BITSAT SOLVED PAPER 2024 SESSION-II

(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

1. If two charges q_1 and q_2 are separated with distance 'd' and placed in a medium of dielectric constant K. What will be the equivalent distance between charges in air for the same electrostatic force ?

(a) $d\sqrt{K}$ (b) $K\sqrt{d}$

(c) $1.5d\sqrt{K}$ (d) $2d\sqrt{K}$

2. A particle executes simple harmonic motion between x = –A and x = +A. If time taken by particle to go from x = 0 to $\frac{A}{2}$ is 2s; then time taken by particle in going from x = $\frac{A}{2}$ to A is:

(a) 3 s (b) 2 s (c) 1.5 s (d) 4 s

3. A wire of resistance 160 Ω is melted and drawn in wire of one-fourth of its length. The new resistance of the wire will be

(a) 10 Ω (b) 640 Ω (c) 40 Ω (d) 16 Ω

4. The dimensional formula of latent heat is:

(a) $[M^0LT^{-2}]$ (b) $[MLT^{-2}]$

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

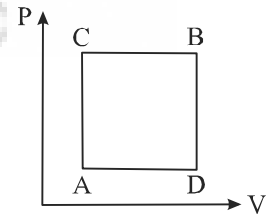
5. Electric potential at a point 'P' due to a point charge of 5×10^{-9} C is 50 V. The distance of 'P' from the point charge is:

(Assume, $\frac{1}{4\pi\varepsilon_0} = 9\times10^{+9}\ Nm^2C^{-2}$)

(a) 3 cm (b) 9 cm

(c) 90 cm (d) 0.9 cm

6. A gas can be taken from A to B via two different processes ACB and ADB. When path ACB is used 60 J of heat flows into the system and 30J of work is done by the system. If path ADB is used work done by the system is 10 J. The heat Flow into the system in path ADB is :



(a) 40 J (b) 80 J (c) 100 J (d) 20 J

7. A long straight wire of radius a carries a steady current I. The current is uniformly distributed across its cross section. The ratio of the magnetic field at $\frac{a}{2}$ and 2a from axis of the wire is :

(a) 1 : 4 (b) 4 : 1 (c) 1 : 1 (d) 3 : 4

8. A particle is moving in a straight line. The variation of position 'x' as a function of time 't' is given as $x = (t^3 - 6t^2 + 20t + 15)$ m.

The velocity of the body when its acceleration becomes zero is :

(a) 6 m/s (b) 10 m/s (c) 8 m/s (d) 4 m/s

9. There are two long co-axial solenoids of same length *l*. The inner and outer coils have radii r_1 and r_2 and number of turns per unit length n_1 and n_2, respectively. The ratio of mutual inductance to the self-inductance of the inner-coil is :

(a) $\frac{n_1}{n_2}$ (b) $\frac{n_2}{n_1}\cdot\frac{r_1}{r_2}$

(c) $\frac{n_2}{n_1}\cdot\frac{r_2^2}{r_1^2}$ (d) $\frac{n_2}{n_1}$

10. Electromagnetic waves travel in a medium with speed of 1.5×10^8 ms^{-1}. The relative permeability of the medium is 2.0. The relative permittivity will be :

(a) 5 (b) 1 (c) 4 (d) 2

11. The range of the projectile projected at an angle of 15° with horizontal is 50 m. If the projectile is projected with same velocity at an angle of 45° with horizontal, then its range will be :

(a) 50 m (b) $50\sqrt{2}$ m

(c) 100 m (d) $100\sqrt{2}$ m

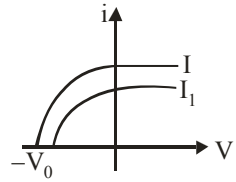
12. In an ac circuit, an inductor, a capacitor and a resistor are connected in series with $X_L = R = X_C$. Impedance of this circuit is :

(a) $2R^2$ (b) Zero

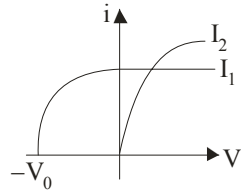
(c) R (d) $R\sqrt{2}$

13. Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light ($I_1 < I_2$) of same wavelengths:

(a)



(b)



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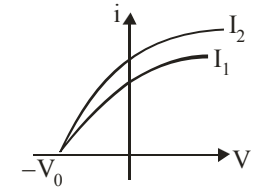
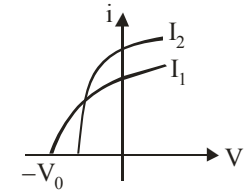


(d)



14. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (where $m_2 > m_1$). If the acceleration of the system is $\frac{g}{\sqrt{2}}$, then the ratio of the masses $\frac{m_1}{m_2}$ is:

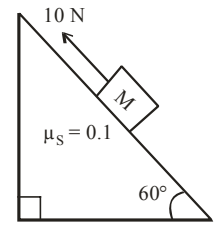
(a) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$ (b) $\frac{1+\sqrt{5}}{\sqrt{5}-1}$

(c) $\frac{1+\sqrt{5}}{\sqrt{2}-1}$ (d) $\frac{\sqrt{3}+1}{\sqrt{2}-1}$

15. The ratio of the shortest wavelength of Balmer series to the shortest wavelength of Lyman series for hydrogen atom is :

(a) 4 : 1 (b) 1 : 2 (c) 1 : 4 (d) 2 : 1

16. A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 60° by a force of 10 *N* parallel to the inclined surface as shown in figure. When the block is pushed up by 10 m along inclined surface, the work done against frictional force is :
[$g = 10\ m/s^2$]



(a) $5\sqrt{3}$J (b) 5 J

(c) 5×10^3 J (d) 10 J

17. In normal adjustment, for a refracting telescope, the distance between objective and eye piece is 30 cm.

The focal length of the objective, when the angular magnification of the telescope is 2, will be:

(a) 20 cm (b) 30 cm

(c) 10 cm (d) 15 cm

18. The atomic mass of $_6C^{12}$ is 12.000000 u and that of $_6C^{13}$ is 13.003354 u. The required energy to remove a neutron from $_6C^{13}$, if mass of neutron is 1.008665 u, will be :

(a) 62. 5 MeV (b) 6.25 MeV

(c) 4.95 MeV (d) 49.5 MeV

19. A particle of mass m is projected with a velocity 'u' making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is:

(a) $\frac{\sqrt{3}}{16}\frac{mu^3}{g}$ (b) $\frac{\sqrt{3}}{2}\frac{mu^2}{g}$

(c) $\frac{mu^3}{\sqrt{2}g}$ (d) zero

20. The acceptor level of a p-type semiconductor is 6eV. The maximum wavelength of light which can create a hole would be : Given hc = 1242 eV nm.

(a) 407 nm (b) 414 nm

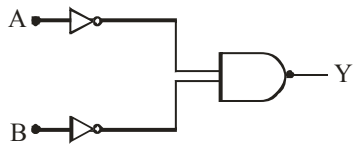
(c) 207 nm (d) 103.5 nm

21. The distance between Sun and Earth is *R*. The duration of year if the distance between Sun and Earth becomes 3*R* will be :

(a) $\sqrt{3}$ years (b) 3 years

(c) 9 years (d) $3\sqrt{3}$ years

22. Identify the logic gate given in the circuit :



(a) NAND - gate (b) OR - gate

(c) AND gate (d) NOR gate

23. The temperature of an ideal gas is increased from 200 K to 800 K. If r.m.s. speed of gas at 200K is v_0. Then, r.m.s. speed of the gas at 800 K will be:

(a) v_0 (b) $4v_0$

(c) $\frac{v_0}{4}$ (d) $2v_0$

24. With rise in temperature, the Young's modulus of elasticity:

(a) changes erratically

(b) decreases

(c) increases

(d) remains unchanged

25. One main scale division of a vernier caliper is equal to m units. If n^{th} division of main scale coincides with $(n+1)^{th}$ division of vernier scale, the least count of the vernier caliper is:

(a) $\frac{n}{(n+1)}$ (b) $\frac{m}{(n+1)}$

(c) $\frac{1}{(n+1)}$ (d) $\frac{m}{n(n+1)}$

26. Pressure inside two soap bubbles are 1.01 and 1.02 atmosphere, respectively. The ratio of their volumes is :

(a) 4 : 1 (b) 0.8 : 1

(c) 8 : 1 (d) 2 : 1

27. A microwave of wavelength 2.0 cm falls normally on a slit of width 4.0 cm. The angular spread of the central maxima of the diffraction pattern obtained on a screen 1.5 m away from the slit, will be:

(a) 60° (b) 45°

(c) 15° (d) 30°

28. A solid metallic cube having total surface area 24 m^2 is uniformly heated. If its temperature is increased by 10°C, calculate the increase in volume of the cube.

(Given : $\alpha = 5.0 \times 10^{-4}\,°C^{-1}$)

(a) $2.4 \times 10^6\ cm^3$

(b) $1.2 \times 10^5\ cm^3$

(c) $6.0 \times 10^4\ cm^3$

(d) $4.8 \times 10^5\ cm^3$

29. Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i}+2\hat{j}+k$ and $-3\hat{i}-2\hat{j}+\hat{k}$ respectively. The magnitude of position vector of centre of mass of this system will be similar to the magnitude of vector :

(a) $\hat{i}-2\hat{j}+\hat{k}$ (b) $-3\hat{i}-2\hat{j}+\hat{k}$

(c) $-2\hat{i}+2\hat{k}$ (d) $-2\hat{i}-\hat{j}+2\hat{k}$

30. The speed of sound in oxygen at S.T.P. will be approximately:

(Given, $R = 8.3\ JK^{-1}, \gamma = 1.4$)

(a) 315 m/s (b) 333 m/s

(c) 341 m/s (d) 325 m/s

PART - II : CHEMISTRY

31. One molar concentration of a solution represents :
(a) 1 mole of solute in 1 kg of solution.
(b) 1 mole of solute in 1 L of solution.
(c) 1 mole of solvent in 1 kg of solution.
(d) 1 mole of solvent in 1 L of solution.

32. In the chemical reaction $A \,'!\, B$, what is the order of the reaction? Given that, the rate of reaction doubles if the concentration of A is increased four times.
(a) 2 (b) 1.5 (c) 0.5 (d) 1

33. The correct order of melting points of the following salts is

LiCl	LiF	LiI
I	II	III

(a) I > II > III (b) II > I > III
(c) III > II > I (d) II > III > I

34. Which of the following relation is not correct?
(a) $\Delta H = \Delta U - P\Delta V$ (b) $\Delta U = q + W$
(c) $\Delta S_{sys} + \Delta S_{surr} \geq 0$ (d) $\Delta G = \Delta H - T\Delta S$

35. Among the following the correct statements are
I. LiH, BeH_2 and MgH_2 are saline hydrides with significant covalent character
II. Saline hydrides are volatile
III. Electron - precise hydrides are Lewis bases
IV. The formula for chromium hydride is CrH
The correct option is
(a) I, III only (b) II, IV only
(c) I, IV only (d) III, IV only

36. The chemical composition of 'slag' formed during the smelting process in the extraction of copper is
(a) $Cu_2O + FeS$ (b) $FeSiO_3$
(c) $CuFeS_2$ (d) $Cu_2S + FeO$

37. Which of the following has least tendency to liberate H_2 from mineral acids ?
(a) Cu (b) Mn (c) Ni (d) Zn

38. In which of the following reactions of H_2O_2 acts as an oxidising agent (either in acidic, alkaline or neutral medium) ?
(i) $2Fe^{2+} + H_2O_2 \,'!$
(ii) $2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow$
(iii) $I_2 + H_2O_2 + 2OH^- \,'!$
(iv) $Mn^{2+} + H_2O_2 \,'!$
(a) (ii), (iii) (b) (i), (iv)
(c) (i), (iii) (d) (ii), (iv)

39. The charge on colloidal particles is due to
(a) presence of electrolyte
(b) very small size of particles
(c) adsorption of ions from the solution
(d) can't be determined

40. Which of the following is correct order of ligand field strength?
(a) $CO < en < NH_3 < C_2O_4^{2-} < S^{2-}$
(b) $S^{2-} < C_2O_4^{2-} < NH_3 < en < CO$
(c) $NH_3 < en < CO < S^{2-} < C_2O_4^{2-}$
(d) $S^{2-} < NH_3 < en < CO < C_2O_4^{2-}$

41. In the Victor-Meyer's test, the colour given by 1°, 2° and 3° alcohols are respectively:
(a) Red, colourless, blue
(b) Red, blue, colourless
(c) Colourless, red, blue
(d) Red, blue, violet

42. Which one of the following is a water soluble vitamin, that is not excreted easily?
(a) Vitamin B_2 (b) Vitamin B_1
(c) Vitamin B_6 (d) Vitamin B_{12}

43. Calculate the activation energy of a reaction, whose rate constant doubles on raising the temperature from 300 K to 600 K.
(a) 3.45 kJ/mol (b) 6.90 kJ/mol
(c) 9.68 kJ/mol (d) 19.6 kJ/mol

44. Which one of the following compounds is having maximum 'lone pair-lone pair' electron repulsions?
(a) ClF_3 (b) IF_5 (c) SF_4 (d) XeF_2

45. The carrect statement among the following is;
(a) Ferrocene has two cyclohexadiene rings corrdinated to iran atam.
(b) Ferocene has two cyclopentudienyl anion rings bonded to iron (II) ion.
(c) Perxenate ion is $[XeO_2F_2]^{2-}$
(d) Perxenate ion is tetrahedral is snape.

