PART-I PHYSICS

1. **(c)** Centripetal force, $f_c = \frac{mv^2}{r}$

Frictional force $= \mu mg$

Here, centripetal force for motion is being provided by the friction.

$\therefore \frac{mV^2}{r} = \mu mg$

$V_{max} = \sqrt{\mu rg} = \sqrt{0.34 \times 50 \times 10} \approx 13 \text{ m/s}$

2. **(c)** Given, R.M.S. speed of chlorine molecule,

$V_{Cl} = 490 \text{ m/s}$

R.M.S. Speed,

$v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow v_{rms} \propto \sqrt{\frac{1}{M}}$

$\therefore \frac{v_{Ar}}{v_{Cl}} = \sqrt{\frac{M_{Cl}}{M_{Ar}}}$

$\Rightarrow \frac{v_{Ar}}{490} = \sqrt{\frac{70.9}{39.9}} = 1.33$

$\Rightarrow v_{Ar} = 1.33 \times 490 = 651.7 \text{ m/s}$

3. **(b)** When magnetic field is applied to a diamagnetic substance, it produces magnetic field in opposite direction so net magnetic field inside the cavity of sphere will be zero. So, field inside the paramagnetic substance kept inside the cavity is zero.

4. **(a)** By Bohr' quantization rule

$L_n = \frac{nh}{2\pi} \Rightarrow mvr = \frac{nh}{2\pi} \Rightarrow mv = \frac{nh}{2\pi r} \Rightarrow p = \frac{nh}{2\pi r}$

5. **(a)** $f = \frac{v}{\lambda} = \frac{v}{(\ell + e)}$

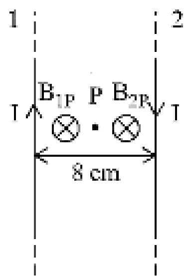
$f = \frac{v}{4(L+e)}$ (e = 0.3r)

Broader pipe has more value of e therefore, it gives note of smaller frequency.

6. **(b)** Here, current cannot be in same direction in both wire because then, $B_p = 0$. So current should be in opposite direction.

$B_p = B_{1p} + B_{2p}$

$B_p = 2\frac{\mu_0 I}{2\pi r}$



$300 \times 10^{-6} = 2 \times 2 \times 10^{-7}$

$\times \frac{I}{4 \times 10^{-2}}$

$3 \times 10^{-4} = 10^{-5} \times I$

$I=30\text{ A}$

7. **(b)** As, $n=\sqrt{\mu_r\varepsilon_r}=\sqrt{\frac{4}{3}\times 3}=2$

And, $\sin\theta_c=\frac{1}{n}=\frac{1}{2}$ $\therefore$ Critical angle, $\theta_c=30^{\circ}$

8. **(a)** Tension, $F=(Y\alpha\Delta T)A$

$=(2\times 10^{11})\times(10^{-5})\times(25-0)\times\pi(0.5\times 10^{-2})^2=3925\text{ N}$

9. **(b)**

10. **(c)** The sum of their KE and PE is a constant.

11. **(b)** Initially

$Q_1=CV=2\text{ V}$ $\quad(\because C=2\text{ F given})$

$E_1=\frac{1}{2}\frac{Q_1^2}{C}=\frac{1}{2}\frac{(2\text{ V})^2}{2}=V^2$

Finally

Charge will be divided equally

$\therefore Q_2=\frac{Q_1}{2}=\frac{2V}{2}=V$

$E_2=2\left(\frac{1}{2}\frac{Q_2^2}{C}\right)=\frac{V^2}{2}\ \therefore\frac{E_2}{E_1}=\frac{1}{2}$

12. **(c)** $x=20te^{-t}$

$\therefore\ v=\frac{dx}{dt}=20\left(t\frac{de^{-t}}{dt}+e^{-t}\times 1\right)$

or $0=20[te^{-t}\times(-1)+e^{-t}]$

$\therefore t=1$

Thus $x=20\times 1\times e^{-1}=\frac{20}{e}$ m.

13. **(a)** Given,

Dipole moment of short electric dipole,

$p=16\times 10^{-9}\text{C m}$.

Distance from centre of dipole, $r=0.6$ m

Electric potential, $V=\frac{kp\cos\theta}{r^2}$

$\Rightarrow V=\frac{9\times 10^9\times 16\times 10^{-9}\times\cos 60}{0.36}=200\text{ V}$

14. **(c)** $\frac{I_0}{4}=I_0\cos^2(\phi/2)\Rightarrow\phi=2\pi/3$

$\Rightarrow\Delta x\times(2\pi/\lambda)=2\pi/3\Rightarrow\Delta x=\lambda/3$

$\sin\theta=\Delta x/d\Rightarrow\sin\theta=\lambda/3\text{ d}\Rightarrow\theta=\sin^{-1}(\lambda/3\text{ d})$

15. **(b)** For projectile motion,

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

As range is same for angle of projection θ and $90-\theta$. So, range is same for 42° and 48°.

Height in projectile motion, $H=\frac{u^2\sin^2\theta}{2\text{ g}}$

$\Rightarrow H\propto\sin^2\theta$

So H is higher for 48° than 42°.

16. **(b)** As given that, $y=3\cos\left(\frac{\pi}{4}-2\omega t\right)$

Velocity of the particle

$v=\frac{dy}{dt}=\frac{d}{dt}\left[3\cos\left(\frac{\pi}{4}-2\omega t\right)\right]$

$=3(-2\omega)\left[-\sin\left(\frac{\pi}{4}-2\omega t\right)\right]$

$=6\omega\sin\left(\frac{\pi}{4}-2\omega t\right)$

So, acceleration,

$a=\frac{dv}{dt}=\frac{d}{dt}\left[6\omega\sin\left(\frac{\pi}{4}-2\omega t\right)\right]$
$=(6\omega)\times(-2\omega)\cos\left(\frac{\pi}{4}-2\omega t\right)$
$=-4\omega^2\left[3\cos\left(\frac{\pi}{4}-2\omega t\right)\right]$
$a=-4\omega^2 y$
In simple harmonic motion acceleration (or force) is directly proportional to the negative of displacement of particle
$\Rightarrow$ as acceleration, $a\propto -y$
Hence, due to negative sign motion is simple harmonic motion (SHM.)
A simple harmonic motion is always periodic.
So motion is periodic simple harmonic.
From the given equation,
$y=3\cos\left(\frac{\pi}{4}-2\omega t\right)$
Compare it by standard equation
$y=a\cos(\omega t+\phi)$
So, $\omega'=2\omega$
$\frac{2\pi}{T'}=2\omega\Rightarrow T'=\frac{2\pi}{2\omega}=\frac{\pi}{\omega}$
Hence, the motion is SHM with period $\frac{\pi}{\omega}$.

