

BITSAT Solved Paper 2025

Session-I

Memory Based

INSTRUCTIONS

- This question paper contains total 130 questions divided into four parts:
Part I : Physics Q. No. 1 to 30
Part II : Chemistry Q. No. 31 to 60
Part III : (A) English Proficiency Q. No. 61 to 70
(B) Logical Reasoning Q. No. 71 to 90
Part IV : Mathematics Q. No. 91 to 130
- All questions are multiple choice questions with four options, only one of them is correct.
- Each correct answer awarded 3 marks and -1 for each incorrect answer.
- Duration of paper-3 Hours

PART - I : PHYSICS

- A car is moving on a horizontal curved road with radius 50 m. The approximate maximum speed of car will be, if friction between tyres and road is 0.34. [Take $g = 10 \text{ ms}^{-2}$]
(a) 3.4 ms^{-1} (b) 22.4 ms^{-1}
(c) 13 ms^{-1} (d) 17 ms^{-1}
- If the r.m.s. speed of chlorine molecule is 490 m/s at 27°C , the r.m.s. speed of argon molecules at the same temperature will be (Atomic mass of argon = 39.9 u , molecular mass of chlorine = 70.9 u)
(a) 751.7 m/s (b) 451.7 m/s
(c) 651.7 m/s (d) 551.7 m/s
- A perfectly diamagnetic sphere has a small spherical cavity at its centre, which is filled with a paramagnetic substance. The whole system is placed in a uniform magnetic field $\vec{B}$. Then the field inside the paramagnetic substance is :
(a) $\vec{B}$
(b) zero
(c) much large than $|\vec{B}|$ and parallel to $\vec{B}$
(d) much large than $|\vec{B}|$ but opposite to $\vec{B}$
- The momentum of an electron revolving in n^{th} orbit is given by:
(a) $\frac{nh}{2\pi r}$ (b) $\frac{nh}{2r}$ (c) $\frac{nh}{2\pi}$ (d) $\frac{2\pi r}{nh}$
- There are two organ pipes of the same length and the same material but of different radii. When they are emitting fundamental notes
(a) broader pipe gives note of smaller frequency
(b) both the pipes give notes of the same frequency
(c) narrower pipe gives note of smaller frequency
(d) either of them gives note of smaller or larger frequency depending on the wavelength of the wave.
- Two long current carrying conductors are placed parallel to each other at a distance of 8 cm between them. The magnitude of magnetic field produced at mid-point between the two conductors due to current flowing in them is $300 \mu\text{T}$. The equal current flowing in the two conductors is :
(a) 30A in the same direction.
(b) 30A in the opposite direction.
(c) 60A in the opposite direction.
(d) 300A in the opposite direction



7. The critical angle of a medium for a specific wavelength, if the medium has relative permittivity 3 and relative permeability $\frac{4}{3}$ for this wavelength, will be:
 (a) 15° (b) 30° (c) 45° (d) 60°
8. A steel rod of diameter 1.0 cm is clamped firmly at each end when its temperature is 25°C so that it cannot contract on cooling. The tension in the rod at 0°C is ($\alpha = 1 \times 10^{-5}/^\circ\text{C}$, $Y = 2 \times 10^{11} \text{ N/m}^2$):
 (a) 3925 N (b) 7000 N (c) 7400 N (d) 4700 N
9. An object of mass 5 kg is thrown vertically upwards from the ground. The air resistance produces a constant retarding force of 10 N throughout the motion. The ratio of time of ascent to the time of descent will be equal to : [Use $g = 10 \text{ ms}^{-2}$]
 (a) 1 : 1 (b) $\sqrt{2} : \sqrt{3}$ (c) $\sqrt{3} : \sqrt{2}$ (d) 2 : 3
10. When a longitudinal wave propagates through a medium, the particles of the medium execute simple harmonic oscillations about their mean positions. These oscillations of a particle are characterised by an invariant
 (a) Kinetic energy
 (b) Potential energy
 (c) Sum of kinetic energy and potential energy
 (d) Difference between kinetic energy and potential energy
11. A parallel plate capacitor of capacitance 2 F is charged to a potential V. The energy stored in the capacitor is E_1 . The capacitor is now connected to another uncharged identical capacitor in parallel combination. The energy stored in the combination is E_2 . The ratio E_2/E_1 is
 (a) 2 : 1 (b) 1 : 2 (c) 1 : 4 (d) 2 : 3
12. An electron moving along the x-axis has a position given by $x = 20t e^{-t} \text{ m}$, where t is in second. How far is the electron from the origin when it momentarily stop ?
 (a) 20 m (b) $20e \text{ m}$ (c) $\frac{20}{e} \text{ m}$ (d) zero
13. A short electric dipole has a dipole moment of $16 \times 10^{-9} \text{ C m}$. The electric potential due to the dipole at a point at a distance of 0.6 m from the centre of the dipole, situated on a line making

an angle of 60° with the dipole axis is :

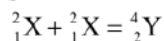
$$\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 / \text{C}^2 \right)$$

- (a) 200 V (b) 400 V (c) zero (d) 50 V
14. In Young's double slit experiment intensity at a point is $(1/4)$ of the maximum intensity. Angular position of this point is
 (a) $\sin^{-1}(\lambda/d)$ (b) $\sin^{-1}(\lambda/2d)$
 (c) $\sin^{-1}(\lambda/3d)$ (d) $\sin^{-1}(\lambda/4d)$
15. The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with the horizontal are R_1, R_2 and H_1, H_2 respectively. Choose the correct option :
 (a) $R_1 > R_2$ and $H_1 = H_2$
 (b) $R_1 = R_2$ and $H_1 < H_2$
 (c) $R_1 < R_2$ and $H_1 < H_2$
 (d) $R_1 = R_2$ and $H_1 = H_2$
16. The displacement of a particle is represented by the equation $y = 3 \cos\left(\frac{\pi}{4} - 2\omega t\right)$. The motion of the particle is
 (a) simple harmonic with period $2\pi/\omega$
 (b) simple harmonic with period π/ω
 (c) periodic but not simple harmonic
 (d) non-periodic
17. A monochromatic neon lamp with wavelength of 670.5 nm illuminates a photo-sensitive material which has a stopping voltage of 0.48 V. What will be the stopping voltage if the source light is changed with another source of wavelength of 474.6 nm?
 (a) 0.96 V (b) 1.25 V (c) 0.24 V (d) 1.5 V
18. A stone of mass m tied to a string of length ℓ is rotating along a circular path with constant speed v . The torque on the stone is
 (a) mv^2/ℓ (b) zero (c) $m\ell v$ (d) mv^2/ℓ
19. An ideal spring with spring-constant k is hung from the ceiling and a block of mass M is attached to its lower end. The mass is released with the spring initially unstretched. Then the maximum extension in the spring is
 (a) $4Mg/k$ (b) $2Mg/k$
 (c) Mg/k (d) $Mg/2k$

20. If E, L, M and G denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of P in the formula $P = EL^2M^{-5}G^{-2}$ are:-

(a) $[M^0 L^1 T^0]$ (b) $[M^{-1} L^{-1} T^2]$
(c) $[M^1 L^1 T^{-2}]$ (d) $[M^0 L^0 T^0]$

21. Two lighter nuclei combine to form a comparatively heavier nucleus by the relation given below:



The binding energies per nucleon 2_1X and 4_2Y are 1.1 MeV and 7.6 MeV respectively. The energy released in this process is

(a) 26 MeV (b) 56 MeV
(c) 78 MeV (d) 108 MeV

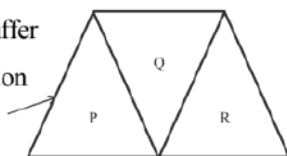
22. A particle moves under the effect of a force $F = Cx$ from $x = 0$ to $x = x_1$. The work done in the process is

(a) Cx_1^2 (b) $\frac{1}{2}Cx_1^2$ (c) Cx_1 (d) Zero

23. A given ray of light suffers minimum deviation in an equilateral prism P. Additional prisms Q and R of identical shape and of same material as that of P are now combined as shown in figure.