46. Which among the following is used in detergent
(a) Sodium acetate
(b) Sodium stearate
(c) Calcium stearate
(d) Sodium lauryl sulphate

47. The standard Gibbs energy (ΔG^0) for the following reaction is
$A(s) + B^{2+}(aq) \rightarrow A^{2+}(aq) + B(s)$, $K_c = 10^{12}$ at 25°C

(K_c = equilibrium constant)

(a) –150 kJ (b) –96.80 kJ
(c) –68.47 kJ (d) –100 kJ

48. The type of isomerism present in nitropentammine chromium (III) chloride is
(a) optical (b) linkage
(c) ionization (d) polymerisation.

49. The strongest reducing agent among the following is:
(a) SbH_3 (b) NH_3 (c) BiH_3 (d) PH_3

50. Identify, from the following, the diamagnetic, tetrahedral complex
(a) $[Ni(Cl)_4]^{2-}$ (b) $[Co(C_2O_4)_3]^{3-}$
(c) $[Ni(CN)_4]^{2-}$ (d) $[Ni(CO)_4]$

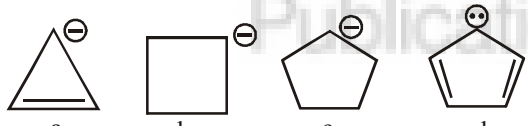
51. What is *X* in the following reaction?

$$CO + 2H_2 \xrightarrow{X} CH_3OH$$

(a) 623 K /300 atm
(b) $KMnO_4 / H^{\oplus}$
(c) Zn/Δ
(d) ZnO–Cr_2O_3, 200-300 atm, 573-673 K

52. When the same quantity of electricity is passed through the aqueous solutions of the given electrolytes for the same amount of time, which metal will be deposited in maximum amount on the cathode?
(a) $ZnSO_4$ (b) $FeCl_3$
(c) $AgNO_3$ (d) $NiCl_2$

53. Correct order of stability of carbanion is



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

54. Which of the following is not a semi-synthetic polymer?
(a) *Cis*-polyisoprene
(b) Cellulose nitrate
(c) Cellulose acetate
(d) Vulcanised rubber

55. Which of the following is not correct about Grignard reagent?
(a) It is a nucleophile
(b) Forms new carbon-carbon bond
(c) Reacts with carbonyl compounds
(d) It is an organomanganese compound

56. An alkene X on ozonolysis gives a mixture of Propan-2-one and methanal. What is X?
(a) Propene
(b) 2-Methylpropene
(c) 2-Methylbut-1-ene
(d) 2-Methylbut-2-ene

57. Which of the following is only a redox reaction but not a disproportionation reaction?
(a) $4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$
(b) $2H_2O_2 \rightarrow 2H_2O + O_2$
(c) $P_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3$
(d) $P_4 + 8SOCl_2 \rightarrow 4PCl_3 + 2S_2Cl_2 + 4SO_2$

58. Le-Chateliers' principle is not applicable to
(a) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(b) $Fe(s) + S(s) \rightleftharpoons FeS(s)$
(c) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(d) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

59. 1 L closed flask contains a mixture of 4 g of methane and 4.4 g of carbon dioxide. The pressure inside the flask at 27°C is [Assume ideal behaviour of gases]
(a) 8.6 atm (b) 2.2 atm
(c) 4.2 atm (d) 6.1 atm

60. The energy of second orbit of hydrogen atom is -5.45×10^{-19} J. What is the energy of first orbit of Li^{2+} ion (in J)?
(a) -1.962×10^{-18} (b) -1.962×10^{-17}
(c) -3.924×10^{-17} (d) -3.924×10^{-18}

PART - III (A): ENGLISH PROFICIENCY

DIRECTION (Q. 61): Rearrange the given four sentences (A, B, C, D) in a proper sequence so as to form a meaningful paragraph and then answer the given questions.

P: And with each passing moment, he felt an urgent need to run and hide as though the bell was sounding a warning.
Q: And heavy that he could scarcely hold onto it and he wanted to know what was in the package and he stopped near an alley corner and unwrapped in.

R: It sounded suddenly directly above his head and when he looked, it was not there but went on tolling.

S: And he stood on a street corner in a red glare of light like that which came from the furnace and he had a big package in his arms so wet and slippery.

61. Which of the following should be the FIRST sentence after rearrangement?

(a) RPSQ (b) RSPQ

(c) RQPS (d) PSRQ

DIRECTION (Q. 62): Select the pair that expresses a relationship most similar to that expressed in the capitalized pair.

62. YOGA: EXERCISE ::

(a) Pineapple : Fruit

(b) Leg : Limb

(c) Mango : Vegetable

(d) Tree : Field

DIRECTION (Q. 63): In the following question, a sentence is given with a blank to be filled with an appropriate phrasal verb. Choose the correct alternative from the given options.

63. The convention was _____ due to the pandemic as they wanted people to remain safe.

(a) cancelled (b) called off

(c) brought up (d) broken off

DIRECTION (Q. 64): Read the following passage and answer the question that follows.

PASSAGE

Since July 1991, the government of India has effectively put the liberalisation policy into practice. The drastic steps even include some administrative reforms for pruning the government agencies. Last year the Japanese business circles represented by the Ishikawa Mission called attention of their Indian counterparts to what they considered to be the major impediments in India. However, thanks to the almost revolutionary reforms put into effect by the Indian government, those impediments either have been removed or now are on their way out. This development gives a new hope for the future of economic co-operation between the two countries. At the same time, it should be borne in mind that there is a stiff competition with other countries, notably China and South-East Asian countries, in this regard. The success stories of ASEAN countries welcoming Japanese investments with adequate infrastructure are already known in India but it may be useful if further studies of Japanese joint ventures in ASEAN countries be made by Indian business circles. The coastal areas of China have initiated a very active campaign to welcome foreign economic participation.

Beyond our bilateral relationship, India's more active participation in global economy is needed. India certainly deserves a far bigger share of world trade considering its vast resources. It is strongly hoped that the Indian government's recently initiated effort of enlarging its export market would bear fruit.

India has steadfastly maintained its parliamentary democracy since independence. Considering its size, its population and its internal complexity, the overall maintenance of national integrity and political stability under parliamentary democracy is remarkable and admirable indeed. Here lies the base for the status of India in the world. By effectively implementing its economic reform with the support of public opinion, this democratic polity of India has again demonstrated its viability and resilience. At the same time, it gives hope and inspiration to the whole world which faces the difficult problem of North-South confromation.

64. Which of the following is TRUE about the author's view regarding India's participation in world trade?

(a) India should actively contribute in a big way as it has tremendous resources.

(b) India's sharing in global economy has already been very fast and beyond its resources.

(c) India should refrain from making efforts in enlarging its export market.

(d) India needs to first strengthen its democracy.

DIRECTION (Q. 65): Choose the correct spelling from the given words.

65. (a) Elusive (b) Elusief

(c) Elusivie (d) Ellusive

DIRECTIONS (Qs. 66-67) : In the following questions, the sentences have been given in Active / Passive Voice. From the given alternatives, choose

the one which best expresses the given sentence in Passive / Active Voice as your answer.

66. They first sun-dried the garbage for one to three days to bring down the moisture level.
(a) The moisture level was brought down by sun-drying the garbage for one to three days
(b) One to three days of sun-drying brought down the moisture level of the garbage.
(c) The moisture level of the garbage came down when it was sun-dried for one to three days.
(d) The garbage was first sundried for one to three days to bring down the moisture level.

67. He was congratulated by his teacher on his brilliant success in the recent examination.
(a) His teacher congratulated him on his brillant success in the recent examination.
(b) His teacher congratulated him for his success in the examination.
(c) His teacher congraulated him on his success.
(d) His teacher congratulated him.

DIRECTION (Q. 68): In the following question, a sentence is given with a blank to be filled with an appropriate word. Four alternatives are suggested for each question. Choose the correct alternative as your answer.

68. These essays are intellectually ..... and represent various levels of complexity.
(a) revealing (b) modern
(c) superior (d) persistent

DIRECTION (Q. 69): In the following question, the sentence may or may not have an error. Find out which part of the sentences has an error. The number of that part is your answer. If there is no error, your answer is (e), i.e., No error.

69. The fear (a) of an impending invasion (b) has more to do than even the debasing of the coinage (c) than / with the financial (d) difficulties No error (e).

DIRECTION (Q. 70): Read the passage and choose a suitable summary from the given options.

PASSAGE - 6

The Prime Minister's recent trip to Nigeria, the first bilateral prime ministerial visit to Africa since Jawaharlal Nehur's 45 years ago, recalls a long neglected Indian obligation. "It is up to Asia to help Africa to the best of her ability," Nehru told the Bandung Conference in 1955, "because we are sister continents. "The Prime Minister's proposed strategic partnership with African nations might at last make good that 52-year old promise and also, perhaps, challenge China's expedient diplomacy.

In the intervening years, the West's sanctimonious boycott of many African regimes - after nearly a century of extreme colonial exploitation – left the continent in the grip of oppressive rulers looking for new political sponsors, arms-sellers and trading partners. Not only was it an abdication of the developed world's responsibility to the world's least developed region, sanctions actually compounded the sufferings of poorer Africans. The Darfur killings continue and there is no mellowing of Robert Mugabe's repression in Zimbabwe.

A bandoned by the West Africa looked elsewhere. Beijing filled the vacuum by eagerly embracing dangerous and unsavoury regimes in its search for oil and other minerals. China demonstrated its influence by playing host to 48 out of 53 African leaders a year ago in a jamboree that was historic as well as historical. Historic because China has succeeded in becoming the pre-eminent outside power in Africa and its second biggest trading partner. Historical because modern Chinese diplomacy draws on the Middle kingdom's ancient formula; the tribute system. It was how the son of Heaven brought those nations whom the Celestial Empire called "barbarians' into his imperial trading and , through it, cultural and political system.

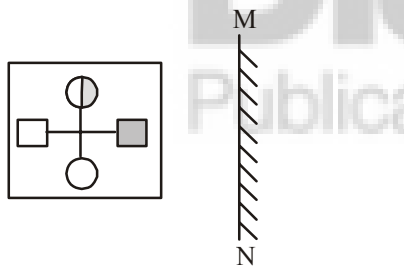
Contemporary China's economic penetration of Africa also heralds a new era of cultural and political ties though the Chinese foreign ministry repeatedly assure the world that "our cooperation is not designed to be against or preclude any third party." This is untrue in a world of finite resources. Once the Chinese are established in a country, no one else gets a foothold. Myanmar, where India failed to obtain the desired gas concessions, is a prime example. Aware that the hunt for energy is a zero-sum game, China's leadership courts African leaders with regular visits and substantial grants.