17. (b) Given wavelength of neon lemp $\lambda_1=670.5$ nm
Stopping potential $V_1=0.48$ V.
From the Einstein's photoelectric equation
$kE_{\max}=\frac{hc}{\lambda_1}+\phi\Rightarrow eV_1=\frac{hc}{\lambda_1}+\phi$
$\Rightarrow e(0.48)=\frac{1240}{670.5}+\phi$ ....(i)
For second case wavelength $\lambda_2=474.6$ nm stopping potential $=V_2$.
$e(V_2)=\frac{1240}{474.6}+\phi\ \ldots\ldots\ldots(ii)$
Subtrating equation (i) from (ii) we get
$e(V_2-0.48)=1240\left(\frac{1}{474.6}-\frac{1}{670.5}\right)$ eV
$\Rightarrow V_2=0.48+1240\left(\frac{670.5-474.6}{474.6\times 670.5}\right)$ volts
$\Rightarrow V_2=0.48+0.76=1.25$ V

18. (b) Torque $=\tau=\vec{r}\times\vec{F}=\mathrm{rF}\sin\theta=\mathrm{rF}\sin 0^\circ=0$

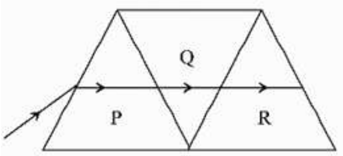
19. (b) $\frac{1}{2}kx^2=Mgx$
or $x=\frac{2Mg}{k}$

20. (d) $[E]=ML^2T^{-2}$
$[L]=ML^2T^{-1}$
$[G]=M^{-1}L^{+3}\,\mathrm{T}^{-2}$
$P=\frac{EL^2}{M^5G^2}$
$[P]=\frac{(ML^2T^{-2})(M^2L^4T^{-2})}{M^5(M^{-2}L^6T^{-4})}=M^0L^0T^0$

21. (a) Energy released in the given process = Binding energy of product- Binding energy of reactants
$=7.6\times 4-(1.1\times 2)\times 2$
$=30.4-4.4=26$MeV

22. (b) $W=\int\ Fdx=\int_0^x\ Cxdx=\frac{1}{2}Cx_1^2$

23. (c) When the ray suffers minimum deviation, it becomes parallel to the base of prism P. As prisms Q and R are of same material and have identical shape, therefore, the ray continues to be parallel to base of Q and R. Hence final deviation of the ray remains the same as before.

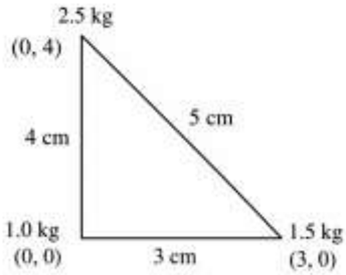


24. (a) In polar molecules, like HCL $\rightarrow H^{\delta+}Cl^{\delta-}$ the centre of positive charges does not coincide with the centre of negative charges. Hence, permanent electric dipole exists.

25. (a) Entire system is thermally insulated. So, no heat exchange with surrounding will take place. Hence, process will be adiabatic.

26. (b) $\frac{P}{Q}=\frac{R}{S}$ where $S=\frac{S_1S_2}{S_1+S_2}$

27. (d)



$$X_{\mathrm{cm}}=\frac{m_1x_1+m_2x_2+m_3x_3}{m_1+m_2+m_3}$$

$$X_{cm}=\frac{1\times 0+1.5\times 3+2.5\times 0}{1+1.5+2.5}=\frac{1.5\times 3}{5}=0.9\text{ cm}$$

$$Y_{\mathrm{cm}}=\frac{m_1y_1+m_2y_2+m_3y_3}{m_1+m_2+m_3}$$

$$Y_{cm}=\frac{1\times 0+1.5\times 0+2.5\times 4}{1+1.5+2.5}=\frac{2.5\times 4}{5}=2\text{ cm}$$

Hence, centre of mass of system is at point (0.9,2)

28. (c) Mass of the satellite $=m$ and height of satellite from earth $(h)=6.4\times 10^6$ m.

We know that gravitational potential energy of the satellite at height

$$\mathrm{h}=-\frac{\mathrm{GM_e\,m}}{\mathrm{R_e+h}}=-\frac{\mathrm{gR_e^2\,m}}{\mathrm{2R_c}}$$

$$=-\frac{\mathrm{gR_e\,m}}{2}=-0.5\mathrm{mgR_c}$$

(where, $\mathrm{GM_e}=\mathrm{gR_e^2}$ and $\mathrm{h}=\mathrm{R_e}$)

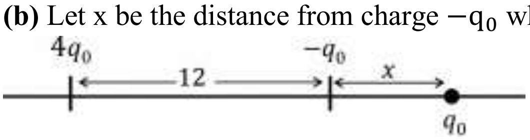
29. (a) We have

$$\mathrm{I_0}=\frac{\mathrm{V_0}}{\mathrm{Z}}=\frac{2500}{\sqrt{\mathrm{R^2+(X_L-X_C)^2}}}$$

$$=\frac{2500}{\sqrt{80^2+60^2}}=\frac{2500}{100}$$

$=25$ A

30. (b) Let x be the distance from charge $-\mathrm{q_0}$ where electric field is zero.



Using the Coulomb'slaw

$$\frac{1}{4\pi E_0}\frac{q_0}{x^2}=\frac{1}{4\pi E_0}=\frac{4q_0}{(x+12)^2}$$

$\Rightarrow x+12=2x$

$x=12$

Distance from origin $-x+12-24$ cm.

PART - II : CHEMISTRY

31. **(d)** (A) $1s^2 2s^2 2p^3 \Rightarrow$ N

(B) $1s^2 2s^2 2p^4 \Rightarrow O$

(C) $1s^2 2s^2 2p^5 \Rightarrow$ F

(D) $1s^2 2s^2 2p^2 \Rightarrow C$

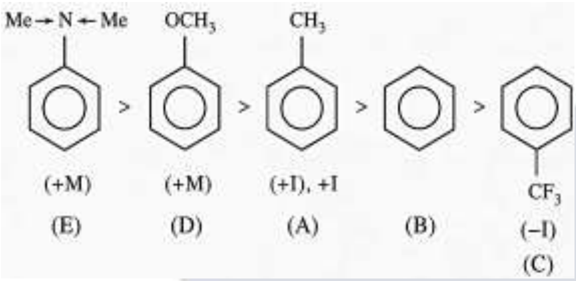
Order of electronegativity: $F > O > N > C$

$\therefore$ $D < A < B < C$

32. **(c)** A $\rightarrow$ Weak electrolyte (greater change of Λ_m)

B $\rightarrow$ Strong electrolyte (less effect of C on Λ_m)

33. **(b)**Higher the electron density on benzene ring, higher is reactivity towards electrophilic substitution reaction



+M in (E) is more than that of (D) due to +I effects of Me groups.

34. **(c)** From the given elements, Chromium has lowest enthalpy of atomisation.

$Cr = [Ar] 3d^5 4s^1$

$\therefore$ Total valence electrons in Cr = 6

35. **(c)** Colloids particles have two layer in solution, one is fixed layer and other is diffused layer. The potential difference between the fixed and diffused layer of charges in a colloidal particle is called zeta potential.