The ray will now suffer

(a) greater deviation
(b) no deviation
(c) same deviation as before
(d) total internal reflection



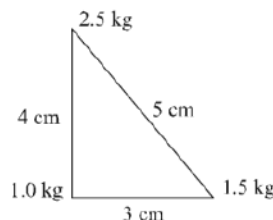
24. Polar molecules are the molecules
(a) having a permanent electric dipole moment
(b) having zero dipole moment
(c) acquire a dipole moment only in the presence of electric field due to displacement of charges
(d) acquire a dipole moment only when magnetic field is absent
25. Two cylinders A and B of equal capacity are connected to each other via a stop cock. A contains an ideal gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stop cock is suddenly opened. The process is :
(a) adiabatic (b) isochoric
(c) isobaric (d) isothermal
26. In a Wheatstone's bridge, three resistances P, Q and R connected in the three arms and the fourth

arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balanced will be

(a) $\frac{P}{Q} = \frac{2R}{S_1 + S_2}$ (b) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{S_1 S_2}$

(c) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{2S_1 S_2}$ (d) $\frac{P}{Q} = \frac{R}{S_1 + S_2}$

27. Three point particles of masses 1.0 kg, 1.5 kg and 2.5 kg are placed at three corners of a right angle triangle of sides 4.0 cm, 3.0 cm and 5.0 cm as shown in the figure. The center of mass of the system is at a point:



(a) 0.6 cm right and 2.0 cm above 1 kg mass
(b) 1.5 cm right and 1.2 cm above 1 kg mass
(c) 2.0 cm right and 0.9 cm above 1 kg mass
(d) 0.9 cm right and 2.0 cm above 1 kg mass

28. The potential energy of a satellite, having mass m and rotating at a height of 6.4×10^6 m from the earth surface, is

(a) $-mgR_e$ (b) $-0.67 mgR_e$
(c) $-0.5 mgR_e$ (d) $-0.33 mgR_e$

29. A series LCR circuit consists of $R = 80\Omega$, $X_L = 100\Omega$, and $X_C = 40\Omega$. The input voltage is $2500 \cos(100\pi t)$ V. The amplitude of current, in the circuit, is

(a) 25 A (b) 50 A (c) 75 A (d) 100 A

30. A point charge $q_1 = 4q_0$ is placed at origin. Another point charge $q_1 = -q_0$ is placed at $x = 12$ cm. Charge of proton is q_0 . The proton is placed on x-axis so that the electrostatic force on the proton is zero. In this situation, the position of the proton from the origin is

(a) 12 cm (b) 24 cm (c) 36 cm (d) 48 cm

PART - II : CHEMISTRY

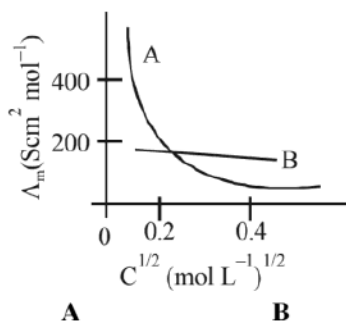
31. Electronic configuration of four elements A, B, C and D are given below :

(A) $1s^2 2s^2 2p^3$ (B) $1s^2 2s^2 2p^4$
(C) $1s^2 2s^2 2p^5$ (D) $1s^2 2s^2 2p^2$

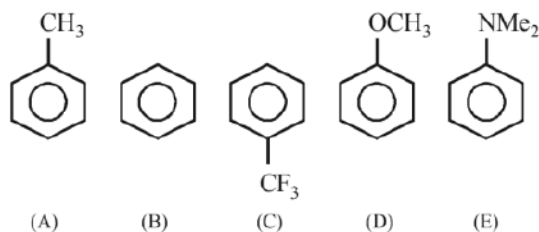
Which of the following is the correct order of increasing electronegativity (Pauling's scale) ?

- (a) $A < D < B < C$ (b) $A < C < B < D$
(c) $A < B < C < D$ (d) $D < A < B < C$

32. The molar conductivity for electrolytes A and B are plotted against $C^{1/2}$ as shown below. Electrolytes A and B respectively are :



- (a) Weak electrolyte weak electrolyte
(b) Strong electrolyte strong electrolyte
(c) Weak electrolyte strong electrolyte
(d) Strong electrolyte weak electrolyte
33. Decreasing order of reactivity towards electrophilic substitution for the following compounds is :



- (a) $C > B > A > D > E$ (b) $E > D > A > B > C$
(c) $A > D > E > B > C$ (d) $D > A > E > C > B$
34. The number of valence electrons present in the metal among Cr, Co, Fe and Ni which has the lowest enthalpy of atomisation is
(a) 8 (b) 9 (c) 6 (d) 10
35. The Zeta potential is related to which property of colloids?
(a) Colour
(b) Tyndall effect
(c) Charge on the surface of colloidal particles
(d) Brownian movement

36. Based on the data given below:

$$E^0_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}} = 1.33 \text{ V} \quad E^0_{\text{Cl}_2/\text{Cl}^-} = 1.36 \text{ V}$$

$$E^0_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V} \quad E^0_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$$

the strongest reducing agent is :

- (a) Mn^{2+} (b) Cr (c) MnO_4^- (d) Cl^-
37. An evacuated glass vessel weighs 40.0 g when empty, 135.0 g when filled with a liquid of density 0.95 g mL^{-1} and 40.5 g when filled with an ideal gas at 0.82 atm at 250 K. The molar mass of the gas in g mol^{-1} is :
(Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
(a) 35 (b) 50 (c) 75 (d) 125

38. Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas ? (Assume non-expansion work is zero)

- (a) Cyclic process : $q = -w$
(b) Adiabatic process : $\Delta U = -w$
(c) Isochoric process : $\Delta U = q$
(d) Isothermal process : $q = -w$

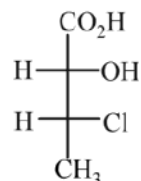
39. Half life of zero order reaction $A \rightarrow \text{product}$ is 1 hour, when initial concentration of reaction is 2.0 mol L^{-1} . The time required to decrease concentration of A from 0.50 to 0.25 mol L^{-1} is:

- (a) 0.5 hour (b) 4 hour
(c) 15 min (d) 60 min

40. Which hydride among the following is less stable?

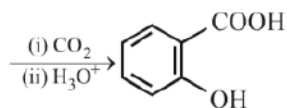
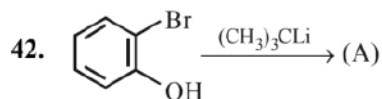
- (a) BeH_2 (b) NH_3 (c) HF (d) LiH

41. The absolute configuration of

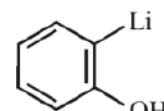
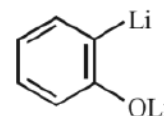
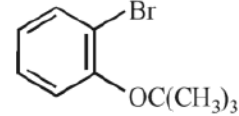
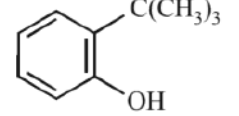


is :

- (a) (2S, 3S) (b) (2R, 3R)
(c) (2R, 3S) (d) (2S, 3R)



In the given conversion the compound A is :

- (a) 
 (b) 
 (c) 
 (d) 

43. Which type of isomerism is shown by 2, 3-dichlorobutane?

- (a) Structural (b) Geometric
 (c) Optical (d) Diastereo

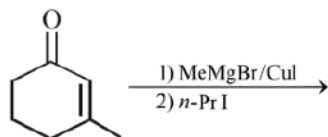
44. Suitable reaction condition for preparation of methyl phenyl ether is

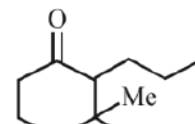
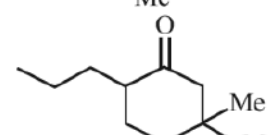
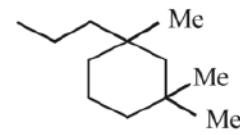
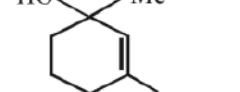
- (a) $\text{Ph}-\text{Br}$, MeO^-Na^+ (b) PhO^-Na^+ , MeOH
 (c) PhO^-Na^+ , MeBr (d) Benzene, MeBr

45. The one giving maximum number of isomeric alkenes on dehydrohalogenation reaction is (excluding rearrangement)

- (a) 1-Bromo-2-methylbutane
 (b) 2-Bromopropane
 (c) 2-Bromopentane
 (d) 2-Bromo-3,3-dimethylpentane

46. Find out the major product from the following reaction

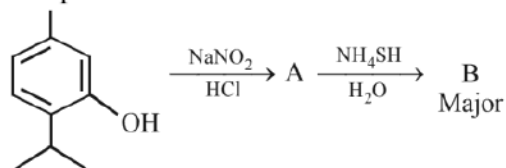


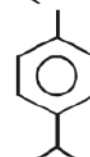
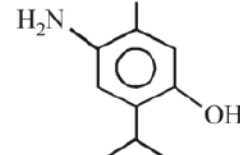
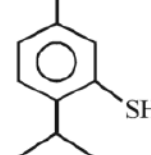
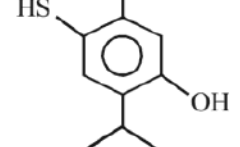
- (a) 
 (b) 
 (c) 
 (d) 

47. Which of the following compounds is likely to show both Frenkel and Schottky defects in its crystalline form?

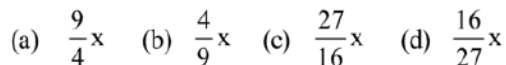
- (a) AgBr (b) CsCl (c) KBr (d) ZnS

48. Compound 'B' is

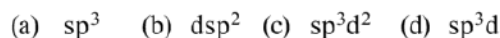


- (a) 
 (b) 
 (c) 
 (d) 

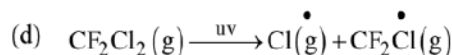
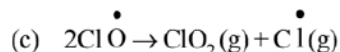
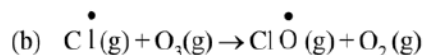
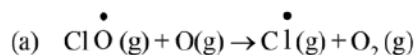
49. The radius of the 2nd orbit of Li²⁺ is x. The expected radius of the 3rd orbit of Be³⁺ is



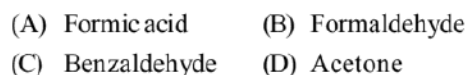
50. Among SO₂, NF₃, NH₃, XeF₂, ClF₃ and SF₆, the hybridization of the molecule with non-zero dipole moment and highest number of lone-pairs of electrons on the central atom is



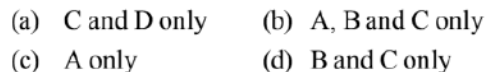
51. Which of these reactions is not a part of breakdown of ozone in stratosphere?