After decades of neglect – Vajpayee's Africa visit over a decade ago was to attend a Commonwealth Summit– India will have to move cautiously but quickly if it is to break China's monopoly. Along with investing in Africa's human capital, China has outlined a strategic investment plan to build three to five trade economic cooperation zones in Africa by 2009 to boost trade, which is expected to tap $40 billion this year. That could double to $30 billion by 2010 on the back of an insatiable demand for natural resources to feed China's **booming** economy.

70. From the passage, it can be inferred that the author's views are:
(a) in favour of India gaining an edge over China
(b) against India entering into a competition with China
(c) in favour of not making any investment in African countries
(d) appreciation of oppressive and barbaric African rulers.

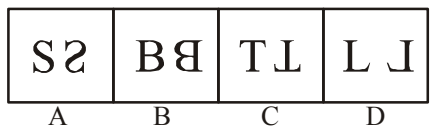
PART - III (B) : LOGICAL REASONING

71. Choose the mirror image for the following figure when the mirror is kept at the MN line.



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

72. Find the odd one out.



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

73. Find the missing number in the following series.
27, 29, 33, ?, 57
(a) 30 (b) 41 (c) 40 (d) 35

74. A family has a man, his wife, their four sons and their wives. The family of every son also have 3 sons and one daughter. Find out the total number of male members in the family.
(a) 4 (b) 8
(c) 12 (d) 17

75. **Statements:**
Some pots are buckets.
Some buckets are bags.
Some bags are purses.
Conclusions:
I. Some purses are buckets.
II. Some bags are pots.
(a) All follow
(b) None follows
(c) Only I follow
(d) Only II follow

76. **Statements:**
All biscuits are chocolates.
Some chocolates are breads.
All breads are pastries.
Conclusions:
I. Some biscuits are pastries.
II. Some pastries are chocolates.
(a) Only I and II follow
(b) Only I follow
(c) Only II follow
(d) None follow

77. Rohit walked 25 metres towards South. Then he turned to his left and walked 20 metres. He then turned to his left and walked 25 metres. He again turned to his right and walked 15 metres. At what distance is he from the starting point and in which direction?
(a) 35 metres East (b) 35 metres North
(c) 40 metres East (d) 60 metres East

DIRECTIONS (Qs. 78-80) : On the basis of the following information, answer the questions that follow.

Six people are sitting on the ground in a hexagonal shape. The hexagon's vertices are marked as A, B, C, D, E and F but not in any order. However, all the sides of the hexagon are of same length. A is not adjacent to

B or C; D is not adjacent to C or E; B and C are adjacent; F is in the middle of D and C.

78. If one neighour of A is D, then who is the other one ?
(a) B (b) C
(c) E (d) F

79. Who is placed opposite to E ?
(a) F (b) D
(c) C (d) B

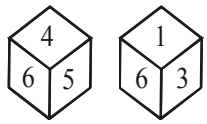
80. Who is at the same distance from D as E is from D ?
(a) B (b) C
(c) D (d) F

81. In the following question you have to identify the correct response from the given premises stated according to the following symbols.
If '+' means '÷' , '–' means '×', '÷' means '+' and '×' means '–', then $63 \times 24 + 8 \div 4 + 2 - 3 = ?$
(a) 54 (b) 66
(c) 186 (d) 48

82. Five boys A, B, C, D and E are standing in a line. A is taller than E but shorter than D. B is shorter than E and C is the tallest. Who is in the middle?
(a) A (b) C
(c) D (d) E

83. In a certain way 'Diploma' is related to 'Education'. Which of the following is related to 'Trophy' in a similar way?
(a) Sports (b) Athlete
(c) Winning (d) Prize

84. Two position of a dice are shown below. Identify the number at the bottom when the top is 3.

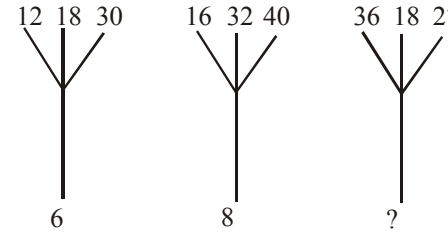


(a) 2 (b) 4
(c) 5 (d) 6

85. If all the letters in the word 'PRINCE' are rearranged in alphabetical order, then how many letter(s) will remain unchanged?
(a) None (b) One
(c) Two (d) Three
(e) More than three

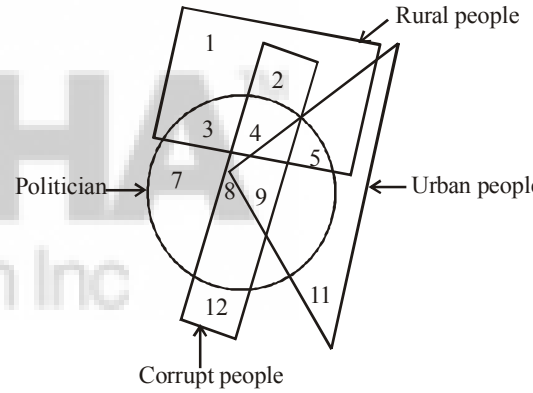
86. If NATION is coded as 467234 and EARN be coded as 1654 then ATTENTION should be coded as :-
(a) 432769561 (b) 956143654
(c) 766412743 (d) 677147234

87. Find the correct number at the place of question mark.



(a) 6 (b) 9
(c) 12 (d) 18

88. In the following venn diagram, Identify the politicians from urban areas who are corrupt.



(a) 4 (b) 8
(c) 9 (d) 10

89. Which sequence of letters when placed at the blanks one after another will complete the given letter series ?
b _ b _ bb _ bbb _ bb _ b
(a) bbbbba (b) bbaabb
(c) ababab (d) aabaab

90. If 'black' means 'white', 'white' means 'red', 'red' means 'yellow', 'yellow' means 'blue', 'blue' means 'green', 'green' means 'purple' and 'purple' means 'orange' then what is the colour of clean sky?
(a) green (b) purple
(c) blue (d) yellow

PART - IV : MATHEMATICS

91. If $A = 1 + r^a + r^{2a} + r^{3a} + ...\infty$

and $B = 1 + r^b + r^{2b} + r^{3b} + ...\infty$, then $\frac{a}{b}$ is equal to

(a) $\log_B (A)$ (b) $\log_{1-B}(1-A)$

(c) $\log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$ (d) None of these

92. The sum of the infinite series

$1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \frac{51}{6^5} + \frac{70}{6^6} + ...$ is equal to:

(a) $\frac{425}{216}$ (b) $\frac{429}{216}$

(c) $\frac{288}{125}$ (d) $\frac{280}{125}$

93. If $z, \bar{z}, -z, -\bar{z}$ forms a rectangle of area $2\sqrt{3}$ square units, then one such z is

(a) $\frac{1}{2} + \sqrt{3}i$ (b) $\frac{\sqrt{5} + \sqrt{3}i}{4}$

(c) $\frac{3}{2} + \frac{\sqrt{3}i}{2}$ (d) $\frac{\sqrt{3} + \sqrt{11}i}{2}$

94. The sum of all values of x in $[0, 2\pi]$, for which $\sin x + \sin 2x + \sin 3x + \sin 4x = 0$, is equal to :

(a) 8π (b) 11π

(c) 12π (d) 9π

95. If p: 2 is an even number
q:2 is a prime number,
r: $2 + 2 = 2^2$
Then the symbolic statement $p \rightarrow (q \vee r)$ means

(a) 2 is an even number and 2 is a prime number or $2 + 2 = 2^2$.

(b) 2 is an even number then 2 is a prime number or $2 + 2 = 2^2$.

(c) 2 is an even number or 2 is a prime number then $2 + 2 = 2^2$

(d) If2 is not even number then 2 is a prime number or $2 + 2 = 2^2$

96. $f(x) = \frac{\cos x}{\left[\frac{2x}{\pi}\right] + \frac{1}{2}}$, where x is not an integral multiple of π and [.] denotes the greatest integer function, is

(a) an odd function

(b) an even function

(c) neither odd nor even

(d) None of these

97. If $z_1, z_2, ... z_n$ are complex numbers such that $|z_1| = |z_2| = ... = |z_n| = 1$, then $|z_1 + z_2 + ... + z_n|$ is equal to

(a) $|z_1 z_2 z_3 ..... z_n|$

(b) $|z_1| + |z_2| + ... + |z_n|$

(c) $\left|\frac{1}{z_1} + \frac{1}{z_2} + ... + \frac{1}{z_n}\right|$

(d) n

98. If the straight line $2x + 3y - 1 = 0, x + 2y - 1 = 0$ and $ax + by - 1 = 0$ form a triangle with origin as orthocentre, then (a, b) is equal to

(a) (6, 4) (b) (–3, 3)

(c) (–8, 8) (d) (0, 7)

99. If p and q be the longest and the shortest distance respectively of the point (–7, 2) from any point (α, β) on the curve whose equation is $x^2 + y^2 - 10x - 14y - 51 = 0$, then G.M. of p and q is

(a) $2\sqrt{11}$ (b) $5\sqrt{5}$

(c) 13 (d) 11

100. If the focus of parabola $(y - k)^2 = 4(x - h)$ always lies between the lines $x + y = 1$ and $x + y = 3$ then

(a) $0 < h + k < 2$ (b) $0 < h + k < 1$

(c) $1 < h + k < 2$ (d) $1 < h + k < 3$

101. Given a real valued function 'f' such that

$$f(x)=\begin{cases}\dfrac{\tan^2\{x\}}{x^2-[x]^2} & \text{for } x>0\\ 1 & \text{for } x=0\\ \sqrt{\{x\}\cot\{x\}} & \text{for } x<0\end{cases}$$

then

(a) LHL = 1

(b) RHL = $\sqrt{\cot 1}$

(c) $\lim\limits_{x\to 0} f(x)$ exist

(d) $\lim\limits_{x\to 0} f(x)$ does not exists

102. Rational roots of the equation $2x^4+x^3-11x^2+x+2=0$ are

(a) $\frac{1}{2}$ and 2 (b) $\frac{1}{2}, 2, \frac{1}{4}, -2$

(c) $\frac{1}{2}, 2, 3, 4$ (d) $\frac{1}{2}, 2, \frac{3}{4}, -2$

103. If ${}^{22}P_{r+1} : {}^{20}P_{r+2} = 11 : 52$, then r is equal to

(a) 3 (b) 5

(c) 7 (d) 9

104. At an election a voter may vote for any number of candidates not exceeding the number to be elected. If 4 candidates are to be elected out of the 12 contested in the election and voter votes for at least one candidate, then the number of ways in which a voter can vote is

(a) 793 (b) 298

(c) 781 (d) 1585

105. The coefficient of the highest power of x in the expansion of

$$\left(x+\sqrt{x^2-1}\right)^8+\left(x-\sqrt{x^2-1}\right)^8 \text{ is}$$

(a) 64 (b) 128

(c) 256 (d) 512

106. If the variance of the data 2, 3, 5, 8, 12 is σ^2 and the mean deviation from the median for this data is M, then $\sigma^2 - M =$