36. **(b)** For strongest reducing agent

Reduction potential should be lowest

37. **(d)** Mass of liquid $= 135 - 40 = 95$ g

Volume of liquid $= \dfrac{\text{mass}}{\text{density}} = \dfrac{95}{0.95}$ mL

$= 100 \text{ mL} = 0.1$ L

Mass of ideal gas $= 40.5 - 40$ g $= 0.5$ g

$PV = nRT$

$0.82 \times 0.1 = \left(\dfrac{0.5}{M}\right) \times 0.082 \times 250 \Rightarrow M = 125$

38. **(b)** From first law of thermodynamics, $\Delta U = q$
$+w$

For adiabatic process, $q = 0 \Rightarrow \Delta U = w$

For isothermal process, $\Delta U = 0 \Rightarrow q = -w$

For cyclic process, $\Delta U = 0 \Rightarrow q = -w$

For isochoric process, $w = 0 \Rightarrow \Delta U = q$

39. **(c)** For zero order reaction :

Halflife $= \dfrac{[A]_0}{2k} \Rightarrow 60 \text{ min} = \dfrac{2}{2k}$

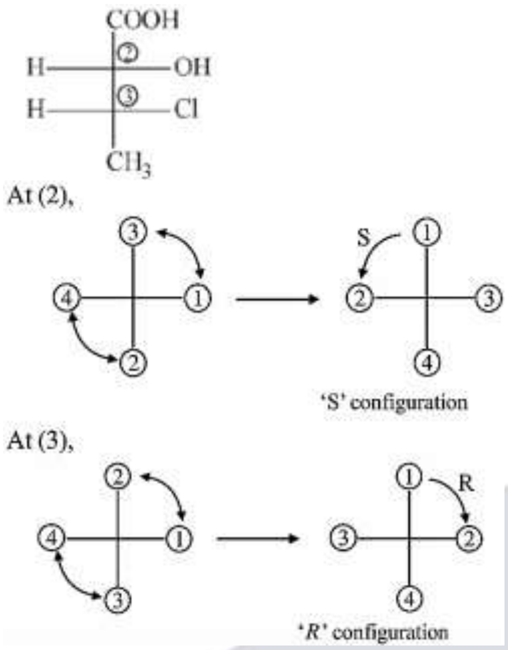
$\Rightarrow k = \dfrac{1}{60}$ M/min

Now, $[A]_t = [A]_o - kt \Rightarrow t = \frac{[A]_o - [A]_t}{k}$

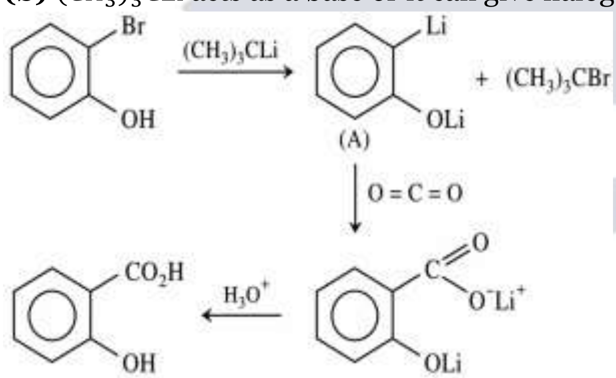
$$= \frac{0.5 - 0.25}{1/60} = 15 \text{ min}$$

40. **(a)** BeH_2 is hypovalent so least stable.

41. **(d)**



42.(b) $(CH_3)_3CLi$ acts as a base or it can give halogen exchange reaction



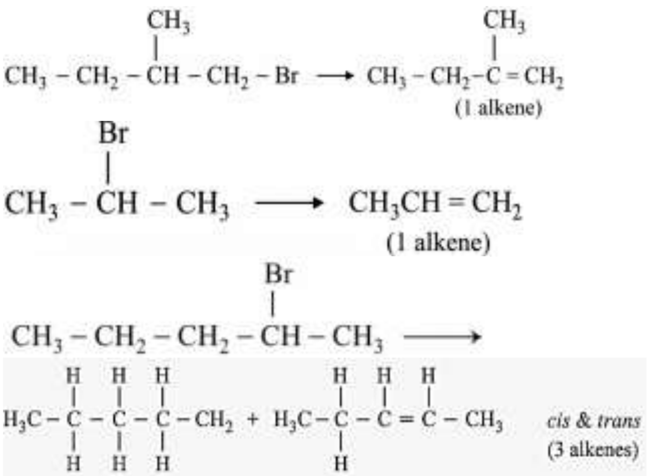
43. **(c)** 2, 3-Dichlorobutane exhibits optical isomerism due to the presence of two asymmetric carbon atoms.

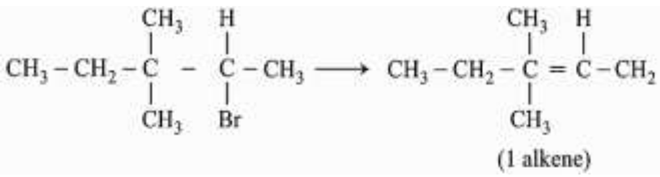
44. **(c)** $PhO^-Na^+ + Me - Br \xrightarrow{S_{N^2}} Ph - O - Me$

Reaction (a) is not possible due to strong Ph — Br bond Reaction (b) is not possible due to nonionising character of the Me — OH bond.

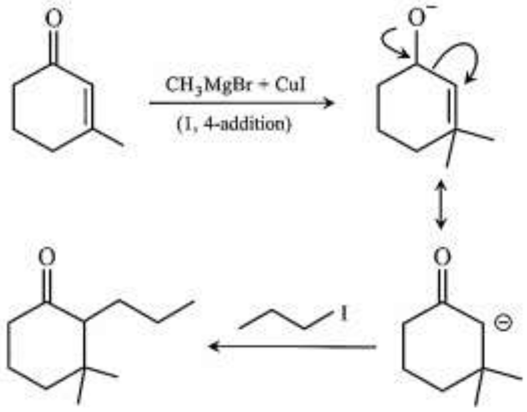
Reaction (d) is not possible due to absence of catalyst.

45.(c)





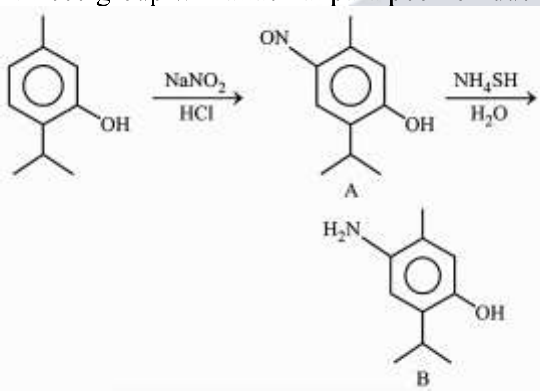
46.(a)



47. (a) AgBr shows both Schottky as well as Frenkel defects.

48. (b) $NaNO_2 + HCl \rightarrow HNO_2 + NaCl$

Nitroso group will attack at para position due to steric considerations.



49. (c) $r_n = \frac{52.9n^2}{z}$pm

$Li^{2+}: r_2 = x = k \times \frac{2^2}{3} = \frac{4k}{2}$

$Be^{3+}: r_3 = y = k \times \frac{3^2}{4}$

$\frac{y}{x} = \frac{9}{4} \times \frac{3}{4} = \frac{27}{16}$

$\Rightarrow y = \frac{27}{16}x$

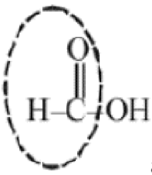
50. (d)

Molecule	Hybridisation	Dipole Moment	Lone pair on the central atom
SO_2	sp^2	Non-zero	1
NF_3	sp^3	Non-zero	1
NH_3	sp^3	Non-zero	1
XeF_2	sp^3 d	zero	3

ClF_3	$sp^3 d$	Non-zero	2
SF_4	$sp^3 d$	Non-zero	1

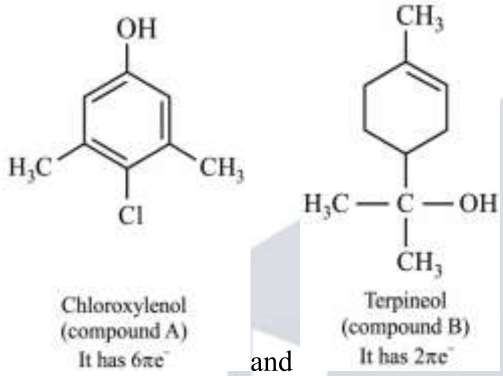
51. (c) Ozone destruction

$CF_2Cl_2 \xrightarrow{hv} Cl^{\cdot} + \dot{C}F_2Cl(g)$
$Cl^{\cdot} + O_3 \rightarrow ClO^{\cdot} + O_2$
$ClO^{\cdot} + O^{\cdot} \rightarrow Cl^{\cdot} + O_2$

52. (b) Apart from aldehyde, Formic acid 

also gives silver mirror test with ammonical silver nitrate.