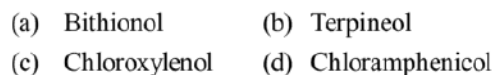
52. Which of the following compounds will give silver mirror with ammoniacal silver nitrate?



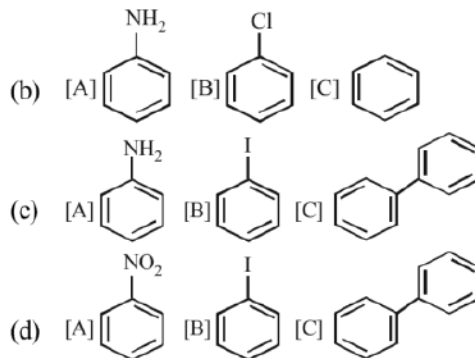
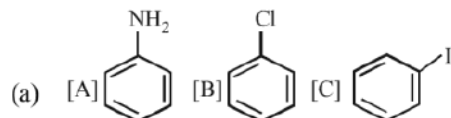
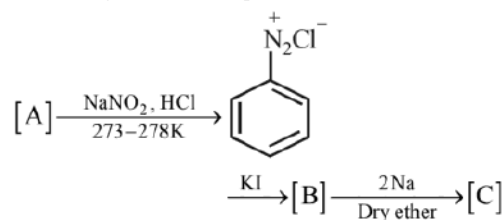
Choose the correct answer from the options given below:



53. An antiseptic dettol is a mixture of two compounds 'A' and 'B' where A has 6π electrons and B has 2π electrons. What is 'B'?



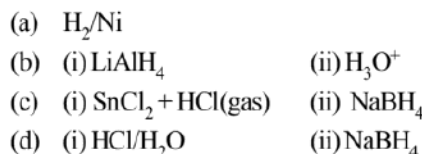
54. Identify [A], [B], and [C], respectively in the following reaction sequence:



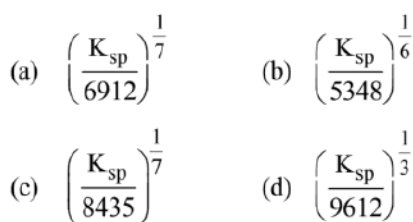
55. A vessel at 1000 K contains CO₂ with a pressure of 0.5 atm. Some of CO₂ is converted into CO on addition of graphite. If total pressure at equilibrium is 0.8 atm, then K_p is:



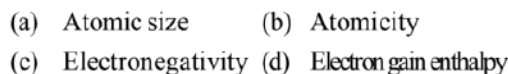
56. Which of the following is NOT a correct method of the preparation of benzylamine from cyanobenzene?



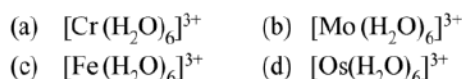
57. The molar solubility(s) of zirconium phosphate with molecular formula (Zr⁴⁺)₃(PO₄³⁻)₄ is given by relation:



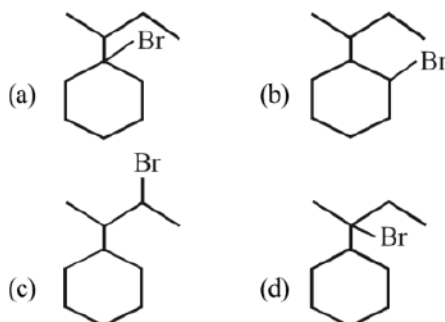
58. The large difference between the melting and boiling points of oxygen and sulphur may be explained on the basis of



59. Transition metal complex with highest value of crystal field splitting (Δ₀) will be



60. When sec-butylcyclohexane reacts with bromine in the presence of sunlight, the major product is:



PART - III (A): ENGLISH PROFICIENCY

DIRECTION (Q. 61): In the following question, four alternatives are given for the Idiom/Phrase underlined in the sentence. Choose the alternative which best expresses the meaning of the Idiom/Phrase.

61. By criticizing the local authorities, the journalist stirred a hornet's nest.
- Discovered a beehive
 - Got himself into a comfortable situation
 - Helped resolve a major conflict
 - Created a troublesome or chaotic situation

DIRECTIONS (Qs. 62-63): Read the passage carefully and answer the questions based on it.

In the rapidly evolving world of technology, the concept of digital minimalism has emerged as a counterbalance to the growing dependency on digital devices. Digital minimalism promotes a conscious and intentional approach to technology use—encouraging individuals to focus only on tools and platforms that add genuine value to their lives. The philosophy does not advocate the rejection of technology altogether but argues against mindless scrolling, constant notifications, and the compulsion to stay perpetually connected. Supporters claim that excessive screen time reduces productivity, impairs mental health, and fragments attention. By contrast, digital minimalists prioritize quality interactions, deep work, and solitude.

This approach demands clarity about personal values and the discipline to align one's digital habits accordingly. In an age where algorithms are designed

to exploit attention, the ability to resist digital distractions becomes a form of self-mastery. Interestingly, more people are now experimenting with "digital detoxes," time-blocked use, and the deliberate uninstallation of non-essential apps. As awareness spreads, digital minimalism is gaining ground not just as a lifestyle trend but as a necessary mindset for sustainable digital well-being in the 21st century.

62. What is the main goal of digital minimalism according to the passage?
- To eliminate all use of digital devices
 - To promote increased use of social media responsibly
 - To encourage purposeful and mindful use of technology
 - To create new algorithms that reduce screen time
63. According to the passage, how is attention treated in the digital age?
- It is protected by apps and platforms
 - It is considered a limited resource exploited by algorithms
 - It is irrelevant in modern multitasking
 - It is enhanced through constant connectivity
64. Choose the word opposite in meaning to the word given in capital.

BRUSQUE

- Affable
- Abrupt
- Stern
- Terse

65. Choose the word which is nearest in meaning to the given word.

Finicky

- Easy-going
- Punctual
- Fussy
- Polite

DIRECTIONS (Qs. 66- 67): Choose the most effective word from the given options to fill in the blank and to make the sentence meaningfully complete.

66. Despite being an expert in her field, she remained _____ and always credited her team for the success.
- arrogant
 - modest
 - boastful
 - dominant
67. Though the evidence was circumstantial, the lawyer skilfully _____ doubts about the witness's credibility during cross-examination.
- concealed
 - fabricated
 - instilled
 - neglected

DIRECTIONS (Qs. 68-69): In the questions given below, find out the part of sentence which contains an error:

68. (a) She insisted / (b) to meet the committee members / (c) before making / (d) the final decision.
 (a) She insisted
 (b) to meet the committee members
 (c) before making
 (d) the final decision
69. (a) The professor discussed / (b) about the new policy / (c) in detail / (d) during the seminar.
 (a) The professor discussed
 (b) about the new policy
 (c) in detail
 (d) during the seminar

DIRECTION (Q. 70): In a question below, a part of the sentence is underlined. Below are given alternatives to the underlined part at (a), (b), (c) which may improve the sentence. Choose the correct alternative. In case no improvement is needed, mark your answer as option (d).

70. Walking through the forest, the chirping of birds soothed her nerves.
 (a) As she walked through the forest,
 (b) Walking through the forest, hearing the chirping of birds soothing her nerves.
 (c) The chirping of birds, while walking through the forest, soothed her nerves.
 (d) No improvement

PART - III (B) : LOGICAL REASONING

DIRECTIONS (Qs. 71-72): On the following question select the related words/letters/ numbers from the attractive.

71. TTT : 777 :: RRR : ?
 (a) 555 (b) 666
 (c) 888 (d) 999
72. xxyzyy : ccabb :: xyyzzy :
 (a) abbacc (b) bbacca
 (c) abbcca (d) cbbaab
73. Three of the following four words are alike in a certain way and one is different. Find the odd one out.