(a) 10.2 (b) 5.8

(c) 10.6 (d) 8.2

107. Let R be the relation "is congruent to" on the set of all triangles in a plane is

(a) Reflexive only

(b) Symmetric only

(c) Symmetric and reflexive only

(d) Equivalence relation

108. If A and B are symmetric matrices of same order such that AB + BA = X and AB – BA = Y, then $(XY)^T =$

(a) XY (b) X^TY^T

(c) –YX (d) $-Y^TX^T$

109. If x is a complex root of the equation

$$\begin{vmatrix}1 & x & x\\ x & 1 & x\\ x & x & 1\end{vmatrix}+\begin{vmatrix}1-x & 1 & 1\\ 1 & 1-x & 1\\ 1 & 1 & 1-x\end{vmatrix}=0,$$

then $x^{2007}+x^{-2007} =$

(a) 1 (b) -1

(c) -2 (d) 2

110. The function $f : \boldsymbol{R} \to \boldsymbol{R}$ defined by $f(x) = \frac{x}{\sqrt{1+x^2}}$ is

(a) surjective but not injective

(b) bijective

(c) injective but not surjective

(d) neither injective nor surjective

111. If $\tan^{-1}\left[\frac{1}{1+1.2}\right]+\tan^{-1}\left[\frac{1}{1+2.3}\right]+$

$$\ldots+\tan^{-1}\left[\frac{1}{1+n(n+1)}\right]=\tan^{-1}[x],$$ then x is equal to

(a) $\frac{1}{n+1}$ (b) $\frac{n}{n+1}$

(c) $\frac{1}{n+2}$ (d) $\frac{n}{n+2}$

112. If $f(x)=\begin{cases}\frac{x^2\log(\cos x)}{\log(1+x)}, & x\neq 0\\ 0, & x=0\end{cases}$, then at $x=0, f(x)$ is

(a) not continuous

(b) continuous but not differentiable

(c) differentiable

(d) not continuous, but differentiable

113. If $f: R\to R, g: R\to R$ are defined by $f(x)=5x-3, g(x)=x^2+3$, then $gof^{-1}(3)$ is equal to

(a) $\frac{25}{3}$ (b) $\frac{111}{25}$

(c) $\frac{9}{25}$ (d) $\frac{25}{111}$

114. If $\cot\left(\cos^{-1}x\right)=\sec\left\{\tan^{-1}\left(\frac{a}{\sqrt{b^2-a^2}}\right)\right\}$ $b>a$, then x =

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

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

115. The equations $x-y+2z=4$
$3x+y+4z=6$
$x+y+z=1$ have

(a) unique solution

(b) infinitely many solutions

(c) no solution

(d) two solutions

116. At $x=\frac{\pi^2}{4}, \frac{d}{dx}\left(\tan^{-1}\left(\cos\sqrt{x}\right)+\sec^{-1}\left(e^x\right)\right)=$

(a) $\frac{1}{\sqrt{e^{\frac{\pi^2}{2}}-1}}-\frac{1}{\pi}$

(b) $\frac{\pi}{4}+\frac{1}{\sqrt{e^{\pi^2}+e^{\pi^2/2}}}$

(c) $\frac{1}{\sqrt{e^{\pi^2}+e^{\pi^2/2}}}+\frac{2}{\pi}\cot\left(\frac{\sqrt{\pi}}{2}\right)$

(d) $\frac{1}{\sqrt{e^{\pi}}}+\frac{1}{\pi}$

117. The maximum volume (in cu. units) of the cylinder which can be inscribed in a sphere of radius 12 units is

(a) $384\sqrt{3}\pi$ (b) $768\sqrt{3}\pi$

(c) $\frac{768\pi}{\sqrt{3}}$ (d) $\frac{1152\pi}{\sqrt{3}}$

118. $\int\frac{x^3-1}{x^3+x}dx=$

(a) $x+\log|x|+\frac{1}{2}\log\left(x^2+1\right)+\sin^{-1}(x)+c$

(b) $x-\log|x|+\frac{1}{2}\log\left(x^2+1\right)-\sin^{-1}(x)+c$

(c) $x+\log|x|-\frac{1}{2}\log\left(x^2+1\right)+\tan^{-1}(x)+c$

(d) $x-\log|x|+\frac{1}{2}\log\left(x^2+1\right)-\tan^{-1}(x)+c$

119. The area of the region bounded by the curves $x=y^2-2$ and $x=y$ is

(a) $\frac{9}{4}$ (b) 9

(c) $\frac{9}{2}$ (d) $\frac{9}{7}$

120. If $\frac{dy}{dx}-y\log_e 2=2^{\sin x}(\cos x-1)\log_e 2$, then y =

(a) $2^{\sin x}+c2^x$ (b) $2^{\cos x}+c2^x$

(c) $2^{\sin x}+c2^{-x}$ (d) $2^{\cos x}+c2^{-x}$

121. Let ABC be a triangle and be $\vec{a},\vec{b},\vec{c}$ the position vectors of A, B, C respectively. Let D divide BC in the ratio 3 : 1 internally and E divide AD in the ratio 4 : 1 internally. Let BE meet AC in F. If E divides BF in the ratio 3 : 2 internally then the position vector of F is

(a) $\frac{\vec{a}+\vec{b}+\vec{c}}{3}$ (b) $\frac{\vec{a}-2\vec{b}+3\vec{c}}{2}$

(c) $\frac{\vec{a}+2\vec{b}+3\vec{c}}{2}$ (d) $\frac{\vec{a}-\vec{b}+3\vec{c}}{3}$

122. The angle between the lines whose direction cosines are given by the equations $3l+m+5n=0$, $6nm-2nl+5lm=0$ is

(a) $\cos^{-1}\left(\frac{1}{6}\right)$ (b) $\cos^{-1}\left(-\frac{1}{6}\right)$

(c) $\cos^{-1}\left(\frac{2}{3}\right)$ (d) $\cos^{-1}\left(-\frac{5}{6}\right)$

123. $\int_5^9 \frac{\log 3x^2}{\log 3x^2+\log(588-84x+3x^2)}dx$ is equal to

(a) 2 (b) 1

(c) $\frac{1}{2}$ (d) 4

124. The probability that certain electronic component fails when first used is 0.10. If it does not fail immediately,the probability that it lasts for one year is 0.99. The probability that a new component will last for one year is

(a) 0.9 (b) 0.01

(c) 0.119 (d) 0.891

125. If $\vec{a}=2\hat{i}+\hat{j}+2\hat{k}$, then the value of $|\hat{i}\times(\vec{a}\times\hat{i})|^2+|\hat{j}\times(\vec{a}\times\hat{j})|^2+|\hat{k}\times(\vec{a}\times\hat{k})|^2$ is equal to

(a) 17 (b) 18

(c) 19 (d) 20

126. Given below is the distribution of a random variable X

X = x	1	2	3	4
P(X = x)	λ	2λ	3λ	4λ

If $\alpha = P(X<3)$ and $\beta = P(X>2)$, then $\alpha:\beta=$

(a) 2 : 5 (b) 3 : 4

(c) 4 : 5 (d) 3 : 7

127. Let the acute angle bisector of the two planes $x-2y-2z+1=0$ and $2x-3y-6z+1=0$ be the plane P. Then which of the following points lies on P?

(a) $\left(3,1,-\frac{1}{2}\right)$ (b) $\left(-2,0,-\frac{1}{2}\right)$

(c) (0, 2, –4) (d) (4, 0, –2)

128. The integral $\int\frac{x^2(x\sec^2 x+\tan x)}{(x\tan x+1)^2}dx$ is equal to

(a) $-\frac{x^2}{x\tan x+1}+c$

(b) $2\log_e|x\sin x+\cos x|+c$

(c) $-\frac{x^2}{x\tan x+1}+2\log_e|x\sin x+\cos x|+c$

(d) $\frac{x^2}{x^2\tan x-1}-2\log_e|x\sin x+\cos x|+c$

129. If the angle made by the tangent at the point (x_0,y_0) on the curve $x=12(t+\sin t\cos t)$, $y=12(1+\sin t)^2$, $0<t<\frac{\pi}{2}$, with the positive x-axis is $\frac{\pi}{3}$, then y_0 is equal to

(a) $6(3+2\sqrt{2})$ (b) $3(7+4\sqrt{3})$

(c) 27 (d) 48

130. Consider the following statements :

A : Rishi is a judge.

B : Rishi is honest.

C : Rishi is not arrogant.

The negation of the statement "if Rishi is a judge and he is not arrogant, then he is honest" is

(a) $B\rightarrow(A\vee C)$

(b) $(\sim B)\wedge(A\wedge C)$

(c) $B\rightarrow((\sim A)\vee(\sim C))$

(d) $B\rightarrow(A\wedge C)$

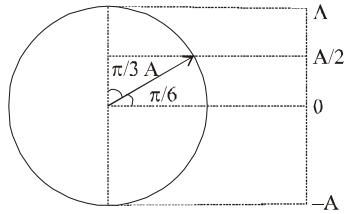
SOLUTIONS

PART - I : PHYSICS

1. **(a)** As, $F_{air} = F_{med}$

$$\Rightarrow \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{d_{air}^2} = \frac{1}{K}\frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{d^2} \Rightarrow d_{air} = d\sqrt{K}$$

2. **(d)**



Let time from 0 to A/2 is t_1
and from A/2 to A is t_2
From the standard equation of SHM,
$x = A_0 \sin(\omega t)$

$$\Rightarrow \frac{A}{2} = A\sin(\omega t_1)$$

$$\Rightarrow \omega t_1 = \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{6} \quad ...(i)$$

then $\omega t_1 = \pi/6$
Using $x = A_0 \sin\omega t$ again
$A = A\sin\omega(t_1 + t_2)$

$$\omega(t_1 + t_2) = \sin^{-1}(1) = \frac{\pi}{2}$$

Using (i)

$$\omega t_2 = \frac{\pi}{2} - \frac{\pi}{6} = \frac{\pi}{3} \quad ...(ii)$$

Dividing equation (i) by (ii) we get

$$\frac{t_1}{t_2} = \frac{1}{2}$$

$$\Rightarrow \quad t_2 = 2t_1 = 2 \times 2 = 4 \text{ sec}$$

3. **(a)** Let
Initial length = l_1
Final length = l_2
Initial area = A_1
Final area = A_2
$\therefore$ Volume remains same

$$\therefore A_1 l_1 = A_2 l_2 \Rightarrow A_1 l_1 = A_2 \frac{l_1}{4}$$

$$\Rightarrow 4A_1 = A_2$$

Initial resistance, $R_1 = \frac{\rho l_1}{A_1} = 160\Omega$ (given)

Final resistance, $R_2 = \frac{\rho l_2}{A_2}$

$$\therefore \frac{R_2}{R_1} = \frac{l_2 A_1}{A_2 l_1} = \frac{l_1}{4}\frac{A_1}{4A_1 l_1}$$

$$\Rightarrow R_2 = \frac{1}{16}R_1 = \frac{1}{16} \times 160 = 10\Omega$$

4. **(c)** Heat, $Q = mL$ where, L = latent heat

$$\therefore \ L = \frac{Q}{m} = \frac{ML^2T^{-2}}{M} = M^0L^2T^{-2}$$

5. **(c)** Electric potential at a point P due to a point charge, ($\because K = 9 \times 10^9$)

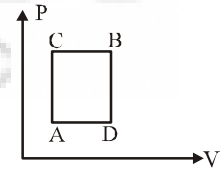
$$V_P = \frac{KQ}{r}$$

$$\Rightarrow \quad 50 = \frac{9 \times 10^9 \times 5 \times 10^{-9}}{r}$$

$$\Rightarrow \quad r = \frac{45}{50} = \frac{9}{10} = 0.9\text{m} = 90\text{cm}$$

6. **(a)** ΔU remains same for both paths ACB and ADB

$$\Delta Q_{ACB} = \Delta W_{ACB} + \Delta U_{ACB}$$



$$\Rightarrow 60\text{ J} = 30\text{ J} + \Delta U_{ACB} \Rightarrow U_{ACB} = 30\text{ J}$$

As change in internal energy depends only on initial and final point

$\therefore \Delta U_{ADB} = \Delta U_{ACB} = 30\text{ J}$

$\Delta Q_{ADB} = \Delta U_{ADB} + \Delta W_{ADB} = 10\text{ J} + 30\text{ J} = 40\text{ J}$