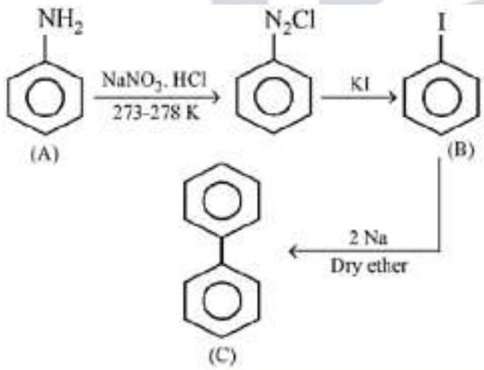
53. (b) Dettol is mixture of



and

Hence compound ' **B** ' is Terpineol.

54. (c)



55. (b) $CO_2(g) + C(s) \rightleftharpoons 2CO(g)$

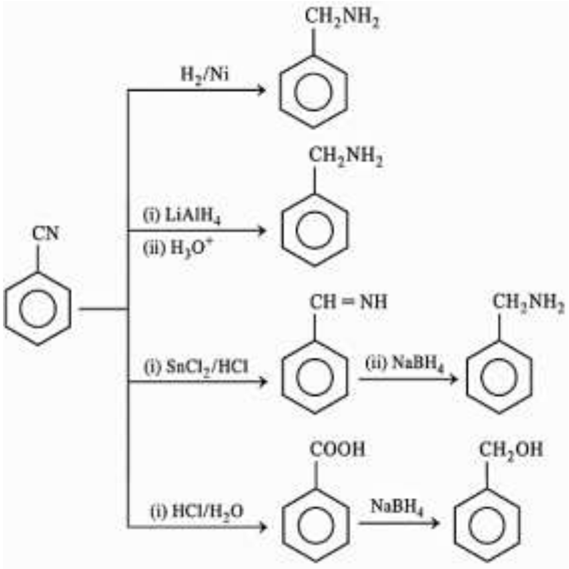
$t = 0 \quad 0.5 \qquad -$

at equi. $0.5 - x \quad 2x$

$P_{total} = 0.5 + x = 0.8 = x = 0.3$

$$K_p = \frac{(0.6)^2}{0.2} = 1.8$$

56. (d)



57. **(a)** $Zr_3(PO_4)_4(s) \rightleftharpoons 3Zr^{+4}(aq) + 4PO_4^{-3}(aq)$

$\quad - \qquad\qquad 3s \qquad\qquad 4s$

$K_{sp} = (3s)^3(4s)^4 = 27s^3 \times 256s^4 = 6912s^7$

$s = \left(\frac{K_{sp}}{6912}\right)^{\frac{1}{7}}$

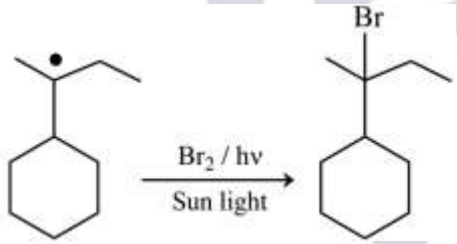
58. **(b)** Oxygen exists as O_2 (Atomicity = 2)

Sulphur exists as S_8 (Atomicity = 8)

Hence, Melting point & Boiling point of sulphur are significantly large compared to oxygen.

59. (d) CFSE of octahedral complexes with water is greater for 5d series metal centre ion as compared to 3d and 4d series metal centre.

60. **(d)**



Formation of more stable tertiary free radical

PART - III (A):
ENGLISH PROFICIENCY

61. **(d)** The idiom "a hornet's nest" refers to a situation full of trouble, conflict, or anger-especially one that gets worse when provoked.

62. **(c)** The passage clearly states that digital minimalism encourages the intentional use of technology that adds genuine value. It criticizes mindless scrolling and promotes deliberate choices instead of the total avoidance of technology.

63. **(b)** The passage explicitly says algorithms are "designed to exploit attention. This implies that attention is treated as a targeted resource, not protected or ignored, making its control crucial.

64. **(a)** Brusque means abrupt or unfriendly in speech or manner. Affable means friendly, warm, and easy to talk to, making it the correct antonym. Other options-Abrupt, Sternand Terse-are similar in tone to brusque and serve as close distractors.

65. **(c)** Finicky means overly particular or difficult to please-someone who is fussyor excessively concerned with minor details. Easy-going is the opposite, while punctualandpolite are unrelated in meaning.

66. **(b)** The word "modest" best fits the sentence as it describes someone who doesn't brag, even when successful. "Arrogant" and "boastful" imply pride, while "dominant" refers to control, not humility.

67. (c) The sentence suggests that the lawyer made the court question the witness. "Instilled" means to gradually cause someone to feel or think something-here, doubts. "Concealed" means to hide, "fabricated" means to invent (usually falsely), and "neglected" means to ignore-none fit the context as precisely.

68. (b) The verb "insisted" should be followed by a gerund, not an infinitive. So the correct form is "on meeting", not "to meet."Hence, option (b) contains the error.

69. (b) "Discuss" is a transitive verb and does not require a preposition. The correct usage is "discussed the new policy," not "discussed about." So, the error lies in option (b).

70. (a) The original sentence contains a dangling modifier - it implies the chirping of birds was walking. (a) correctly places the subject "she" after the introductory phrase, fixing the grammatical issue.

PART - III (B) : LOGICAL REASONING

71. (d) $T \Rightarrow 27 - 20 = 7$

$R \Rightarrow 27 - 18 = 9$

Therefore, $? = 999$

72. (d)

$$\begin{array}{cccccc} x & x & y & z & y & y \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & c & b & a & b & b \end{array}$$

Pairs of opposite letters

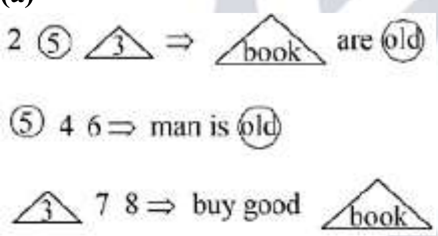
Therefore,

$$\begin{array}{cccccc} x & y & y & z & z & y \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & b & b & a & a & b \end{array}$$

73. (b) Except Ellipse, All are 3-dimensional Figure but ellipse is simple curve.

74. (c) There is no ' V ' letter in the given word.

75. (a)



Codes are :

5 ⇒ old 4 ⇒ man or is

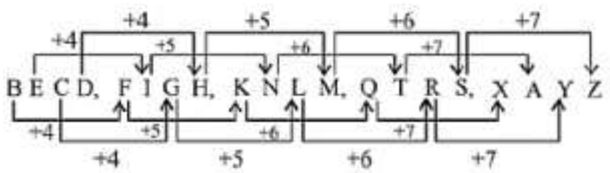
8 ⇒ buy or good

3 ⇒ books 6 ⇒ man or is

2 ⇒ are 7 ⇒ buy or good

2 stands for "are" in that code.