- (a) Hexagon (b) Ellipse
 (c) Parallelogram (d) Rhombus

74. From the given alternative words, select the word which cannot be formed using the letters of the given word :

Given : IMPASSIONABLE

- (a) IMPASSABLE
 (b) IMPOSSIBLE
 (c) IMPASSIVE
 (d) IMPASSION

75. In a certain code, '253' means 'books are old'; '546' means 'man is old' and '378' means 'buy good books'. What stands for "are" in that code?

- (a) 2 (b) 4
 (c) 5 (d) 6

76. Which letter-cluster will replace the question mark (?) in the following series?

BECD, FIGH, KNLM, ?, XAYZ

- (a) QWSU (b) ORPQ
 (c) PSQR (d) QTRS

77. Select the missing number from the given responses.

	8	
6	54	7
	4	

	12	
8	51	4
	7	

	14	
9	?	5
	9	

- (a) 53 (b) 71
 (c) 76 (d) 68

DIRECTIONS (Qs. 78-79) : In these questions, two statements followed by two conclusions numbered I and II have been given. You have to take the two given statements to be true even if they seem to be at variance from commonly known facts. Read all the conclusions and then decide which of the given conclusions logically follows from the given statements disregarding commonly known facts.

Give Answer :

- (a) If only conclusion I is true
 (b) If neither conclusions I nor II is true
 (c) If both conclusions I and II are true
 (d) If only conclusion II is true
 (e) If either conclusion I or II is true

78. Statements :

Some jars are bowls.

Some spoons are jars.

Conclusions :

I. No bowl is a spoon.

II. Some jars are definitely not bowls.

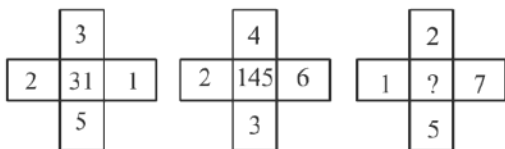
79. Statements :

Some paints are brushes.
No brush is a canvas.

Conclusions :

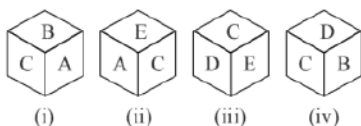
- I. No paint is a canvas.
II. All brushes can be paints is a possibility.

- 80.** In the following question, select the number which can be placed at the sign of question non marking the given alternatives.



- (a) 43 (b) 49
(c) 59 (d) 71

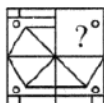
- 81.** Four forms of a dice are shown below. In this dice which word will be on the surface opposite to the word *D*?



- (a) *D* (b) *A*
(c) *B* (d) *C*

DIRECTION (Qs. 82): Which answer figure complete the form in question figure ?

82. Question Figure:



X

Answer Figures:

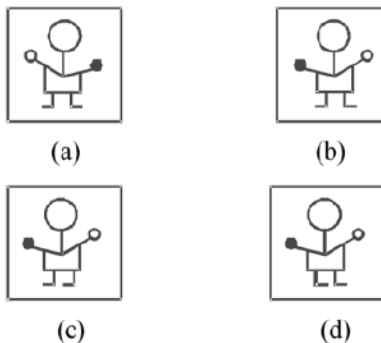
- (a) (b)
(c) (d)

DIRECTIONS: In questions 83, there is a problem figure and four answer figures marked (a), (b), (c), (d) are given. Select the answer figure which is exactly the mirror image of the problem figure.

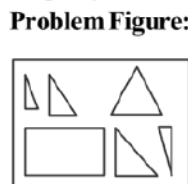
83. Question Figure:



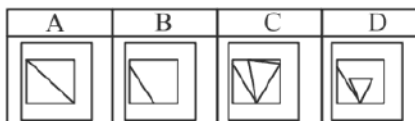
Answer Figures:



- 84.** Which of the answer figures is formed from the shapes given the problem figure?



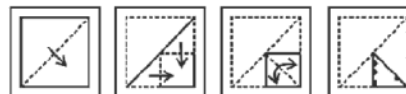
Answer Figure:



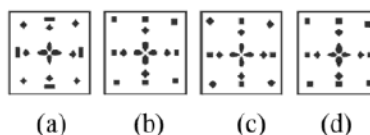
- (a) C (b) B (c) D (d) A

- 85.** A piece of paper is folded and punched as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

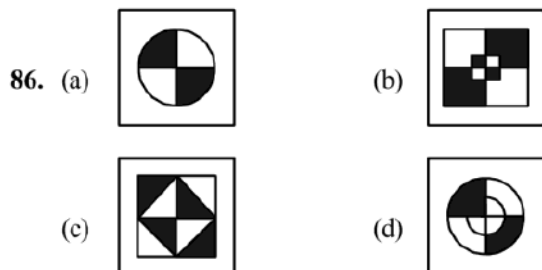
Question Figure:



Answer Figures:



DIRECTIONS: Four figures (a),(b),(c),(d) have been given in each question of these four figure these figure are similar in some way and one figure different select the figure which is different



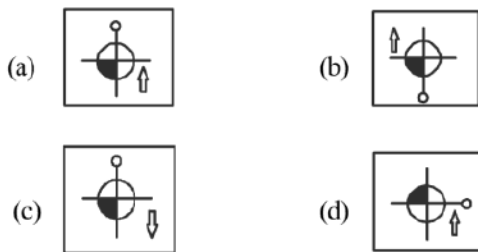
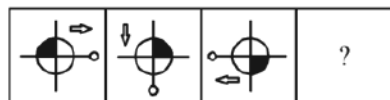
87. Select the correct option that indicates the arrangement of the given words in the order in which they appear in an English dictionary.

- | | |
|-------------|-------------|
| 1. Industry | 2. Indent |
| 3. Indoor | 4. Indolent |

5. Index

- | | |
|-------------------|-------------------|
| (a) 1, 2, 3, 5, 4 | (b) 2, 4, 5, 3, 1 |
| (c) 2, 5, 4, 3, 1 | (d) 2, 1, 3, 5, 4 |

88. Select the figure that will replace the question mark (?) in the following figure series.



89. X told Y, "Though I am the son of your father, you are not my brother". How is X related to Y?

- | | |
|------------|-------------------|
| (a) Son | (b) Daughter |
| (c) Father | (d) None of these |

90. If DANGER is coded as 11 - 8 - 21 - 14 - 12 - 25, then how will be coded the word MACHINE?

- | |
|--------------------------------------|
| (a) 10 - 21 - 15 - 14 - 26 - 17 - 18 |
| (b) 20 - 8 - 10 - 16 - 17 - 22 - 13 |
| (c) 20 - 10 - 8 - 12 - 15 - 16 - 7 |
| (d) 20 - 8 - 10 - 15 - 16 - 21 - 12 |

PART - IV : MATHEMATICS

91. If $A = \{a, \{b\}\}$, then $P(A)$ equals.

- | |
|--|
| (a) $\{\phi, \{a\}, \{\{b\}\}, \{a, \{b\}\}\}$ |
| (b) $\{\phi, \{a\}\}$ |
| (c) $\{\{a\}, \{b\}, \phi\}$ |
| (d) None of these |

92. The relation R defined on the set of natural numbers as $\{(a, b) : a \text{ differs from } b \text{ by } 3\}$ is given

- | |
|---|
| (a) $\{(1, 4), (2, 5), (3, 6), \dots\}$ |
| (b) $\{(4, 1), (5, 2), (6, 3), \dots\}$ |
| (c) $\{(1, 3), (2, 6), (3, 9), \dots\}$ |
| (d) None of these |

93. The value of $\sin 765^\circ$ is $\frac{1}{\sqrt{n}}$. Value of n is

- | | | | |
|-------|-------|-------|-------|
| (a) 2 | (b) 3 | (c) 4 | (d) 0 |
|-------|-------|-------|-------|

94. If $\tan \theta = -\frac{1}{\sqrt{3}}$, then general solution of the equation is

- | | |
|---|--|
| (a) $2n\pi + \frac{\pi}{6}, n \in \mathbb{I}$ | (b) $n\pi + \frac{\pi}{6}, n \in \mathbb{I}$ |
|---|--|

- | | |
|---|--|
| (c) $2n\pi - \frac{\pi}{6}, n \in \mathbb{I}$ | (d) $n\pi - \frac{\pi}{6}, n \in \mathbb{I}$ |
|---|--|

95. The real part of the complex number $\frac{(1+2i)^8 \cdot (1-2i)^2}{(3+2i) \cdot (4-6i)}$ is equal to:

- | | | | |
|----------------------|----------------------|--------------------|----------------------|
| (a) $\frac{500}{13}$ | (b) $\frac{110}{13}$ | (c) $\frac{55}{6}$ | (d) $\frac{550}{13}$ |
|----------------------|----------------------|--------------------|----------------------|

96. If α, β are the roots of the equation $ax^2 + bx + c = 0$, then $\frac{\alpha}{a\beta + b} + \frac{\beta}{a\alpha + b} =$

- | | | | |
|-------------------|-------------------|-------------------|--------------------|
| (a) $\frac{2}{a}$ | (b) $\frac{2}{b}$ | (c) $\frac{2}{c}$ | (d) $-\frac{2}{a}$ |
|-------------------|-------------------|-------------------|--------------------|

97. If α, β be the roots of the equation $2x^2 - 35x + 2 = 0$, then the value of $(2\alpha - 35)^3 \cdot (2\beta - 35)^3$ is equal to

- | | |
|-------|-------------------|
| (a) 1 | (b) 64 |
| (c) 8 | (d) None of these |

98. Which of the following is the solution set of $3x - 7 > 5x - 1 \forall x \in \mathbb{R}$?

- | | |
|---------------------|---------------------|
| (a) $(-\infty, -3)$ | (b) $(-\infty, -3]$ |
| (c) $(-3, \infty)$ | (d) $(-3, 3)$ |

99. The number of four digit numbers with distinct digits is :

(a) $9 \times {}^9C_3$ (b) $9 \times {}^9P_3$
(c) ${}^{10}C_3$ (d) ${}^{10}P_3$

100. On a railway route there are 20 stations. What is the number of different tickets required in order that it may be possible to travel from every station to every other station?