7. **(c)** Magnetic field due to straight wire,

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

Magnetic field at $\frac{a}{2}$ is,

$$B_{a/2} = \frac{\mu_0 I}{2\pi(a/2)}$$

$$\therefore \frac{B_{a/2}}{B_{2a}} = \frac{1}{1} = 1:1$$

8. **(c)** Displacement, $x = t^3 - 6t^2 + 20t + 15$

$$\therefore \text{Velocity, } v = \frac{dx}{dt} = 3t^2 - 12t + 20$$

$$\therefore \text{Acceleration, } a = \frac{dv}{dt} = 6t - 12$$

When $a = 0$

$\Rightarrow 6t - 12 = 0 \Rightarrow t = 2$ s

At $t = 2$s, $v = 3(2)^2 - 12(2) + 20 = 8$ m/s

9. **(d)** The rate of mutual inductance is given by

$$M = \mu_0 n_1 n_2 \pi r_1^2 \quad ...(i)$$

The rate of self inductance is given by

$$L = \mu_0 n_1^2 \pi r_1^2 \quad ...(ii)$$

Dividing (i) by (ii)

$$\Rightarrow \frac{M}{L} = \frac{n_2}{n_1}$$

10. **(d)** $$v = \frac{C}{\sqrt{\mu_r \in_r}}$$

$$\Rightarrow 1.5 \times 10^8 = \frac{3 \times 10^8}{\sqrt{2 \times \in_r}}$$

$$\Rightarrow 2 \in_r = 4 \Rightarrow \in_r = 2$$

11. **(c)** Range of projectile

$$R = \frac{v^2 \sin 2\theta}{g} \quad (\because R \propto \sin(2\theta))$$

$$\frac{R_1}{R_2} = \frac{\sin(2\theta_1)}{\sin(2\theta_2)} = \frac{\sin(2\times 15)}{\sin(2\times 45)} = \frac{\sin 30°}{\sin 90°}$$

$$\Rightarrow \frac{50}{R_2} = \frac{1}{2} \Rightarrow R_2 = 100\text{m}$$

12. **(c)** Impedance in LCR circuit

$$Z = \sqrt{(X_L - X_C)^2 + R^2} \qquad \because X_L = X_C = R$$

$$\therefore Z = R$$

13. **(c)** Given lights are of same wavelength and stopping potential is independent on intensity. Hence stopping potential will remain same.

Intensity $I_2 > I_1$, hence saturation current corresponding to I_2 will be greater than that corresponding to I_1.

14. **(a)** Acceleration is given as:

$$a = \left(\frac{m_2 - m_1}{m_1 + m_2}\right) g$$

$$\Rightarrow \frac{g}{\sqrt{2}} = \left(\frac{m_2 - m_1}{m_1 + m_2}\right) g$$

$$\Rightarrow \sqrt{2}(m_2 - m_1) = m_1 + m_2$$

$$\Rightarrow \frac{m_1}{m_2} = \left(\frac{\sqrt{2} - 1}{\sqrt{2} + 1}\right)$$

15. **(a)** Wavelength of H-atom is

$$\frac{1}{\lambda} = Rz^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Shortest wavelength for Balmer series:

$$\frac{1}{\lambda_B} = Rz^2\left(\frac{1}{2^2} - \frac{1}{\infty}\right) \quad ...(i)$$

Shortest wavelength for Lyman series:

$$\frac{1}{\lambda_L} = Rz^2\left(\frac{1}{1^2} - \frac{1}{\infty}\right) \quad ...(ii)$$

Dividing eq. (i) and (ii),

$\lambda_B : \lambda_L = 4 : 1$

16. **(b)** Mass of black, $m = 1$ kg

Force of parallel inclined surface, $F = 10$ N

Work done against frictional force

$= \mu_s N \times 10 = \mu_s Mg \times 10 = 0.1 \times 5 \times 10 = 5$ J

17. **(a)** $\because f_0 + f_e = 30$

And magnification, $m = \frac{f_0}{f_e}$

$$2 = \frac{f_0}{f_e} \Rightarrow f_0 = 2f_e \Rightarrow f_0 + \frac{f_0}{2} = 30 \ \therefore \ f_0 = 20\text{ cm}$$

18. **(c)** ${}_6C^{13} + \text{Energy} \rightarrow {}_6C^{12} + {}_0n^1$

Mass defect, $\Delta m = (12.000000 + 1.008665) - 13.003354$

$= -0.00531$ u

$\therefore$ Energy required $= \Delta m \times 931.5 = 0.00531 \times 931.5$ MeV $= 4.95$ MeV

19. **(a)** Angular momentum, $L = mvH = mu\cos 30\, H$

$$= mu\cos 30° \times \frac{u^2 \sin^2\theta}{2g} \quad \left[\because H = \frac{u^2 \sin^2\theta}{2g}\right]$$

$$= \frac{mu^3}{2g} \times \frac{\sqrt{3}}{2} \times \left(\frac{1}{2}\right)^2 = \frac{\sqrt{3}mu^3}{16g}$$

20. **(c)** Energy is, $E = \frac{hc}{\lambda}$

$E = \frac{1242\text{nm} - \text{eV}}{\lambda} \Rightarrow \lambda = \frac{1242}{6} = 207\text{ nm}$

21. **(d)** Basically 1 year is equal to time period of earth revolution around sun.

So, $T_i = 1$ year

Now,

$T^2 \propto R^3$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3$

$\Rightarrow T_2 = \left(\frac{R_2}{R_1}\right)^{3/2} .T_1 = \left(\frac{3R}{R}\right)^{3/2} \times 1$

$= 3\sqrt{3}$ years.

22. **(b)** Output $Y = \overline{\overline{A}.\overline{B}} = \overline{\overline{A + B}}$ (By De-Morgan Law)

$\therefore Y = A + B$

This Boolean expression represents OR gate.

23. **(d)** RMS speed,

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$\Rightarrow \quad V_{rms} \propto \sqrt{T}$

Here, $T_{initial} = 200$ K

$T_{final} = 800$ K

Initial RMS speed = v_0

$\therefore \frac{v_0}{v_{rms}} = \sqrt{\frac{200}{800}} \Rightarrow v_{rms} = 2v_0$

24. **(b)** Young's modulus, $Y = \frac{\text{Stress}}{\text{Strain}}$

If the temperature increases, strain also increases. Hence young's modulus decreases.

25. **(b)** Given 1 Main scale division = m

n MSD = (n + 1) VSD

$\Rightarrow \quad 1\text{ VSD} = \frac{n}{n+1}\text{MSD}$

Least count of vernier caliper = 1 MSD – 1 VSD

$\Rightarrow \quad \text{L.C} = m - m\left(\frac{n}{n+1}\right) = \left(1 - \frac{n}{n+1}\right)m$

$= m\left(\frac{n+1-n}{n+1}\right) = \left(\frac{1}{n+1}\right)m \Rightarrow \text{L.C} = \left(\frac{m}{n+1}\right)$

26. **(c)** According to question, pressure inside, 1st soap bubble,

$\Delta P_1 = P_1 - P_0 = 0.01 = \frac{4T}{R_1}$ ...(i)

And $\Delta P_2 = P_2 - P_0 = 0.02 = \frac{4T}{R_2}$ ...(ii)

Dividing, equation (ii) by (i),

$\frac{1}{2} = \frac{R_2}{R_1} \Rightarrow R_1 = 2R_2$

Volume $V = \frac{4}{3}\pi R^3 \Rightarrow \frac{V_1}{V_2} = \frac{R_1^3}{R_2^3} = \frac{8R_2^3}{R_2^3} = \frac{8}{1}$

27. **(a)** Condition for minima is $d \sin\theta = n\lambda$

For Ist minima $d \sin\theta = \lambda$

$\sin\theta = \frac{\lambda}{a} = \frac{2}{4} = \frac{1}{2} \qquad \therefore \theta = 30°$

Angular spread = $2\theta = 60°$

28. **(b)** We have $\Delta V = V_0 \gamma \Delta T$

$\Delta V = a^3.(3\alpha)\,\Delta T$

Now, $6a^2 = 24$ [$\because$ Total surface area of cube = $6a^2$]

$\Rightarrow a^2 = 4 \quad \Rightarrow a = 2$

So, $\Delta V = 2^3(3 \times 5 \times 10^{-4}) \times 10 = 1200 \times 10^{-4}\text{ m}^3$

$= 1200 \times 10^2\text{ cm}^3 = 1.2 \times 10^5\text{ cm}^3$

29. **(a)** Position of COM of a mass – system is given as,

$\vec{r}_{com} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2} = \frac{1(\hat{i} + 2\hat{j} + \hat{k}) + 3(-3\hat{i} - 2\hat{j} + \hat{k}}{1+3}$

$= -2\hat{i} - \hat{j} + \hat{k}$

$|\vec{r}_{cm}| = |-2\hat{i} - \hat{j} + \hat{k}| = \sqrt{(2)^2 + (1)^2 + (1)^2} = \sqrt{6}$

Only option (a) magnitude is

$\sqrt{1^2 + (-2)^2 + 1^2} = \sqrt{6}$

So option (a) is correct.

30. **(a)** At STP

Temperature, T = 273K

Molecular mass of oxygen, $M = 32 \times 10^{-3}$kg

Speed of sound is given by

$v = \sqrt{\frac{\gamma RT}{M}} = \sqrt{\frac{1.4 \times 8.3 \times 273}{32 \times 10^{-3}}}$

$= 314.8541 \simeq 315$m/s

PART - II : CHEMISTRY

31. **(b)** 1 M = mole of solute in 1 L solution.

32. **(c)** We know, $r_1 = k[A]^n$ ...(i)
If conc. of A is increased four times rate of reaction on doubles.
$2r_1 = k[4A]^n$ ...(ii)
Divide Eq. (ii) by (i).

$$\frac{2r_i}{r_1} = \frac{k(4A)^n}{k(A)^n}$$

$\Rightarrow \quad 2 = (4)^n \Rightarrow 2n = (2)^{2n} \Rightarrow n = 0.5$

33. **(b)** Smaller the size of anion, smaller is the covalent character and higher will be its melting point. Hence, the order of melting point of lithium salts is LiF > LiCl > LiBr.

34. **(a)** H = U + PV (By definition)
$\Delta H = \Delta U + \Delta(PV)$ at constant pressure
$\Delta H = \Delta U + P\Delta V$

35. **(c)** Saline hydrides are not volatile as the strong ionic bonds keep the constituent ions together.
Thus, statement II is incorrect.
Electron-precise hydrides like CH_4, SiH_4, act as pH- neutral species.
Thus, statement III is incorrect.

36. **(b)** During the extraction of copper, iron is present in the ore as impurity (FeS).
The ore together with a little coke and silica is smelted; FeS present as impurity in the ore is oxidized to iron oxide, which then reacts with silica to form fusible ferrous silicate which is removed as slag.

$$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2\uparrow;$$
$$FeO + SiO_2 \rightarrow \underset{\text{(Slag)}}{FeSiO_3}$$

37. **(a)** In reactivity series, Cu lies below Hydrogen and it is least electropositive among the given metals.

38. **(b)** Let us complete the reactions:
(*i*) $Fe^{2+} + H_2O_2 \longrightarrow Fe^{3+} + H_2O$
(*ii*) $\overset{+7}{MnO_4^-} + H^+ + H_2O_2 \longrightarrow Mn^{2+} + O_2 + H_2O$
(*iii*) $I_2 + H_2O_2 + OH^- \longrightarrow I^- + O_2 + H_2O$
(*iv*) $Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + OH^-$
In reactions, (*i*) and (*iv*) H_2O_2, acts as oxidising agent and itself gets reduced to H_2O.

39. **(c)** The colloidal particles have a tendency to preferentially adsorb a particular type of ions form the solution. This preferential adsorption of a particular type of ions imparts a particular type of charge to colloidal particles.