76. (d) The pattern is



77. (d) The pattern is:

$(6 \times 7) + 8 + 4 = 54$

$(8 \times 4) + 12 + 7 = 51$

$(9 \times 5) + 14 + 9 = 68$

78. (b)

79. (d)

80. (d) As,

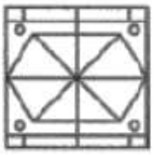
$3 \times 1 \times 5 \times 2 + 1 = 31$ and $4 \times 6 \times 3 \times 2 + 1 = 145$

Similarly,

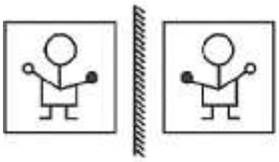
$2 \times 7 \times 5 \times 1 + 1 = 71$

81. (b) In figure (ii) and (iii) C and E are common. So A is opposite of D

82. (b)



83.(b)



84. (a) Answer figure 'c' consist all parts of problem figure.

85. (c)

86. (d) Figure in options (a), (b) and (c) have shaded fraction equal to $\frac{1}{2}$.

87. (c)

Indent, Index, Indolent, Indoor, Industry,
(2) (5) (4) (3) (1)

88. (a) Shaded part and small circle shift in clockwise direction. And, arrow shifts in anticlockwise direction in a pattern.

89. (d) As X is the son of Y 's father and Y is the sister of X he has to be the brother of Y .

90. (d) Coding has been started from number 8 .

A B C D E F
(8) (9) (10) (11) (12) (13)

$$\Rightarrow \begin{array}{ccccccc} M & A & C & H & I & N & E \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 20 & 8 & 10 & 15 & 16 & 21 & 12 \end{array}$$

Codes as

PART - IV : MATHEMATICS

91. (a) Let B = {b}. Then, A = {a, B}.

$\therefore$ P(A) = $\{\phi, \{a\}, \{B\}, \{a, B\}\} = \{\phi, \{a\}, \{\{b\}\}, \{a, \{b\}\}\}$.

92. (b) The set is $\{(a, b): a - b = 3, a, b \in N\}$

Here $a = b + 3$; For $b = 1, a = 4$

For $b = 2, a = 5$; For $b = 3, a = 6$. and so, on

Hence the given set is : $\{(4,1), (5,2), (6,3) \ldots\}$

93. (a) $\sin 765^\circ = \sin(360 \times 2 + 45)^\circ$

$= \sin 45^\circ = \frac{1}{\sqrt{2}}$

94. (d) $\tan\theta = -\frac{1}{\sqrt{3}} = \tan\left(-\frac{\pi}{6}\right) \therefore \theta = n\pi = \frac{\pi}{6}$

95. (d) We have $\frac{(1+2i)^8 \cdot (1-2i)^2}{(3+2i) \cdot \overline{(4-6i)}}$

$$\Rightarrow \frac{(1+2i)^2(1-2i)^2(1+2i)^6}{26i}$$

$$\Rightarrow \frac{25(1+2i)^6}{26i} \Rightarrow (-i)\frac{25}{26}(7+24i)(3-4i)$$

$$\Rightarrow \frac{(72-28)25}{26} = \frac{44 \times 25}{26} = \frac{550}{13}$$

96. **(d)** $\alpha+\beta=-\frac{b}{a}, \alpha\beta=\frac{c}{a}$ and $\alpha^2+\beta^2$

$$-\frac{(b^2-2ac)}{a^2}$$

Now,

$$\frac{\alpha}{a\beta+b}+\frac{\beta}{a\alpha+b}=\frac{\alpha(a\alpha+b)+\beta(a\beta+b)}{(a\beta+b)(a\alpha+b)}$$

$$=\frac{a(\alpha^2+\beta^2)+b(\alpha+\beta)}{\alpha\beta a^2+ab(\alpha+\beta)+b^2}=\frac{(b^2-2ac)}{\left(\frac{c}{a}\right)a^2+ab\left(-\frac{b}{a}\right)+b^2}$$

$$=\frac{b^2-2ac-b^2}{a^2c-ab^2+ab^2}=\frac{-2ac}{a^2c}=-\frac{2}{a}.$$

97. **(b)** Since α, β are the roots of the equation

$2x^2-35x+2=0$

Also, $\alpha\beta=1$

$\therefore\ 2\alpha^2-35\alpha=-2$ or $2\alpha-35=\frac{-2}{\alpha}$

$2\beta^2-35\beta=-2$ or $2\beta-35=\frac{-2}{\beta}$

Now, $(2\alpha-35)^3(2\beta-35)^3=\left(\frac{-2}{\alpha}\right)^3\left(\frac{-2}{\beta}\right)^3$

$$=\frac{8\cdot 8}{\alpha^3\beta^3}=\frac{64}{1}=64.$$

98. **(a)** We have, $3x-7>5x-1$

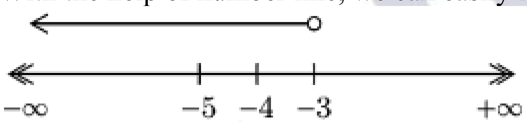
Transferring the term 5 x to L.H.S. and the term -7 to R.H.S.

$3x-5x>-1+7 \Rightarrow -2x>6$

Dividing both sides by 2 ,

$\Rightarrow \frac{2x}{2}<-\frac{6}{2} \Rightarrow x<-3$

With the help of number line, we can easily look for the numbers less than -3 .



$\therefore$ Solution set is $(-\infty,-3)$, i.e. all the numbers lying between $-\infty$ and -3 but $-\infty$ and -3 are not included as $x<-3$.

99. **(b)**

100. **(b)** From each railway station, there are 19 different tickets to be issued. There are 20 railway station

So, total number of tickets $=20\times 19=380$.

101. **(a)** Let r^{th} and $(r+1)^{\text{th}}$ term has equal coefficient

$$\left(2+\frac{x}{3}\right)^{55}=2^{55}\left(1+\frac{x}{6}\right)^{55}$$

r^{th} term $=2^{55}\,{}^{55}C_r\left(\frac{x}{6}\right)^r$

Coefficient of x^r is $2^{55}\,{}^{55}C_r\frac{1}{6^r}$

$(r+1)^{\text{th}}$ term $=2^{55}\,{}^{55}C_{r+1}\left(\frac{x}{6}\right)^{r+1}$

Coefficient of x^{r+1} is $2^{55}\,{}^{55}C_{r+1}\cdot\frac{1}{6^{r+1}}$

Both coefficients are equal

$$2^{55}\,{}^{55}C_r\frac{1}{6^r}=2^{55}\,{}^{55}C_{r+1}\frac{1}{6^{r+1}}$$

$$\frac{1}{|r|55-r}=\frac{1}{|r+1|54-r}\cdot\frac{1}{6}$$

$6(r+1)=55-r$

$6r+6=55-r$

$7r=49$

$r=7$

$(r+1)=8$

Coefficient of 7^{th} and 8^{th} terms are equal.

102. **(a)** Sum of an A.P. is given by

$$S_n=\frac{n}{2}[2a+(n-1)d]$$

where ' a ' is the first term and ' d ' is the common difference of A.P.

Let S_{n_1} be the sum of n terms of I^{st} A.P.

and S_{n_2} be the sum of n terms of II $^{\text{nd}}$ A.P.