(a) 40 (b) 380 (c) 400 (d) 420

101. If $\left(2 + \frac{x}{3}\right)^{55}$ is expanded in the ascending

powers of x and the coefficients of powers of x in two consecutive terms of the expansion are equal, then these terms are:

(a) 7th and 8th (b) 8th and 9th
(c) 28th and 29th (d) 27th and 28th

102. The sum of n terms of two arithmetic series are in the ratio $2n + 3 : 6n + 5$, then the ratio of their 13th terms is

(a) 53 : 155 (b) 27 : 87
(c) 29 : 83 (d) 31 : 89

103. The value of x in $(0, \pi)$ which satisfy the equation

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

(a) $\left\{\frac{\pi}{2}, \frac{3\pi}{4}\right\}$ (b) $\left\{\frac{\pi}{4}, \frac{3\pi}{4}\right\}$
(c) $\left\{\frac{\pi}{3}, \frac{2\pi}{3}\right\}$ (d) $\left\{\frac{\pi}{6}, \frac{5\pi}{6}\right\}$

104. Let α_1, α_2 ($\alpha_1 < \alpha_2$) be the values of α for the points $(\alpha, -3)$, $(2, 0)$ and $(1, \alpha)$ to be collinear. Then the equation of the line, passing through

(α_1, α_2) and making an angle of $\frac{\pi}{3}$ with the positive direction of the x -axis, is:

(a) $x - \sqrt{3}y - 3\sqrt{3} + 1 = 0$
(b) $\sqrt{3}x - y + \sqrt{3} + 3 = 0$
(c) $x - \sqrt{3}y + 3\sqrt{3} + 1 = 0$
(d) $\sqrt{3}x - y + \sqrt{3} - 3 = 0$

105. If $(-4, 5)$ is one vertex and $7x - y + 8 = 0$ is one diagonal of a square, then the equation of second diagonal is

(a) $x + 3y = 21$ (b) $2x - 3y = 7$
(c) $x + 7y = 31$ (d) $2x + 3y = 21$

106. The angle between the pair of straight lines

$$y^2 \sin^2 \theta - xy \sin^2 \theta + x^2 (\cos^2 \theta - 1) = 0 \text{ is}$$

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{2\pi}{3}$ (d) $\frac{\pi}{2}$

107. The set of values of k for which the circle $C : 4x^2 + 4y^2 - 12x + 8y + k = 0$ lies inside the

fourth quadrant and the point $\left(1, -\frac{1}{3}\right)$ lies on or inside the circle C is :

(a) An empty set (b) $\left[6, \frac{95}{9}\right]$
(c) $\left[\frac{80}{9}, 10\right)$ (d) $\left[9, \frac{92}{9}\right]$

108. Let P be the point $(1, 0)$ and Q a point on the locus $y^2 = 8x$. The locus of mid point of PQ is

(a) $y^2 - 4x + 2 = 0$ (b) $y^2 + 4x + 2 = 0$
(c) $x^2 + 4y + 2 = 0$ (d) $x^2 - 4y + 2 = 0$

109. What is the shortest distance of the point $(1, 2, 3)$ from x -axis ?

(a) 1 (b) $\sqrt{6}$ (c) $\sqrt{13}$ (d) $\sqrt{14}$

110. If value of $\lim_{x \rightarrow a} \frac{\sqrt{a+2x} - \sqrt{3x}}{\sqrt{3a+x} - 2\sqrt{x}}$ is equal to $\frac{2\sqrt{3}}{m}$, where m is equal to

(a) 2 (b) 8 (c) 9 (d) 3

111. Find the mean deviation about the mean for the data.

x_i	5	10	15	20	25
f_i	7	4	6	3	5

(a) 6 (b) 7.3 (c) 8 (d) 6.32

112. Let $S = \{1, 2, 3, \dots, 2022\}$. Then the probability, that a randomly chosen number n from the set S such that $\text{HCF}(n, 2022) = 1$, is :

(a) $\frac{128}{1011}$ (b) $\frac{166}{1011}$ (c) $\frac{127}{337}$ (d) $\frac{112}{337}$

113. Let $f : (4, 6) \rightarrow (6, 8)$ be a function defined by $f(x) = x + \left[\frac{x}{2} \right]$ (where $[.]$ denotes the greatest

integer function), then $f^{-1}(x)$ is equal to

- (a) $x - \left[\frac{x}{2} \right]$ (b) $-x - 2$
(c) $x - 2$ (d) $\frac{1}{x + \left[\frac{x}{2} \right]}$

114. The value of x satisfying the equation

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

- (a) $x = 2$ (b) $x = \frac{1}{2}$
(c) $x = \frac{1}{2 - \sqrt{3}}$ (d) none of these

115. Let A be a 3×3 invertible matrix. If $|\text{adj}(24A)| = \text{adj}[(3 \text{adj}(2A))]$, then $|A|^2$ is equal to:

- (a) 6^6 (b) 2^{12} (c) 2^6 (d) 1

116. If the system of equations

$$x + y + z = 16$$

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

$$x + 2y + 3z = 14$$

has infinitely many solutions, then $\alpha + \beta$ is equal to:

- (a) 8 (b) 36
(c) 44 (d) 48

117. If $f(x) = \begin{cases} \frac{\sqrt{1+kx} - \sqrt{1-kx}}{x} & \text{for } -1 \leq x < 0 \\ 2x^2 + 3x - 2, & \text{for } 0 \leq x \leq 1 \end{cases}$ is continuous at $x = 0$, then $k =$

- (a) -4 (b) -3 (c) -2 (d) -1

118. If $\sin y = x \sin(a + y)$, then value of dy/dx is

- (a) $\frac{\sin(a + y)}{\sin a}$ (b) $\frac{\sin^2(a + y)}{\sin a}$
(c) $\sin^2(a + y)$ (d) $\frac{\cos^2(a + y)}{\sin a}$

119. The maximum value of $(\log x)/x$ is

- (a) e (b) $2e$ (c) $1/e$ (d) $2/e$

120. If $\int \frac{6x + 7}{\sqrt{(x-5)(x-4)}} dx = A\sqrt{x^2 - 9x + 20}$

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

Then the values of A and B are

- (a) 6, 34 (b) 3, 9
(c) 12, 17 (d) None of these

121. The value of $\int_0^{\pi} \frac{e^{\cos x} \sin x}{(1 + \cos^2 x)(e^{\cos x} + e^{-\cos x})} dx$ is equal to

- (a) $\frac{\pi^2}{4}$ (b) $\frac{\pi^2}{2}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

122. The area enclosed between the graph of $y = x^3$ and the lines $x = 0$, $y = 1$, $y = 8$ is

- (a) $\frac{45}{4}$ (b) 14 (c) 7 (d) None

123. The solution of the differential equation

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

- (a) $ye^x + x = C$ (b) $xe^y + y = C$

- (c) $\frac{y}{ye^x + y} = C$ (d) $\frac{x}{ye^y + y} = C$

124. Statement 1: Integrating factor of $\frac{dy}{dx} + y = x^2$

is e^x

Statement 2: Integrating factor of

$$\frac{dy}{dx} + P(x)y = Q(x) \text{ is } e^{\int P(x)dx}$$

- (a) Statement -1 is false, Statement-2 is true
(b) Statement -1 is true, Statement-2 is true; Statement -2 is a correct explanation for Statement-1
(c) Statement -1 is true, Statement-2 is true; Statement -2 is not a correct explanation for Statement-1
(d) Statement -1 is true, Statement-2 is false

125. If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors, then

$[\vec{a} + \vec{b} + \vec{c}, \vec{a} - \vec{c}, \vec{a} - \vec{b}]$ is equal to

- (a) 0 (b) $2[\vec{a} \vec{b} \vec{c}]$
(c) $-3[\vec{a} \vec{b} \vec{c}]$ (d) $2[\vec{a} \vec{b} \vec{c}]$

126. If the position vectors of the vertices A, B, C of a triangle ABC are $7\hat{j} + 10\hat{k}$, $-\hat{i} + 6\hat{j} + 6\hat{k}$ and $-4\hat{i} + 9\hat{j} + 6\hat{k}$ respectively, the triangle is :

- (a) equilateral
(b) isosceles
(c) scalene
(d) right angled and isosceles also

127. Under what condition do $\left\langle \frac{1}{\sqrt{2}}, \frac{1}{2}, k \right\rangle$ represent direction cosines of a line?