40. **(b)** The increasing order of field strength of ligands (according to spectrochemical series)
$S^{2-} < C_2O^{2-}_4 < NH_3 < en < CO$

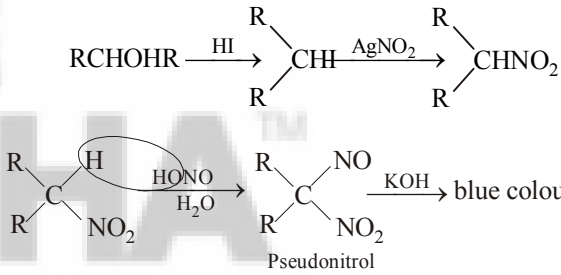
41. **(b)** **Victor Meyer's test:** The various steps involved are
(i)

$$RCH_2OH \xrightarrow{HI} RCH_2I \xrightarrow{AgNO_2} RCH_2NO_2$$

$$\xrightarrow{HNO_2} R-\underset{\underset{NOH}{\|}}{C}-NO_2 \xrightarrow{KOH} \underset{(\text{Pot salt})}{\text{Blool red colour}}$$

Nitrolic acid

(ii)



(iii)

$$R_3COH \xrightarrow{HI} R_3CI \xrightarrow{AgNO_2} R_3CNO_2$$

$$\xrightarrow{HNO_2} \text{No reaction} \xrightarrow{KOH} \text{Colourless}$$

42. **(d)** B group vitamins and vitamin C are soluble in water except vitamin B_{12} all are excreted easily.

43. **(a)** $\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

or, $\log\left(\frac{2k}{k}\right) = \frac{E_a}{2.303 \times 8.3} \times \frac{[600-300]}{300 \times 600}$

$E_a \approx 3.45 \text{kJ/mol}$

44. **(d)** XeF_2 has three lone pairs and two bond pairs. The three lone pairs are arranged in the equatorial positions because of which they face maximum repulsion from each other.

45. **(b)** Ferocene is Fe $(\eta^5 - C_5H_5)_2$
Perxenate ion is $[XeO_6]^{4-}$ which is octahedral.

46. **(d)** Sodium stearate is used in soap and sodium lauryl sulphate

$CH_3(CH_2)_{10}CH_2 - OSO_3^{\ominus}Na^{\oplus}$ is an anionic detergent.

47. **(c)** $A + B^{2+} \rightleftharpoons A^{2+} + B$

$G^\circ = -RT \ln K_c$

$= -8.314 \times 298 \times 2.303 \times \log 10^{12} = 68.47$ kJ/mol

48. **(b)** The chemical formula of nitropenta ammine chromium (III) chloride is:

$\left[Cr(NH_3)_5(NO_2)\right]Cl_2$

It can exist in following two structures

$\left[Cr(NH_3)_5(NO_2)\right]Cl_2$ and

Pentaamminenitrochromium (III) chloride

$\left[Cr(NH_3)_5ONO\right]Cl_2$

Pentaamminenitritochromium (III) chloride

Therefore, the type of isomerism found in this compound is linkage isomerism as NO_2 group is linked through N as $-NO_2$ or through O as –ONO.

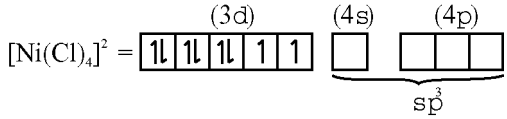
49. **(c)** The stability of hydrides decreases from NH_3 to BiH_3 but their reducing character increases down the group.

50. **(d)**

(a) Ni in $[Ni(Cl)_4]^{2-}$ exist as Ni^{2+} ion.

Cl is a weak field ligand (high spin). It will not cause pairing of electrons.

Hence, configuration of $[Ni(Cl)_4]^{2-}$ is

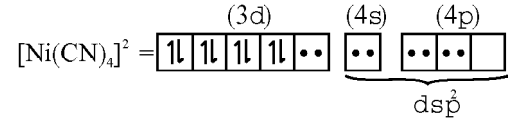


Tetrahedral with two unpaired electrons (i.e., paramagnetic) and has sp^3 hybridisation.

(b) In $\left[Co(C_2O_4)_3\right]^{3-}, (C_2O_4)_3^{2-}$ is a bidentate ligand thus, give octahedral structure.

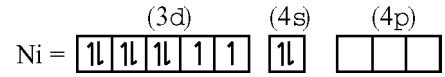
(c) In $\left[Ni(CN)_4\right]^{2-}$, Ni exist as Ni^{2+} ion.

CN^- is a strong field ligand (low spin). Causes pairing of electrons of 3*d* orbital.

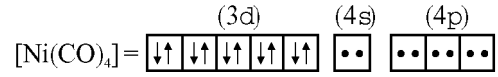


Hence, the structure of is square planar and it is diamagnetic.

(d) In $[Ni(CO)_4]$, Ni has zero oxidation state. i.e.,



CO is a strong field ligand causes rearrangement and pairing of electrons of 3*d* and 4*s* orbital.



Structure of $Ni(CO_4)$ is tetrahedral with sp^3 hybridisation and it is diamagnetic.

Hence, (d) is the correct answer.

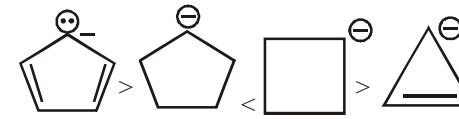
51. **(d)**

52. **(c)**

$$\frac{\text{Mass of metal}_1\text{ deposited}}{\text{Mass of metal}_2\text{ deposited}} = \frac{\text{Eq.wt.of metal}_1}{\text{Eq.wt.of metal}_2}$$

The equivalent weight of silver is highest among the given options.

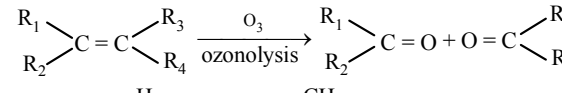
53. **(d)** As we know compound (4) is aromatic and the compound (1) is anti-aromatic. Hence compound (4) is most stable and compound (1) is least stable among these in compound (2) and (3) carbon atom having charge is sp^3 hybridised. On the basis of angle strain theory compound (3) is more stable than compound (2).

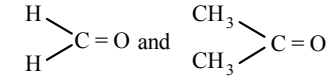


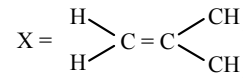
54. **(a)** *cis*-polyisoprene is natural rubber.

55. **(d)** Grignard reagent = $R - \overset{\delta+\ \delta-}{Mg\ X}$

56. **(b)**



We have, 

Thus, 

57. (d) The reaction $P_4 + 8\,SOCl_2 \rightarrow 4\,PCl_3 + 2S_2Cl_2 + 4SO_2$ involves change of oxidation state of P from 0 to +3 and that of S from + 4 to + 2.
Thus, it is a redox reaction but not a disproportionation reaction.

58. (b) Le-Chatelier principle is not applicable to pure solids and liquids because they experience negligible change in concentration during chemical equilibrium.

59. (a) no. of moles of $CH_4\,(n_1) = \frac{4}{16} = 0.25$ mol

no. of moles of $CO_2\,(n_2) = \frac{4.4}{44} = 0.1$ mol

Total no. of moles $(n_T) = n_1 + n_2 = 0.35$ mol

$$\therefore \quad P = \frac{0.35 \times 0.082 \times 300}{1} = 8.6 \text{ atm}$$

60. (b) $E_n = -13.6\left[\frac{z^2}{n^2}\right]$ eV

$$\Rightarrow \quad E_1 = -13.6\left[\frac{3^2}{1^2}\right] \text{eV} = -122.4 \text{ eV}$$

$$= -122.4 \times 1.602 \times 10^{-19}\,\text{J} = -1.962 \times 10^{-17}\,\text{J}$$

PART - III (A): ENGLISH PROFICIENCY

61. (a) 62. (a) 63. (b)

64. (a) India deserves a far bigger share of world trade considering its vast resources.

65. (a)

66. (d) The garbage was first sundried for one to three days to bring down the moisture level.

67. (a) In Voice change, one can transform the sentence from Active to Passive or vice versa, but can't change the sense. That is, one can't remove the information conveyed through the sentence or add any additional information. That is, transformation must be done keeping the information intact. This is the reason behind selecting (a) as the answer.

68. (c)

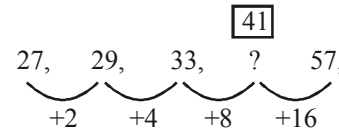
69. (c) with the debasing of the coinage than

70. (a) Every where in the passage we find that the author favours India gaining an edge over China. The author, throughout the passage, is highlighting China's own prospective while they are helping the Africans.

PART - III (B) : LOGICAL REASONING

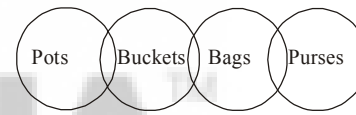
71. (c) 72. (c)

73. (b)



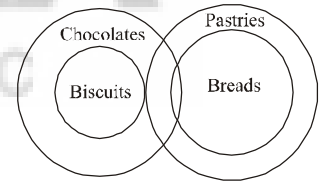
74. (d) The male members in the family are:-
(i) The man himself
(ii) his four sons; and
(iii) his $(3 \times 4) = 12$ grandsons.
Hence total number of male members
$= 1 + 4 + 12 = 17$

75. (b) Venn-Diagram Representation:



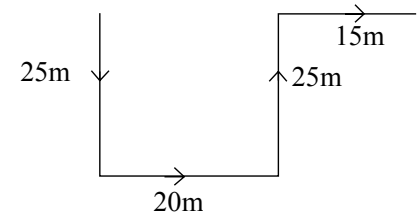
Conclusions:
I. False II. False

76. (c) Venn-Diagram Representation:



Conclusions:
Only II follows.

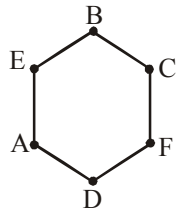
77. (a)



$\therefore$ Rohit is 35 m east.

For Sol. (78-80)

The following hexagonal arrangement is possible.



78. (c) The other neighbour of A is E.

79. (a) F is placed opposite to E.

80. (b) Clearly, C is the required person.

81. (b)

$+ \Rightarrow \div$	$- \Rightarrow \times$
$\div \Rightarrow +$	$\times \Rightarrow -$

$63 \times 24 + 8 \div 4 + 2 - 3 = ?$

or, $? = 63 - 24 \div 8 + 4 \div 2 \times 3$

or, $? = 63 - 3 + 2 \times 3$

or, $? = 66$

82. (d) Arrangement as per height:

$C > D > A > E > B$

(Middle)

83. (a) A successful completion of 'Education' equips one with 'Diploma'. Similary, a successful completion in 'Sports' equips one with 'Trophy'.

84. (b)

85. (c) According to english alphabet, resultant group will be as follows:

P R I N C E

C E I N P R

Only two letters 'I and N' will remain unchanged.

86. (d)

N A T I O N

4 6 7 2 3 4

E A R N

1 6 5 4

A T T E N T I O N

6 7 7 1 4 7 2 3 4

87. (b) 12, 18, 30 is multiple of 6.
16, 32, 40 is multiple of 8.
36, 18, 27 is multiple of 9.

88. (c) Required area common to △, ○, □. i.e. 9

89. (c) The series is babb/bbab/bbba/bbbb.
Thus, in each sequence, 'a' moves one step forward and 'b' takes its place and finally in the fourth sequence, it is eliminated.

90. (a) The colour of clean sky is blue and blue means green. Hence, the colour of clean sky is green.