Given that the sum of n terms of two arithmetic series is in the ratio $2n+3:6n+5$

$\Rightarrow \frac{S_{n_1}}{S_{n_2}}=\frac{2n+3}{6n+5}\qquad \ldots.(i)$

$\Rightarrow\ S_{n_1}=\frac{n}{2}[2a_1+(n-1)d_1]=2n+3$ and

$S_{n_2}=\frac{n}{2}[2a_2+(n-1)d_2]=6n+5$

From Eq. (i), we get

$$\frac{S_{n_1}}{S_{n_2}}=\frac{\frac{n}{2}[2a_1+(n-1)d_1]}{\frac{n}{2}[2a_2+(n-1)d_2]}=\frac{2n+3}{6n+5}$$

$$\Rightarrow\frac{2a_1+(n-1)d_1}{2a_2+(n-1)d_2}=\frac{2n+3}{6n+5}$$

For $a=13, n=2a-1=2\times13-1=25$

$$\therefore\frac{2a_1+(25-1)d_1}{2a_2+(25-1)d_2}=\frac{53}{155}$$

$$\Rightarrow\frac{a_1+12d_1}{a_2+12d_2}=\frac{53}{155}$$

103. **(c)** We have

$8^{1+|\cos x|+|\cos x|^2+|\cos x|^3+\cdots\text{to }\infty}=4^3$

$[\because \cos^2 x=|\cos^2 x|$ also $|\cos^n x|=|\cos x|^n]$

$\Rightarrow 8^{\frac{1}{1-|\cos x|}}=4^3\Rightarrow 2^{\frac{3}{1-|\cos x|}}=2^6$

$$\frac{3}{1-|\cos x|}=6\Rightarrow 1-|\cos x|=\frac{1}{2}$$

$$|\cos x|=\frac{1}{2}\Rightarrow\cos x=\pm\frac{1}{2}$$

$$x=\frac{\pi}{3},\frac{2\pi}{3}$$

104. **(b)** We have point $(\alpha,-3),(2,0)$ and $(1,\alpha)$

For collinearity, $\left(\frac{\alpha-0}{-1}\right)=\frac{\alpha+3}{1-\alpha}$

$\Rightarrow\alpha=-1,3\Rightarrow\alpha_1=-1,\alpha_2=3$

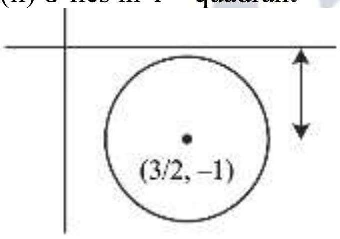
$\Rightarrow y-3=\sqrt{3}(x+1)$

105. **(c)** One vertex of square is $(-4,5)$ and equation of one diagonal is $7x-y+8=0$

Diagonal of a square are perpendicular and bisect each other
Let the equation of the other diagonal be $y = mx$ +c where m is the slope of the line and c is the y-intercept.
Since this line passes through $(-4,5)$
$\therefore\ 5 = -4m + c$ ……(i)
Since this line is at right angle to the line $7x - y + 8 = 0$ or $y = 7x + 8$, having slope $= 7$,
$\therefore\ 7 \times m = -1$ or $m = \frac{-1}{7}$
Putting this value of m in equation (i) we get
$5 = -4 \times \left(\frac{-1}{7}\right) + c$
or $5 = \frac{4}{7} + \mathbf{c}$ or $\mathbf{c} = 5 - \frac{4}{7} = \frac{31}{7}$
Hence equation of the other diagonal is
$y = -\frac{1}{7}x + \frac{31}{7}$ or $7y = -x + 31$
or $x + 7y - 31 = 0$ or $x + 7y = 31$.

106. **(d)** Required angle between given pair of st.
line $= \frac{\pi}{2}$

107. **(d)** Given circle is $4x^2 + 4y^2 - 12x + 8y + k = 0$
$\Rightarrow x^2 + y^2 - 3x + 2y + \left(\frac{k}{4}\right) = 0$
Centre $\left(\frac{3}{2}, -1\right)$; $r = \sqrt{\frac{13-k}{2}}$
Here, $r \geq 0$, then $\sqrt{\frac{13-k}{2}} \geq 0$. So, $k \leq 13$. ……(i)
(i) Point $\left(1, \frac{-1}{3}\right)$ lies on or inside circle C
$\Rightarrow S_1 \leq 0 \Rightarrow k \leq \frac{92}{9}$ …. (ii)
(ii) C lies in 4^{th} quadrant



$\mathbf{r} < 1$
$\Rightarrow \frac{\sqrt{13-k}}{2} < 1 \Rightarrow k < 9$ …..(iii)
Hence (i) ∩ (ii) ∩ (iii) ⇒ $k \in \left(9, \frac{92}{9}\right]$

108. **(a)** Given $P = (1,0)$, let $Q = (h, k)$
Since Q lies on $y^2 = 8x \therefore k^2 = 8h$ …..(i)
Let (α, β) be the midpoint of PQ
$\therefore \alpha = \frac{h+1}{2}, \beta = \frac{k+0}{2}, 2\alpha - 1 = h\ 2\beta = k.$
Putting value of h and k in (i)
$(2\beta)^2 = 8(2\alpha - 1)$
$\Rightarrow \beta^2 = 4\alpha - 2 \Rightarrow y^2 - 4x + 2 = 0$

109. **(c)** Any point on x-axis has $y = z = 0$
Distance of the point (1,2,3) from x-axis is the distance between point (1,2,3) and point (1,0,0)

110. **(c)** $\lim\limits_{x \to a} \frac{\sqrt{a+2x} - \sqrt{3x}}{\sqrt{3a+x} - 2\sqrt{x}} \times \frac{\sqrt{a+2x} + \sqrt{3x}}{\sqrt{a+2x} + \sqrt{3x}}$
$= \lim\limits_{x \to 4} \frac{(a + 2x) - 3x}{(\sqrt{3a + x} - 2\sqrt{x})(\sqrt{a + 2x} + \sqrt{3x})}$

Again rationalizing, we get

$$= \lim_{x \to 0} \frac{(a-x)[\sqrt{3a+x}+2\sqrt{x}]}{(\sqrt{a+2x}+\sqrt{3x})(3a-3x)} = \frac{4\sqrt{a}}{6\sqrt{3a}}$$

$$= \frac{2\sqrt{3}}{9}$$

111. **(d)**

x_i	f_i	$f_i x_i$	$\lvert x_i - \bar{x} \rvert$	$f_i \lvert x_i - \bar{x} \rvert$
5	7	35	9	63
10	4	40	4	16
15	6	90	1	6
20	3	60	6	18
25	5	125	11	55
Total	**25**	**350**		**158**

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{350}{25} = 14$$

Mean deviation from the mean

$$= \frac{\sum f_i \lvert x_i - \bar{x} \rvert}{\sum f_i} = \frac{158}{25} = 6.32$$

112. **(d)** Total number of elements $= 2022$

$2022 = 2 \times 3 \times 337$

$\text{HCF}(n, 2022) = 1$

is feasible when the value of ' n ' and 2022 has no common factor.