- (a) $k = \frac{1}{2}$ (b) $k = -\frac{1}{2}$
(c) $k = \pm \frac{1}{2}$ (d) k can take any value

128. If the plane $x - 3y + 5z = d$ passes through the point (1, 2, 4), then the length of intercepts cut by it on the axes of X, Y, Z are respectively, is

- (a) 15, -5, 3 (b) 1, -5, 3
(c) -15, 5, -3 (d) 1, -6, 20

129. If A and B are two events such that $P(A)$

$= \frac{1}{3}$, $P(B) = \frac{1}{5}$ and $P(A \cup B) = \frac{1}{2}$, then

$P(A|B') + P(B|A')$ is equal to

- (a) $\frac{3}{4}$ (b) $\frac{5}{8}$ (c) $\frac{5}{4}$ (d) $\frac{7}{8}$

130. For a biased dice, the probability for the different faces to turn up are

Face	1	2	3	4	5	6
P	0.10	0.32	0.21	0.15	0.05	0.17

The dice is tossed and it is told that either the face 1 or face 2 has shown up, then the probability that it is face 1, is

- (a) $\frac{16}{21}$ (b) $\frac{1}{10}$
(c) $\frac{5}{16}$ (d) $\frac{5}{21}$

SOLUTIONS

PART - I : PHYSICS

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

Frictional force = μmg

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,

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

R.M.S. Speed,

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

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

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

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

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's 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) $f = \frac{v}{\lambda} = \frac{v}{(\ell + e)}$

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



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.

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

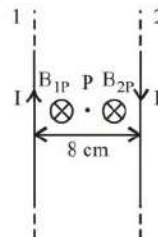
$$B_p = 2 \frac{\mu_0 I}{2\pi r}$$

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

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

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

$$I = 30 \text{ A}$$



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

$$\text{And, } \sin \theta_c = \frac{1}{n} = \frac{1}{2}$$

$\therefore$ 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

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

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

Finally

Charge will be divided equally

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

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

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

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

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

$$\therefore t = 1$$

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

13. (a) Given,

Dipole moment of short electric dipole,

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

Distance from centre of dipole, $r = 0.6 \text{ m}$

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

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

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

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

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

15. (b) For projectile motion,

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

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

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

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

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

$$y = a \cos(\omega t + \phi)$$

$$\text{So, } \omega' = 2\omega$$

$$\frac{2\pi}{T'} = 2\omega \Rightarrow T' = \frac{2\pi}{2\omega} = \frac{\pi}{\omega}$$

Hence, the motion is SHM with period $\frac{\pi}{\omega}$.

17. (b) Given wavelength of neon lamp $\lambda_1 = 670.5 \text{ nm}$

$$\text{Stopping potential } V_1 = 0.48 \text{ V.}$$

From the Einstein's photoelectric equation

$$kE_{\max} = \frac{hc}{\lambda_1} + \phi \Rightarrow eV_1 = \frac{hc}{\lambda_1} + \phi$$

$$\Rightarrow e(0.48) = \frac{1240}{670.5} + \phi \quad \dots(i)$$

For second case wavelength $\lambda_2 = 474.6 \text{ nm}$
stopping potential = V_2 .

$$e(V_2) = \frac{1240}{474.6} + \phi \quad \dots(ii)$$

Subtracting equation (i) from (ii) we get

$$e(V_2 - 0.48) = 1240 \left(\frac{1}{474.6} - \frac{1}{670.5} \right) eV$$

$$\Rightarrow V_2 = 0.48 + 1240 \left(\frac{670.5 - 474.6}{474.6 \times 670.5} \right) \text{ volts}$$

$$\Rightarrow V_2 = 0.48 + 0.76 = 1.25 \text{ V}$$

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

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

or $x = \frac{2Mg}{k}$

20. (d) $[E] = ML^2T^{-2}$
 $[L] = ML^2T^{-1}$
 $[G] = M^{-1}L^3T^{-2}$

$P = \frac{EL^2}{M^5G^2}$

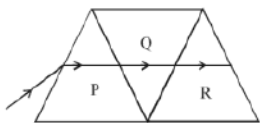
$\Rightarrow$

$[P] = \frac{(ML^2T^{-2})(M^2L^4T^{-2})}{M^5(M^{-2}L^6T^{-4})} = M^0L^0T^0$

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

22. (b) $W = \int F dx = \int_0^{x_1} Cx dx = \frac{1}{2} Cx_1^2$

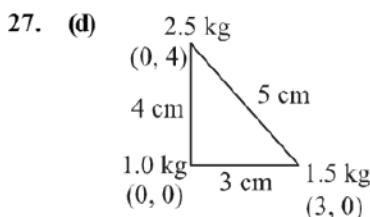
23. (c) When the ray suffers minimum deviation, it becomes parallel to the base of prism P. As prisms Q and R are of same material and have identical shape, therefore, the ray continues to be parallel to base of Q and R. Hence final deviation of the ray remains the same as before.



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 $S = \frac{S_1S_2}{S_1 + S_2}$



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

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

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

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

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) = $6.4 \times 10^6 \text{ m}$.

We know that gravitational potential energy of the satellite at height

$h = -\frac{GM_em}{R_e + h} = -\frac{gR_e^2m}{2R_e}$

$= -\frac{gR_em}{2} = -0.5mgR_e$

(where, $GM_e = gR_e^2$ and $h = R_e$)

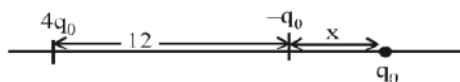
29. (a) We have

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

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

$= 25 \text{ A}$

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



Using the Coulomb's law

$$\frac{1}{4\pi\epsilon_0} \frac{q_0}{x^2} = \frac{1}{4\pi\epsilon_0} = \frac{4q_0}{(x+12)^2}$$

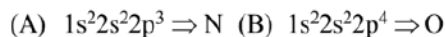
$$\Rightarrow x+12=2x$$

$$x=12$$

$$\text{Distance from origin} = x+12 = 24 \text{ cm.}$$

PART - II : CHEMISTRY

31. (d)



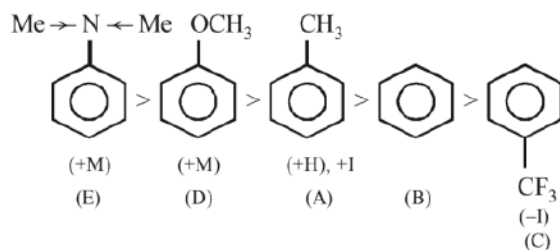
Order of electronegativity: $\text{F} > \text{O} > \text{N} > \text{C}$

$$\therefore \text{D} < \text{A} < \text{B} < \text{C}$$

32. (c) $\text{A} \rightarrow$ Weak electrolyte (greater change of Λ_m)

$\text{B} \rightarrow$ 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.



$\therefore$ Total valence electrons in $\text{Cr} = 6$

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

Hence Cr is the strongest reducing agent.

37. (d) Mass of liquid = $135 - 40 = 95 \text{ g}$

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

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

$$\text{Mass of ideal gas} = 40.5 - 40 \text{ g} = 0.5 \text{ g}$$

$$PV = nRT$$

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

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 :

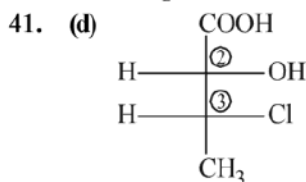
$$\text{Half life} = \frac{[A]_0}{2k} \Rightarrow 60 \text{ min} = \frac{2}{2k}$$

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

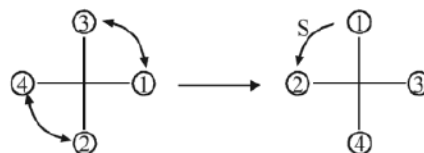
$$\text{Now, } [A]_t = [A]_0 - kt \Rightarrow t = \frac{[A]_0 - [A]_t}{k}$$

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

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

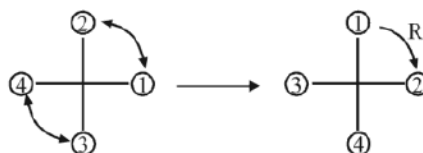


At (2),



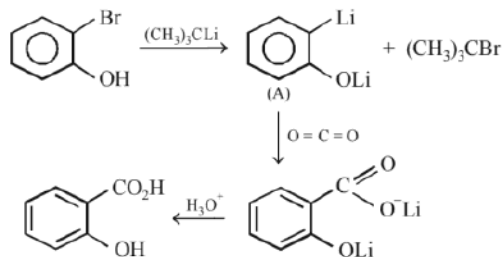
'S' configuration

At (3),



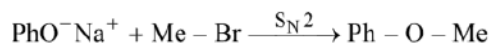
'R' configuration

42. (b) $(\text{CH}_3)_3\text{CLi}$ 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.