PART - IV : MATHEMATICS

91. (c)

$$A = \frac{1}{1-r^a} \Rightarrow 1 - r^a = \frac{1}{A} \Rightarrow r^a = 1 - \frac{1}{A} = \frac{A-1}{A}$$

$$B = \frac{1}{1-r^b} \Rightarrow 1 - r^b = \frac{1}{B} \Rightarrow r^b = 1 - \frac{1}{B} = \frac{B-1}{B}$$

$$\therefore \; a \log r = \log\left(\frac{A-1}{A}\right)$$

$$\text{and } b \log r = \log\left(\frac{B-1}{B}\right)$$

$$\therefore \frac{a}{b} = \frac{\log\left(\frac{A-1}{A}\right)}{\log\left(\frac{B-1}{B}\right)} = \log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$$

92. (c) Let $S = 1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \ldots$ ...(i)

$$\frac{S}{6} = \frac{1}{6} + \frac{5}{6^2} + \frac{12}{6^3} + \frac{22}{6^4} + \ldots \quad \text{...(ii)}$$

On subtracting (i) from (ii)

$$\frac{5}{6}S = 1 + \frac{4}{6} + \frac{7}{6^2} + \frac{10}{6^3} + \frac{13}{6^4} + \cdots$$

$$\frac{5}{36}S = \frac{1}{6} + \frac{4}{6^2} + \frac{7}{6^3} + \frac{10}{6^4} + \frac{13}{6^5} + \cdots$$

on subtraction

$$\frac{25}{36}S = 1 + \frac{3}{6} + \frac{3}{6^2} + \frac{3}{6^3} + ... = \frac{8}{5};$$

$$S = \frac{8}{5} \times \frac{36}{25} = \frac{288}{125}$$

93. **(a)** Let a complex number, $z = x + iy$

$\Rightarrow \bar{z} = \bar{x} - i\bar{y}$

Then, vertices of rectangle for $z, \bar{z}, -z, -\bar{z}$ are $(x, y), (x, -y), (-x, -y), (-x, y)$.

Now, Area of rectangle $= (2x)(2y) = 4xy$

It is given that,

Area $= 2\sqrt{3} = 4xy \Rightarrow 2xy = \sqrt{3}$

$\therefore\ x = \frac{1}{2}, y = \sqrt{3}\ \ \therefore z = \frac{1}{2} + \sqrt{3}i$

94. **(d)** $(\sin x + \sin 4x) + (\sin 2x + \sin 3x) = 0$

$$\Rightarrow 2\sin\frac{5x}{2}.\cos\frac{3x}{2} + 2\sin\frac{5x}{2}.\cos\frac{x}{2} = 0$$

$$\Rightarrow 2\sin\frac{5x}{2}\left\{\cos\frac{3x}{2} + \cos\frac{x}{2}\right\} = 0$$

$$\Rightarrow 2\sin\frac{5x}{2}\left\{2\cos x\cos\frac{x}{2}\right\} = 0$$

$$2\sin\frac{5x}{2} = 0 \Rightarrow \frac{5x}{2} = 0, \pi, 2\pi, 3\pi, 4\pi, 5\pi, ...$$

$$\Rightarrow x = 0, \frac{2\pi}{5}, \frac{4\pi}{5}, \frac{6\pi}{5}, \frac{8\pi}{5}, 2\pi$$

$$\cos\frac{x}{2} = 0 \Rightarrow \frac{x}{2} = \frac{\pi}{2} \Rightarrow x = \pi;$$

$$\cos x = 0 \Rightarrow x = \frac{\pi}{2}, \frac{3\pi}{2}$$

So, sum $= 6\pi + \pi + 2\pi = 9\pi$

95. **(b)** $p \rightarrow (q \vee r)$. If 2 is even number then 2 is a prime number or $2 + 2 = 2^2$.

96. **(a)** $$f(-x) = \frac{\cos(-x)}{\left[-\frac{2x}{\pi}\right] + \frac{1}{2}} = \frac{\cos x}{-1 - \left[\frac{2x}{\pi}\right] + \frac{1}{2}}$$

(As x is not an integral multiple of π)

$$= -\frac{\cos x}{\left[\frac{2x}{\pi}\right] + \frac{1}{2}} = -f(x)$$

Therefore, f(x) is an odd function.

97. **(c)** $|z_1| = |z_2| = |z_3| = ... = |z_n| = 1$

$\Rightarrow z_1\bar{z}_1 = z_2\bar{z}_2 = z_3\bar{z}_3 = ... = z_n\bar{z}_n = 1$

$$\bar{z}_1 = \frac{1}{z}, \bar{z}_2 = \frac{1}{z_2}, \bar{z}_3 = \frac{1}{z_3}, ..., \bar{z}_n = \frac{1}{z_n}$$

Now, $|z_1 + z_2 + z_3 + ... + z_n|$

$= |\bar{z}_1 + \bar{z}_2 + ... + \bar{z}_n|$

$$|\bar{z}_1 + \bar{z}_2 + \bar{z}_3 + ... + \bar{z}_n| = \left|\frac{1}{z_1} + \frac{1}{z_2} + \frac{1}{z_3} + ... + \frac{1}{z_n}\right|$$

98. **(c)** Here, point A is the intersection of line AB and AC so equation of line passing through A.

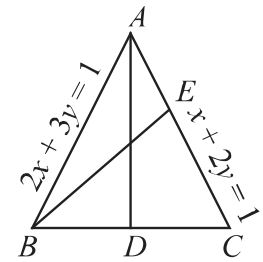
$(x + 2y - 1) + \lambda(2x + 3y - 1) = 0$ ... (i)

This line passes through the orthocentre (0,0), then

$-1 - \lambda = 0$

$\Rightarrow \lambda = -1$

On substituting $\lambda = -1$ in Eq. (*i*), we get $x + y = 0$ as the equation of AD. Since $AD \perp BC$, therefore



$$-1 \times -\frac{a}{b} = -1$$

$\Rightarrow a + b = 0$ ... (ii)

Similarly, by applying the condition that BE is perpendicular to CA, we get $a + 2b = 8$ ... (iii)

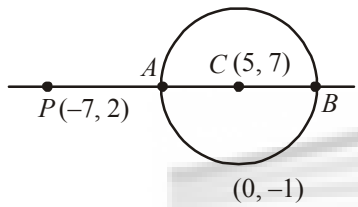
Now, solving Eqs. (ii) and (iii), we get $a = -8$, $b = 8$

99. (a) The centre C of the circle $= (5, 7)$ and the radius

$= \sqrt{5^2 + 7^2 + 51} = 5\sqrt{5}$

$PC = \sqrt{12^2 + 5^2} = 13 \Rightarrow q = PA = 13 - 5\sqrt{5}$

and $p = PB = 13 + 5\sqrt{3}$



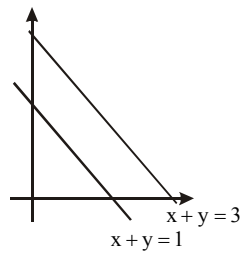
$\therefore$ G.M. of p and q

$= \sqrt{pq} = \sqrt{(13 - 5\sqrt{5})(13 + 5\sqrt{5})}$

$= \sqrt{169 - 125} = 2\sqrt{11}.$

100. (a) Coordinate of focus will be $(h + 1, k)$

Now focus should lie to the opposite side of origin with respect to line $x + y - 1 = 0$ and same side as origin with respect to line $x + y - 3 = 0$



Hence $h + k > 0$ and $h + k < 2$.

101. (d) $\lim\limits_{x \to 0^-} f(x) = \lim\limits_{h \to 0} \sqrt{\{-h\} \cot\{-h\}}$

$= \lim\limits_{h \to 0} \sqrt{(1 - h)\cot(1 - h)} = \sqrt{\cot 1}$

$\lim\limits_{x \to 0^+} f(x) = \lim\limits_{h \to 0} \dfrac{\tan^2\{h\}}{h^2 - [h]^2} = \lim\limits_{h \to 0} \dfrac{\tan^2 h}{h^2} = 1$

$\therefore \lim\limits_{x \to 0} f(x)$ does not exist.

102. (a) Given equation can be reduced to a quadratic equation.

$\therefore 2x^2 + x - 11 + \dfrac{1}{x} + \dfrac{2}{x^2} = 0$

$\Rightarrow 2\left(x^2 + \dfrac{1}{x^2}\right) + \left(x + \dfrac{1}{x}\right) - 11 = 0$

Put $x + \dfrac{1}{x} = y$

$2(y^2 - 2) + y - 11 = 0$

$\Rightarrow 2y^2 + y - 15 = 0$

$\Rightarrow y = -3$ and $\dfrac{5}{2}$

$\Rightarrow x + \dfrac{1}{x} = -3, x + \dfrac{1}{x} = \dfrac{5}{2}$

$\Rightarrow x^2 + 3x + 1 = 0, 2x^2 - 5x + 2 = 0$

Only 2nd equation has rational roots as D = 9

and roots are $\dfrac{1}{2}$ and 2.

103. (c) ${}^{22}P_{r+1} : {}^{20}P_{r+2} = 11 : 52$

or $(21 - r)(20 - r)(19 - r) = 52 \times 2 \times 21$

$\Rightarrow (21 - r)(20 - r)(19 - r) = 14 \times 13 \times 12$

$\Rightarrow (21 - r)(20 - r)(19 - r) = (21 - 7)(20 - 7)(19 - 7)$

$\Rightarrow r = 7$

$\Rightarrow x + \dfrac{1}{x} = -3, x + \dfrac{1}{x} = \dfrac{5}{2}$

$\Rightarrow x^2 + 3x + 1 = 0, 2x^2 - 5x + 2 = 0$

Only 2nd equation has rational roots as D = 9

and roots are $\dfrac{1}{2}$ and 2.

104. (a) Total contested candidates = 12

4 candidates are to be elected and voter votes for at least one candidate then total number of

ways of selections.

$= {}^{12}C_1 + {}^{12}C_2 + {}^{12}C_3 + {}^{12}C_4$

$= 12 + \frac{12\times11}{2\times1} + \frac{12\times11\times10}{3\times2\times1} + \frac{12\times11\times10\times9}{4\times3\times2\times1}$

$= 12 + 66 + 220 = 495 = 793$

105. (c) Since $(x+\sqrt{x^2-1})^8 + (x-\sqrt{x^2-1})^8$

$= 2\left\{ {}^8C_0x^8 + {}^8C_2x^6(x^2-1) + {}^8C_4x^4(x^2-1)^2 + {}^8C_6x^2(x^2-1)^3 + {}^8C_8x^0(x^2-1)^4 \right\}$

So coefficient of highest power of x

$= 2\left\{ {}^8C_0 + {}^8C_2 + {}^8C_4 + {}^8C_6 + {}^8C_8 \right\}$

$= (1+1)^8 + (1-1)^8 = 2^8 = 256$

106. (a) Observations : 2, 3, 5, 8, 12

$\text{Mean} = \frac{2+3+5+8+12}{5} = 6$

$\therefore\ \sigma^2 = \frac{\Sigma(x_i-\bar{x})^2}{n} = \frac{16+9+1+4+36}{5} = \frac{66}{5}$

$\therefore\ \sigma^2 = 13.2$

Median $= 5 = m$

$\therefore$ Mean deviation about median

$\Rightarrow \quad \frac{\Sigma|x_i-m|}{n} = \frac{3+2+0+3+7}{5} = 3$

$M = 3 \Rightarrow \sigma^2 - M = 13.2 - 3 = 10.2.$

107. (d) Let S denote the set of all triangles in a plane. Let R be the relation on S defined by $(\Delta_1, \Delta_2) \in R$

$\Rightarrow$ triangle $\Delta_1 \cong \Delta_2$:

(i) Let any triangle $\Delta \in S$, we have

$\Delta_1 \cong \Delta_2 \Rightarrow (\Delta, \Delta) \in R\ \forall\ \Delta \in S \Rightarrow$ R is reflexive on S.

(ii) Let $\Delta_1, \Delta_2 \in$ S, such that $(\Delta_1, \Delta_2) \in R$, then $\Delta_1 \cong \Delta_2 \Rightarrow \Delta_2 \cong \Delta_1 \Rightarrow (\Delta_2, \Delta_1) \in R \Rightarrow R$ is symmetric

(iii) Again, let $\Delta_1, \Delta_2, \Delta_3 \in$ S such that $(\Delta_1, \Delta_2) \in R$ and

$(\Delta_2, \Delta_3) \in$ R $\therefore\ \Delta_1 \cong \Delta_2 \cong \Delta_3$

$\therefore\ (\Delta_1, \Delta_3) \in R$

$\Rightarrow R$ is transitive.