A = Number which are divisible by 2 from {1,2,3.......2022}

$\Rightarrow\ n(A) \div 2 = 1011$

B = Number which are divisible by 3

from {1,2,3 … … … . .2022}

$n(B) = 674$

$A \cap B$ = Number which are divisible by 6

from {1,2,3 … … . .2022}

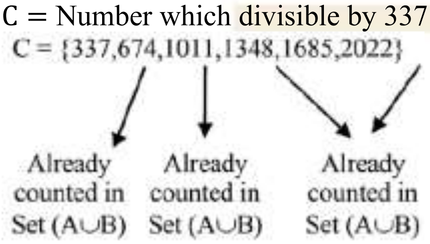
6,12,18.............,2022

Here $n(A \cap B) = 337$

$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= 1011 + 674 - 337 = 1348$

C = Number which divisible by 337 from {1, … … … . . .1022}



Total elements which are divisible by 2 or 3 or 337

$= 1348 + 2 = 1350$

Favourable cases = Element which are neither divisible by 2,3 or 337 $= 2022 - 1350 = 672$

Required probability $= \frac{672}{2022} = \frac{112}{337}$

113. **(c)** Since $f : (4,6) \to (6,8) \Rightarrow f(x) = x + 2$

$\therefore\ f^{-1}(x) = x - 2$

114. **(a)** $3\tan^{-1}\frac{1}{2+\sqrt{3}} - \tan^{-1}\frac{1}{x} = \tan^{-1}\frac{1}{3}$

$$\Rightarrow 2\tan^{-1}\frac{1}{2+\sqrt{3}}+\tan^{-1}\frac{1}{2+\sqrt{3}}-\tan^{-1}\frac{1}{3}=\tan^{-1}\frac{1}{x}$$

$$\Rightarrow \tan^{-1}\frac{2\times\frac{1}{2+\sqrt{3}}}{1-\frac{1}{(2+\sqrt{3})^2}}+\tan^{-1}\frac{\frac{1}{2+\sqrt{3}}-\frac{1}{3}}{1+\frac{1}{3}\times\frac{1}{2+\sqrt{3}}}=\tan^{-1}\frac{1}{x}$$

$$\Rightarrow \tan^{-1}\frac{1}{\sqrt{3}}+\tan^{-1}\frac{1-\sqrt{3}}{7+3\sqrt{3}}=\tan^{-1}\frac{1}{x}$$

$$\Rightarrow \tan^{-1}\frac{\frac{1}{\sqrt{3}}+\frac{1-\sqrt{3}}{7+3\sqrt{3}}}{1-\frac{1}{\sqrt{3}}\times\frac{1-\sqrt{3}}{7+3\sqrt{3}}}=\tan^{-1}\frac{1}{x}$$

$$\Rightarrow \frac{7+3\sqrt{3}+\sqrt{3}-3}{\sqrt{3}(7+3\sqrt{3})-(1-\sqrt{3})}=\frac{1}{x}\Rightarrow x=2$$

115. **(c)** Given |adj(24 A)| =| adj3 (adj 2A) |

$\Rightarrow |24a|^2=|3\text{adj}(2\text{ A})|^2$

$\Rightarrow (24^3|\text{ A}|)^2=(3^3\ |\text{ adj}(2\text{ A}))^2\Rightarrow 3^6(|2\text{ A}|^2)^2$

$\Rightarrow 24^6|\text{ A}|^2=(24^3|\text{ A}|)^2=3^6\times 2^{12}|\text{ A}|^4$

$\Rightarrow |\text{ A}|^2=\dfrac{24^6}{3^6\times 2^{12}}=64$

116. **(c)** Given system of equations are $x+y+z=6$

$2x+5y+\alpha z=\beta$

$x+2y+3z=14$

From the given equations.

$x+y=6-z$ …..(i)

(... ...ii)) $x+2y=14-3z$ …..(ii)

Subtract (i) from (ii),

$\Rightarrow y=8-2z$, then $x=z-2$.

Now, put the values x & y

in eq. $zx+5y+\alpha z=\beta$.

$2(z-2)+5(8-2z)+\alpha z=\beta$

$(\alpha-8)z=\beta-36$

For having infinite solutions

$\alpha-8=0\&\beta-36=0$

$\alpha=8,\beta=36$

Required sum $=\alpha+\beta=44$

117. **(c)** LH. L $=\lim\limits_{x\to 0^-}\frac{\sqrt{1+kx}-\sqrt{1-kx}}{x}=k$

R.H.L $=\lim\limits_{x\to 0^+}(2x^2+3x-2)=-2$

Since it is continuous, L.H.L = R. H. L $\Rightarrow k=-2$

118. **(b)** $\sin y=x\sin(a+y)$

$\therefore x=\dfrac{\sin y}{\sin(a+y)}$

Differentiating the function with respect to y

$\dfrac{dx}{dy}=\dfrac{\sin(a+y)\cos y-\sin y\cos(a+y)}{\sin^2(a+y)}$

$=\dfrac{\sin(a+y-y)}{\sin^2(a+y)}=\dfrac{\sin a}{\sin^2(a+y)}$

$\therefore \dfrac{dy}{dx}=\dfrac{\sin^2(a+y)}{\sin a}$

119. **(a)** Let, $y=\frac{\log x}{x}$

$$\Rightarrow \frac{dy}{dx} = \frac{x \times \frac{d}{dx}\log x - \log x \frac{d}{dx} x}{x^2}$$

$$= \frac{x \times \frac{1}{x} - \log_e x}{x^2} = \frac{1 - \log_e x}{x^2}$$

For maximum value, put

$$\frac{dy}{dx} = 0 \Rightarrow \frac{1 - \log_e x}{x^2} = 0, \because x^2 \neq 0$$

$$\log_e x = 1 \Rightarrow x = e$$

120. **(a)** Let $6x + 7 = \lambda \frac{d}{dx}(x-5)(x-4) + \mu$

i.e. $6x + 7 = \lambda(2x - 9) + \mu$ which gives

$\lambda = 3$ and $\mu = 34$

$$\therefore \int \frac{6x+7}{\sqrt{(x-5)(x-4)}}dx = \int \frac{3(2x-9)+34}{\sqrt{x^2-9x+20}}dx$$

$$= 3\int (2x-9)(x^2-9x+20)^{-\frac{1}{2}}dx + 34\int \frac{dx}{\sqrt{x^2-9x+20}}$$

$$= 3\frac{(x^2-9x+20)^{-\frac{1}{2}+1}}{-\frac{1}{2}+1} + 34\int \frac{dx}{\sqrt{x^2-9x+\frac{81}{4}-\frac{1}{4}}}$$

$$= 6\sqrt{x^2-9x+20} + 34\int \frac{dx}{\sqrt{\left(x-\frac{9}{2}\right)^2 - \left(\frac{1}{2}\right)^2}}$$

$$=6\sqrt{x^2-9x+20}$$
$$+34\log\left\{\left| x - \frac{9}{2} + \sqrt{\left(x-\frac{9}{2}\right)^2 - \left(\frac{1}{2}\right)^2}\right|\right\} + C$$

$$=6\sqrt{x^2-9x+20}$$
$$+34\log\left|x + \sqrt{x^2-9x+20} - \frac{9}{2}\right| + C$$

$\therefore$ A = 6, B = 34.

