circles are passing through the origin (0, 0), the equation of tangent at (0, 0) to circle (i) will be the same as that of the tangent (0, 0) to circle (ii). Therefore,

$(3+\sin\beta)x+(2\cos\alpha)y=0$ .....(iii)

Tangent at (0, 0) to circle (ii) is

$(2\cos\alpha)x+2cy=0$ ....(iv)

Therefore, (iii) and (iv) must be identical.

Comparing (iii) and (iv), we get

$$\frac{3+\sin\beta}{2\cos\alpha}=\frac{2\cos\alpha}{2c}$$

or $c=\frac{2\cos^2\alpha}{3+\sin\beta}$

or $c_{max} = 1$ when $\sin\beta=-1$ and $\alpha=0$

87. (41)

$$1+\frac{n}{z}=-\frac{i}{4} \Rightarrow z=\frac{-n}{1+\frac{i}{4}}=\frac{-n\left(1-\frac{i}{4}\right)}{\frac{17}{16}}$$

$$z=-\frac{16}{17}n\left(1-\frac{i}{4}\right)$$

$$\therefore\quad 164=\frac{4n}{17} \quad\Rightarrow\quad \frac{n}{17}=41$$

88. (1)

When $\cot x>0, \frac{1}{\sin x}=0$

i.e. not possible

when $\cot x<0, \frac{2\cos x+1}{\sin x}=0$

$\Rightarrow \cos x=\frac{-1}{2} \quad \Rightarrow x=\frac{2\pi}{3}$

89. **(33)**

Variance, $\sigma^2 = \frac{\sum (x_i - \overline{x})^2}{N}$

$\Rightarrow \overline{x} = \frac{6+24}{2} = 15$

$\therefore \sigma^2 = \frac{(9^2 + 7^2 + 5^2 + 3^2 + 1^2)2}{10} = 33$

90. **(17)**

Given, $a + b + c = 25$ ....(i)

$2a = 2 + b$ ....(ii)

$c^2 = 18b$ ....(iii)

Substituting the values of a and b in terms of c from equations (ii) and (iii) in equation (i), then

$$\frac{1}{2}\left(2 + \frac{c^2}{18}\right) + \frac{c^2}{18} + c = 25$$

$\Rightarrow c^2 + 12c - 288 = 0$ $\therefore c = 12, -24$

$\because$ a, b, c are between 2 and 18 ($\therefore c \neq -24$).

Hence, $c = 12$, $b = 8$, $a = 5$

So, $G = 12$, $L = 5$

PW Web/App - https://smart.link/7wwosivoicgd4

Library- https://smart.link/sdfez8ejd80if