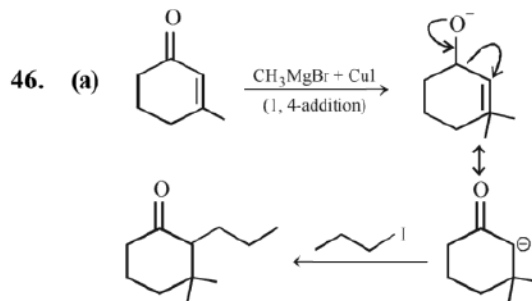
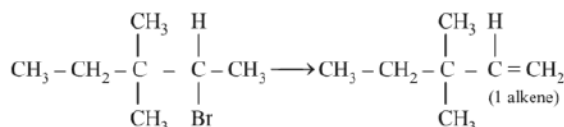
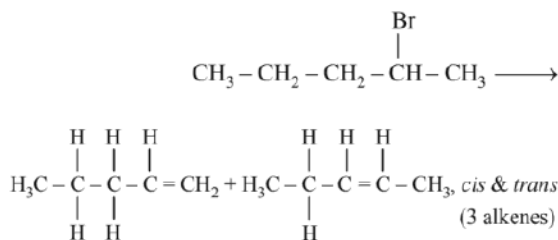
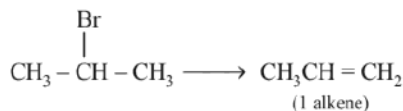
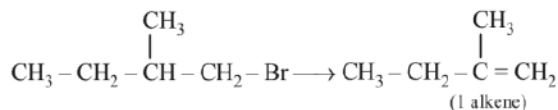
44. (c)



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

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

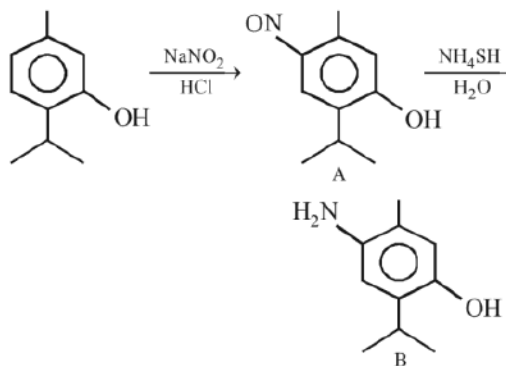
45. (c)



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

48. (b) $\text{NaNO}_2 + \text{HCl} \rightarrow \text{HNO}_2 + \text{NaCl}$

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



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

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

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

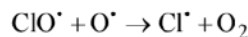
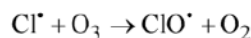
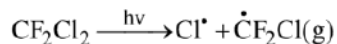
$$\frac{y}{x} = \frac{9}{4} \times \frac{3}{4} = \frac{27}{16}$$

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

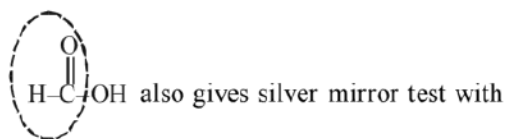
50. (d)

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

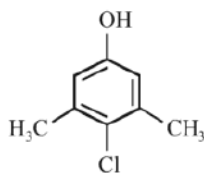


52. (b) Apart from aldehyde, Formic acid



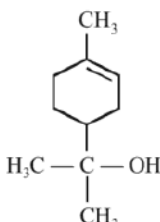
ammonical silver nitrate.

53. (b) Dettol is mixture of



Chloroxylenol
(compound A)
It has 6πe⁻

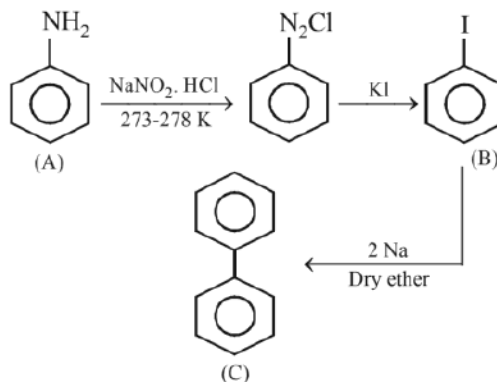
and



Terpineol
(compound B)
It has 2πe⁻

Hence compound 'B' is Terpineol.

54. (c)

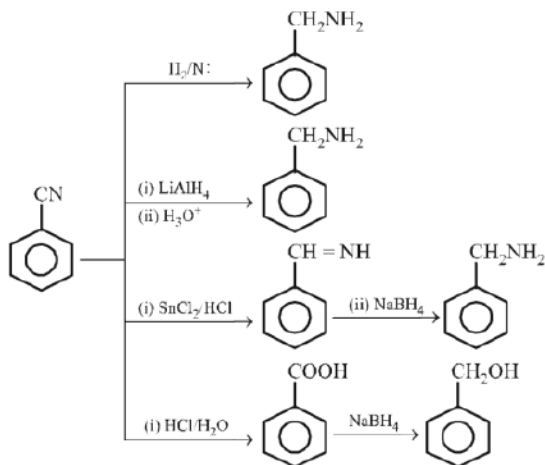


55. (b) $\text{CO}_2(\text{g}) + \text{C}(\text{s}) \rightleftharpoons 2\text{CO}(\text{g})$

$$\begin{array}{ccc} t=0 & 0.5 & - \\ \text{at equi.} & 0.5 - x & 2x \\ P_{\text{total}} = 0.5 + x = 0.8 = x = 0.3 \end{array}$$

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

56. (d)



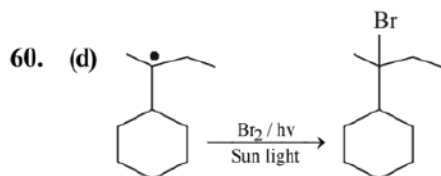
57. (a)

$$\text{Zr}_3(\text{PO}_4)_4(\text{s}) \rightleftharpoons 3\text{Zr}^{+4}(\text{aq}) + 4\text{PO}_4^{-3}(\text{aq})$$

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

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

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.



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*, *Stern* and *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 *fussy* or excessively concerned with minor details. *Easy-going* is the opposite, while *punctual* and *polite* 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)
- | | | | | | |
|---|---|---|---|---|---|
| x | x | y | z | y | y |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| c | c | b | a | b | b |
- Pairs of opposite letters
Therefore,
- | | | | | | |
|---|---|---|---|---|---|
| x | y | y | z | z | y |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| c | b | b | a | a | b |
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) 2 ⑤ $\Rightarrow$ are ⑥
- ⑤ 4 6 $\Rightarrow$ man is ⑥
- 7 8 $\Rightarrow$ buy good

Codes are :

5 $\Rightarrow$ old 4 $\Rightarrow$ man or is

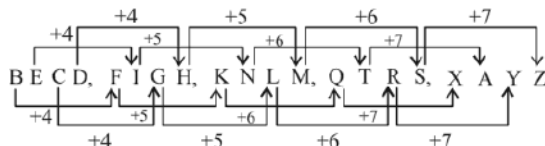
8 $\Rightarrow$ buy or good

3 $\Rightarrow$ books 6 $\Rightarrow$ man or is

2 $\Rightarrow$ are 7 $\Rightarrow$ buy or good

2 stands for "are" in that code.

76. (d) The pattern is



77. (d) The pattern is:

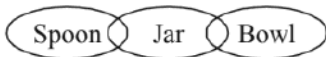
$$(6 \times 7) + 8 + 4 = 54$$

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

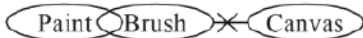
$$(9 \times 5) + 14 + 9 = 68$$

Sol. (78-79):

78. (b)



79. (d)



80. (d) As,

$$3 \times 1 \times 5 \times 2 + 1 = 31 \quad \text{and}$$

$$4 \times 6 \times 3 \times 2 + 1 = 145$$

Similarly,

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

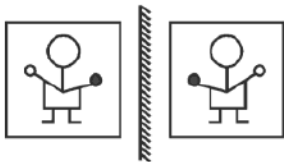
81. (b) In figure (ii) and (iii) C and E are common.