121. **(c)** Let $I = \int_0^{\pi} \frac{e^{\cos x}\sin x}{(1+\cos^2 x)(e^{\cos x}+e^{-\cos x})}dx$ …..(i)

Applying identity $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

$I = \int_0^{\pi} \frac{e^{-\cos x}\sin x}{(1+\cos^2 x)(e^{-\cos x}+e^{\cos x})}dx$ …..(ii)

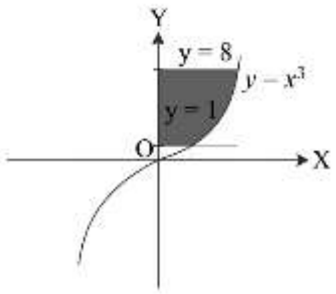
Add equations (i) and (ii), we get

$$2I = \int_0^{\pi} \frac{\sin x}{1+\cos^2 x}dx$$

On putting $\cos x = t$, we get

$$2I = 2\int_0^1 \frac{dt}{1+t^2} = (\tan^{-1} t)_0^1 = \frac{\pi}{4}$$

122. **(a)** Given curve is $y = x^3$ or $x = y^{1/3}$



Considering the areas with y -axis, we find that required area

$= \int_1^8 y^{1/3} dy = \left[\frac{y^{4/3}}{4/3}\right]_1^8 = \frac{3}{4}\left[8^{4/3} - 1^{4/3}\right]$

$= \frac{3}{4} \times (16 - 1) = \frac{3}{4} \times 15 = \frac{45}{4}$ sq.units

123. **(d)** The given differential equation is

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

$\frac{dx}{dy} = \frac{e^{\frac{x}{y}}\left(\frac{x}{y}-1\right)}{\left(e^{x/y}+1\right)}$ ...(i)

$= g\left(\frac{x}{y}\right) \because \frac{dx}{dy} = g\left(\frac{x}{y}\right)$

$\therefore$ eq. (i) is the homogeneous differential equation so, put $\frac{x}{y} = v$ i.e., $x = vy$

$\Rightarrow \frac{dx}{dy} = v + y\frac{dv}{dy}$

Then, eq. (i) becomes

$v + y\frac{dv}{dy} = \frac{e^v(v-1)}{e^v+1} \Rightarrow y\frac{dv}{dy} = \frac{e^v(v-1)}{e^v+1} - v$

$\Rightarrow\ y\frac{dv}{dy} = \frac{ve^v - e^v - ve^v - v}{e^v+1} - v$

$\Rightarrow \frac{e^v+1}{e^v+v} dv = -\frac{1}{y} dy$

On integrating both sides, we get

$\int \frac{e^v+1}{e^v+v} dv = -\int \frac{1}{y} dy$

Put $e^v + v = t$

$\Rightarrow e^v + 1 = \frac{dt}{dv} \Rightarrow dv = \frac{dt}{e^v+1}$

$\therefore \int \frac{e^v+1}{t}\frac{dt}{e^v+1} - \log|y| + \log C$

$\Rightarrow \log|t| + \log|y| = \log C$

$\Rightarrow \log|e^v + v| + \log|y| = \log C$

$(\because t = e^v + v)$

$\Rightarrow \log|(e^v + v)y| = C \Rightarrow |(e^v + v)y| = C$

$\Rightarrow (e^v + v)y = C \cdot$ So, put $v = \frac{x}{y}$, we get

$\left(c^{x/y} + \frac{x}{y}\right) y = C \Rightarrow yc^{x/y} + x = C$

This is the required solution of the given differential equation.

124. **(b)** I.F. of $\frac{dy}{dx} + y = x^2$ is $e^{\int 1 dx}$.

125. **(c)** $(\vec{a} + \vec{b} + \vec{c}) \cdot [(\vec{a} - \vec{c}) \times (\vec{a} - \vec{b})]$

$= (\vec{a} + \vec{b} + \vec{c}) \cdot [-\vec{a} \times \vec{b} - \vec{c} \times \vec{a} + \vec{c} \times \vec{b}]$

$= -3[\vec{a}\vec{b}\vec{c}]$

126. **(d)** Given, $\overrightarrow{OA} = 7\hat{j} + 10\hat{k}$,

$\overrightarrow{OB} = -\hat{i} + 6\hat{j} + 6\hat{k}$,

$\overrightarrow{OC} = -4\hat{i} + 9\hat{j} + 6\hat{k}$

$\Rightarrow \overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = -\hat{i} - \hat{j} - 4\hat{k}$

$\overrightarrow{BC} = \overrightarrow{OC} - \overrightarrow{OB} = -3\hat{i} + 3\hat{j}$;

$\overrightarrow{CA} = \overrightarrow{OA} - \overrightarrow{OC} = 4\hat{i} - 2\hat{j} + 4\hat{k}$

$\Rightarrow |\overrightarrow{AB}| = \sqrt{1^2 + 1^2 + 4^2} = \sqrt{18} = 3\sqrt{2}$;

$\Rightarrow |\overrightarrow{BC}| = \sqrt{3^2 + 3^2} = \sqrt{18} = 3\sqrt{2}$;

$\Rightarrow |\overrightarrow{CA}| = \sqrt{4^2 + 2^2 + 4^2} = \sqrt{36} = 6$

$3\sqrt{2}, 3\sqrt{2}$&6 are sides of a right angled Δ.

$\because (3\sqrt{2})^2 + (3\sqrt{2})^2 = 36 = 6^2$

Hence, the $\triangle$ ABC is a right-angled and isosceles also.

127. **(c)** For $\left(\frac{1}{\sqrt{2}}, \frac{1}{2}, \mathrm{k}\right)$ to represent direction cosines, we should have

$$\left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{2}\right)^2 + k^2 = 1$$

or, $\frac{1}{2} + \frac{1}{4} + k^2 = 1 \Rightarrow k = \pm\frac{1}{2}$

128. **(a)** Given equation of plane is

$x - 3y + 5z = d$

Since, it passes through (1,2,4), then

$1 - 3(2) + 5(4) - d$

$\Rightarrow 1 - 6 + 20 = d$

$d = 15$

Therefore, the equation of the plane will be

$x - 3y + 5z = 15$

$$\Rightarrow \frac{x}{15} - \frac{3y}{15} + \frac{5z}{15} = 1$$

$$\Rightarrow \frac{x}{15} + \frac{y}{-5} + \frac{z}{3} = 1$$

Hence, the intercept cut by the plane on axes X , Y, Z are $15, -5$ and 3 , respectively.

129. **(b)** $\because \mathrm{P}(\mathrm{A} \cap \mathrm{B}) = \mathrm{P}(\mathrm{A}) + \mathrm{P}(\mathrm{B}) - \mathrm{P}(\mathrm{A} \cup \mathrm{B})$

$$= \frac{1}{3} + \frac{1}{5} - \frac{1}{2} = \frac{10 + 6 - 15}{30} = \frac{1}{30}$$

$$P(A \cap B') = P(A) - P(A \cap B) = -\frac{1}{3} - \frac{1}{30} = \frac{3}{10}$$

$$P(B \cap A') = P(B) - P(A \cap B) = \frac{1}{5} - \frac{1}{30} = \frac{1}{6}$$

$$\therefore P(A/B') + P(B/A') = \frac{P(A \cap B')}{P(B')} + \frac{P(B \cap A')}{P(A')}$$

$$= \frac{3}{10} \times \frac{5}{4} + \frac{1}{6} \times \frac{3}{2} = \frac{3}{8} + \frac{1}{4} = \frac{5}{8}$$

130. **(d)** Let E: 'face 1 comes up' and F: 'face 1 or 2 comes up'

$\Rightarrow E \cap F = E (\because E \subset F)$

$P(E) = 0.10$ and $P(F) = P(1) + P(2) = 0.10 + 0.32$

$= 0.42$

Hence, required probability

$$= P(E/F) = \frac{P(E \cap F)}{P(F)} = \frac{P(E)}{P(F)} = \frac{0.10}{0.42} = \frac{5}{21}$$