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)

$\Rightarrow$ M A C H I N E
 $\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$

Codes as 20 8 10 15 16 21 12

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 $\{(a, b) : a - b = 3, a, b \in \mathbb{N}\}$

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 : $\{(4, 1), (5, 2), (6, 3), \dots\}$

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 $\frac{(1+2i)^8 \cdot (1-2i)^2}{(3+2i) \cdot (4-6i)}$

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

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

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

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

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

Now,

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

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

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

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

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

Also, $\alpha\beta = 1$

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

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

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

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

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

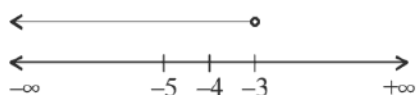
Transferring the term $5x$ to L.H.S. and the term -7 to R.H.S.

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

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) $9 \times 9P_3$

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

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

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

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

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

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

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 1st A.P.

and S_{n_2} be the sum of n terms of IInd A.P.

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

$$\Rightarrow \frac{S_{n_1}}{S_{n_2}} = \frac{2n+3}{6n+5} \quad \dots (i)$$

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

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

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 $a = 13, n = 2a - 1 = 2 \times 13 - 1 = 25$

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

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

103. (c) We have

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

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

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

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

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

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

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

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

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

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

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 $(-4, 5)$

$$\therefore 5 = -4m + c \quad \dots (i)$$

Since this line is at right angle to the line

$$7x - y + 8 = 0 \text{ or } y = 7x + 8, \text{ having slope} = 7,$$

$$\therefore 7 \times m = -1 \text{ or } m = \frac{-1}{7}$$

Putting this value of m in equation (i) we get

$$5 = -4 \times \left(\frac{-1}{7} \right) + c$$

$$\text{or } 5 = \frac{4}{7} + c \text{ or } c = 5 - \frac{4}{7} = \frac{31}{7}$$

Hence equation of the other diagonal is

$$y = -\frac{1}{7}x + \frac{31}{7} \text{ or } 7y = -x + 31$$

$$\text{or } x + 7y - 31 = 0 \text{ or } x + 7y = 31.$$

106. (d) Required angle between given pair of st.

$$\text{line} = \frac{\pi}{2}$$

107. (d) Given circle is $4x^2 + 4y^2 - 12x + 8y + k = 0$

$$\Rightarrow x^2 + y^2 - 3x + 2y + \left(\frac{k}{4} \right) = 0$$

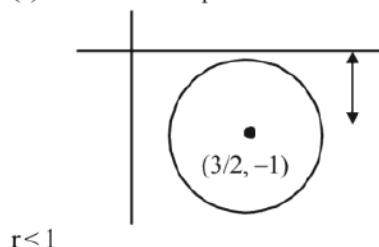
$$\text{Centre } \left(\frac{3}{2}, -1 \right); r = \sqrt{\frac{13-k}{2}}$$

$$\text{Here, } r \geq 0, \text{ then } \sqrt{\frac{13-k}{2}} \geq 0. \text{ So, } k \leq 13. \quad \dots (i)$$

(i) Point $\left(1, \frac{-1}{3} \right)$ lies on or inside circle C

$$\Rightarrow S_1 \leq 0 \Rightarrow k \leq \frac{92}{9} \quad \dots (ii)$$

(ii) C lies in 4th quadrant



$$\Rightarrow \frac{\sqrt{13-k}}{2} < 1 \Rightarrow k < 9 \quad \dots(iii)$$

$$\text{Hence } (i) \cap (ii) \cap (iii) \Rightarrow k \in \left(9, \frac{92}{9}\right]$$

108. (a) Given $P = (1, 0)$, let $Q = (h, k)$
Since Q lies on $y^2 = 8x \therefore k^2 = 8h \quad \dots(i)$

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 $(1, 0, 0)$

$$110. (c) \lim_{x \rightarrow a} \frac{\sqrt{a+2x} - \sqrt{3x}}{\sqrt{3a+x} - 2\sqrt{x}} \times \frac{\sqrt{a+2x} + \sqrt{3x}}{\sqrt{a+2x} + \sqrt{3x}}$$

$$= \lim_{x \rightarrow a} \frac{(a+2x) - 3x}{(\sqrt{3a+x} - 2\sqrt{x})(\sqrt{a+2x} + \sqrt{3x})}$$

Again rationalizing, we get

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

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

111. (d)

x_i	f_i	$f_i \cdot x_i$	$ x_i - \bar{x} $	$f_i x_i - \bar{x} $
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

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

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 $\{1, 2, 3, \dots, 2022\}$

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

B = Number which are divisible by 3 from $\{1, 2, 3, \dots, 2022\}$

$$n(B) = 674$$

$A \cap B$ = Number which are divisible by 6 from $\{1, 2, 3, \dots, 2022\}$

$$6, 12, 18, \dots, 2022$$

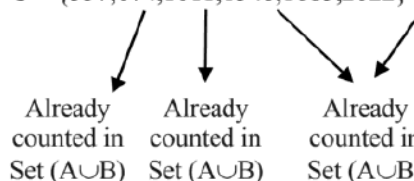
$$\text{Here } n(A \cap B) = 337$$

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

$$= 1011 + 674 - 337 = 1348$$

C = Number which divisible by 337 from $\{1, \dots, 1022\}$

$$C = \{337, 674, 1011, 1348, 1685, 2022\}$$



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 = $2022 - 1350 = 672$

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

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

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

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

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

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

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

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

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)

$$x + 2y = 14 - 3z$$

...(ii)

Subtract (i) from (ii),

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

Now, put the values x & y

in eq. $2x + 5y + \alpha z = \beta$.

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

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

For having infinite solutions

$$\alpha - 8 = 0 \text{ \& } \beta - 36 = 0$$

$$\alpha = 8, \beta = 36$$

$$\text{Required sum} = \alpha + \beta = 44$$

117. (c) L.H.L. = $\lim_{x \rightarrow 0^-} \frac{\sqrt{1+kx} - \sqrt{1-kx}}{x} = k$

$$\text{R.H.L.} = \lim_{x \rightarrow 0^+} (2x^2 + 3x - 2) = -2$$

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

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

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

Differentiating the function with respect to y

$$\begin{aligned} \frac{dx}{dy} &= \frac{\sin(a + y) \cos y - \sin y \cos(a + y)}{\sin^2(a + y)} \\ &= \frac{\sin(a + y - y)}{\sin^2(a + y)} = \frac{\sin a}{\sin^2(a + y)} \end{aligned}$$

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

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

$$\lambda = 3 \text{ and } \mu = 34$$

$$\begin{aligned}
\therefore \int \frac{6x+7}{\sqrt{(x-5)(x-4)}} dx &= \int \frac{3(2x-9)+34}{\sqrt{x^2-9x+20}} dx \\
&= 3 \int \frac{(2x-9)(x^2-9x+20)^{-\frac{1}{2}}}{dx} + 34 \int \frac{dx}{\sqrt{x^2-9x+20}} \\
&= 3 \frac{(x^2-9x+20)^{-\frac{1}{2}+1}}{-\frac{1}{2}+1} + 34 \int \frac{dx}{\sqrt{x^2-9x+\frac{81}{4}-\frac{1}{4}}} \\
&= 6 \sqrt{x^2-9x+20} + 34 \int \frac{dx}{\sqrt{\left(x-\frac{9}{2}\right)^2 - \left(\frac{1}{2}\right)^2}} \\
&= 6 \sqrt{x^2-9x+20} + 34 \log \left\{ x - \frac{9}{2} + \sqrt{\left(x-\frac{9}{2}\right)^2 - \left(\frac{1}{2}\right)^2} \right\} + C \\
&= 6 \sqrt{x^2-9x+20} + 34 \log \left| x + \sqrt{x^2-9x+20} - \frac{9}{2} \right| + C \\
\therefore A=6, B=34.
\end{aligned}$$

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)

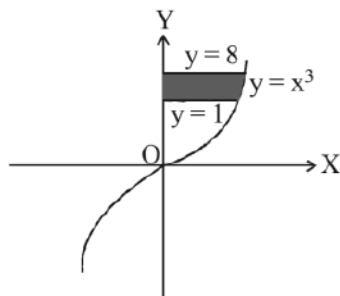
Add equations (i) and (ii), we get

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

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

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

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

123. (d) The given differential equation is

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

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

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

∴ 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 $e^v + v = t$

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

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

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

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

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

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

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

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

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, $\vec{OA} = 7\hat{j} + 10\hat{k}$,

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

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

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

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

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

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

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

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

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

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

Hence, the ΔABC is a right-angled and isosceles also.

127. (c) For $\left(\frac{1}{\sqrt{2}}, \frac{1}{2}, k \right)$ to represent direction

cosines, we should have

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

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

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) $\therefore P(A \cap B) = P(A) + P(B) - P(A \cup B)$

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

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

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

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

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

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

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

$$\therefore P(E) = 0.10 \text{ and } P(F) = P(1) + P(2) = 0.10 + 0.32 = 0.42$$

Hence, required probability

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