$\therefore$ R is an equivalence relation.

108. (c) Since $XY = (AB + BA)(AB - BA)$

$= (AB)AB + (BA)(AB) - (AB)(BA) - (BA)(BA)$

Now $(XY)^T = ((AB).(AB))^T + (BA.AB)^T - (AB.BA)^T$

$= (AB)^T.(AB)^T + (AB)^T.(BA)^T - (BA)^T(AB)^T - (BA)^T(BA)^T$

$= (B^T.A^T)(B^T.A^T) + (B^T.A^T).(A^TB^T) - (A^TB^T)(B^TA^T) - (A^TB^T)(A^TB^T)$

Since, A & B are symmetric matrix.

$= (BA)(BA) + (BA)(AB) - (AB)(BA) - (AB)(AB)$

$= (BA - AB)(BA + AB) = -YX$

109. (c) Expanding the two determinants, we get

$(1-3x^2+2x^3) + (3x^2 - x^3) = 0$

$\Rightarrow x^3 + 1 = 0$

$\Rightarrow x = -\omega, -\omega^2, -1$

$x^{2007} + x^{-2007} = -1 - 1 = -2$

110. (c) Given that, $f(x) = \frac{x}{\sqrt{1+x^2}}$

For injective: Let $x_1, x_2 \in \boldsymbol{R}$ such that $f(x_1) = f(x_2)$

$\Rightarrow \frac{x_1}{\sqrt{1+x_1^2}} = \frac{x_2}{\sqrt{1+x_2^2}} \Rightarrow \frac{x_1^2}{1+x_1^2} = \frac{x_2^2}{1+x_2^2}$

$\Rightarrow x_1^2 + x_1^2x_1^2 = x_2^2 + x_1^2x_2^2 \Rightarrow x_1^2 = x_2^2$

$\Rightarrow x_1 = x_2$

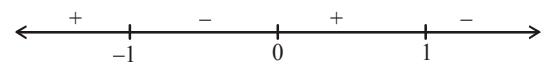
So, $f(x)$ is injective.

For surjective: Let $y = \frac{x}{\sqrt{1+x^2}}$

$\Rightarrow y^2(1+x^2) = x^2 \Rightarrow y^2 + y^2x^2 = x^2$

$\Rightarrow x^2(1-y^2) = y^2 \Rightarrow x = \sqrt{\frac{y^2}{1-y^2}}$

$\Rightarrow \frac{y^2}{1-y^2} \geq 0$



$\therefore\ y \in (-1, 1)$

So, $f(x)$ is not surjective.

111. (d) Given $\tan^{-1}\left(\frac{1}{1+1.2}\right)+\tan^{-1}\left(\frac{1}{1+2.3}\right)+\ldots$

$$+\tan^{-1}\left(\frac{1}{1+n(n+1)}\right)=\tan^{-1}(x)$$

$$\Rightarrow \tan^{-1}\left(\frac{2-1}{1+1.2}\right)+\tan^{-1}\left(\frac{3-2}{1+2.3}\right)+\ldots$$

$$+\tan^{-1}\left(\frac{n+1-n}{1+n(n+1)}\right)=\tan^{-1}(x)$$

$\Rightarrow \tan^{-1}(2)-\tan^{-1}(1)+\tan^{-1}(3)-\tan^{-1}(2)+\ldots$
$+\tan^{-1}(n+1)-\tan^{-1}(n)=\tan^{-1}(x)$
$\Rightarrow \tan^{-1}(n+1)-\tan^{-1}(1)=\tan^{-1}(x)$

$$\left\{\because \tan^{-1}(A)-\tan^{-1}(B)=\tan^{-1}\left(\frac{A-B}{1+A.B}\right)\right\}$$

$$\Rightarrow \tan^{-1}\left(\frac{n}{n+2}\right)=\tan^{-1}(x)\Rightarrow x=\frac{n}{n+2}$$

112. (c) $\lim\limits_{x\to 0} f(x)=\lim\limits_{x\to 0}\dfrac{x^2\log(\cos x)}{\log(1+x)}$

$$=\lim_{x\to 0}-\frac{x\cdot\log(\cos x)}{\frac{\log(1+x)}{x}}$$

$$=\lim_{x\to 0} x.\log(\cos x)=0\cdot\log 1=0$$

$\because \lim\limits_{x\to 0} f(x)=f(0)$

$\therefore$ $f(x)$ is continuous at $x=0$

Now, $\lim\limits_{x\to 0}\dfrac{f(x+h)-f(x)}{h}$

$$\lim_{h\to 0}\frac{f(h)-f(0)}{h}=\lim_{h\to 0}\frac{h^2\log\cos h-0}{\frac{\log(1+h)}{h}}$$

$$\lim_{h\to 0}\frac{h^2\log(\cos h)}{1}=0$$

$\therefore$ $f(x)$ is differentiable at $x=0$

113. (b) Given, $f(x)=5x-3$ and $g(x)=x^2+3$

Let, $y=f(x)$, $\therefore$ $y=5x-3$

$$y+3=5x \Rightarrow x=\frac{y+3}{5}$$

$$\therefore \quad f^{-1}(y)=\frac{y+3}{5} \Rightarrow f^{-1}(x)=\frac{x+3}{5}$$

Now, $g(x)=x^2+3$;
So, $gof^{-1}(3)=g[f^{-1}(3)]$

$$=g\left(\frac{3+3}{5}\right)=g\left(\frac{6}{5}\right)=\frac{(6)^2}{(5)^2}+3=\frac{36}{25}+3=\frac{111}{25}$$

114. (a) Given that,

$$\cot\left(\cos^{-1}x\right)=\sec\left\{\tan^{-1}\left(\frac{a}{\sqrt{b^2-a^2}}\right)\right\}$$

Since, $\cos^{-1}x=\cot^{-1}\left(\dfrac{x}{\sqrt{1-x^2}}\right)$

and $\tan^{-1}x=\sec^{-1}\left(\sqrt{1+x^2}\right)$

$$\Rightarrow \quad \cot\left(\cot^{-1}\frac{x}{\sqrt{1-x^2}}\right)=$$

$$\sec\left\{\sec^{-1}\sqrt{1+\left(\frac{a}{\sqrt{b^2-a^2}}\right)^2}\right\}$$

$$\Rightarrow \quad \frac{x}{\sqrt{1-x^2}}=\sqrt{\frac{b^2-a^2+a^2}{b^2-a^2}}$$

$$\Rightarrow \quad \frac{x}{\sqrt{1-x^2}}=\frac{b}{\sqrt{b^2-a^2}}$$

On squaring both the sides, we get

$$\Rightarrow \quad \frac{x^2}{1-x^2}=\frac{b^2}{b^2-a^2}$$

$$\Rightarrow \quad x^2b^2-x^2a^2=b^2-b^2x^2$$

$$x^2b^2+b^2x^2-x^2a^2=b^2$$

$\Rightarrow \quad 2x^2b^2 - x^2a^2 = b^2 \Rightarrow x^2\left(2b^2 - a^2\right) = b^2$

$\Rightarrow \quad x = \dfrac{b}{\sqrt{2b^2 - a^2}}$

115. (b) Given equations, $x - y + 2z = 4$

$3x + y + 4z = 6$

$x + y + z = 1$

Let $\Delta = \begin{vmatrix} 1 & -1 & 2 \\ 3 & 1 & 4 \\ 1 & 1 & 1 \end{vmatrix}$

$= 1(1-4) + 1(3-4) + 2(3-1)$

$= -3 - 1 + 4 = 0$

and $\Delta_1 = \begin{vmatrix} 4 & -1 & 2 \\ 6 & 1 & 4 \\ 1 & 1 & 1 \end{vmatrix}$

$= 4(1-4) + 1(6-4) + 2(6-1)$

$= -12 + 2 + 10 = 0$

Now, $\Delta = 0$ and $\Delta_1 = 0$

$\therefore$ These equations have infinitely many solutions.

116. (a) $\dfrac{d}{dx}\left(\tan^{-1}(\cos\sqrt{x}) + \sec^{-1}(e^x)\right)$

$= \dfrac{(-\sin\sqrt{x})}{1+\cos^2\sqrt{x}} \cdot \left(\dfrac{1}{2\sqrt{x}}\right) + \dfrac{1}{e^x\sqrt{e^{2x}-1}} \cdot e^x$

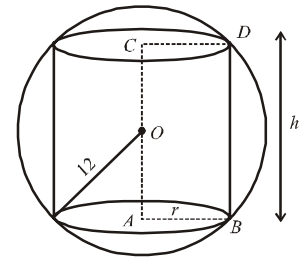
but when $x = \dfrac{\pi^2}{4}$

$= \dfrac{-\sin\dfrac{\pi}{2}}{1+\cos^2\dfrac{\pi}{2}}\left(\dfrac{1}{2}\right)\left(\dfrac{2}{\pi}\right) + \dfrac{1}{\sqrt{e^{\pi^2/2}-1}}$

$= -\dfrac{1}{\pi} + \dfrac{1}{\sqrt{e^{\pi^2/2}-1}}$

117. (b) $12^2 = r^2 + \left(\dfrac{h}{2}\right)^2 \Rightarrow V = \pi r^2 h$

$\Rightarrow \quad V = \pi\left(144 - \dfrac{h^2}{4}\right)h$



$\Rightarrow \quad V = 144\pi h - \dfrac{\pi}{4}h^3 \Rightarrow \dfrac{dV}{dh} = 144\pi - \dfrac{3\pi}{4}h^2$

$\Rightarrow \quad \dfrac{dV}{dh} = 0 \Rightarrow 144\pi = \dfrac{3\pi}{4}h^2$

$\Rightarrow \quad h^2 = 48 \times 4 \Rightarrow h = 8\sqrt{3}$

$\therefore \quad 12^2 = r^2 + 48 \Rightarrow r^2 = 96$

Volume $= \pi r^2 h = \pi \times 96 \times 8\sqrt{3} = 768\sqrt{3}\pi \text{ cm}^3$.

118. (d) $I = \int \left(\dfrac{x^3-1}{x^3+x}\right)dx = \int \left(1 - \dfrac{x+1}{x^3+x}\right)dx$

$\Rightarrow I = \int 1 \cdot dx - \int \dfrac{(x+1)}{x^3+x}dx$

$= x - \int \dfrac{(x+1)}{x(x^2+1)}dx$

Let $\dfrac{x+1}{x(x^2+1)} = \dfrac{A}{x} + \dfrac{Bx+C}{x^2+1}$

$\Rightarrow (x+1) = A(x^2+1) + (Bx+C)x$

$\Rightarrow (x+1) = (A+B)x^2 + Cx + A$

On comparing coefficient, we get

$A + B = 0, C = 1, A = 1$

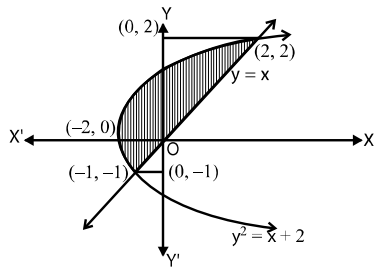
$\Rightarrow B = -1$

$\therefore I = x - \int \dfrac{1}{x}dx - \int \dfrac{(1-x)}{x^2+1}dx$

$\Rightarrow I = x - \log|x| - \int \dfrac{1}{x^2+1}dx + \dfrac{1}{2}\int \dfrac{2x}{x^2+1}dx$

$\Rightarrow I = x - \log|x| - \tan^{-1}x + \dfrac{1}{2}\log(x^2+1) + c$

119. (c) Given, $x = y^2 - 2$ and $x = y$.



On solving, $x = y^2 - 2$ and $x = y$, we get $(-1, -1)$ and $(2,2)$.

Area of the shaded region,

$$A = \int_{-1}^{2} y\,dy - \int_{-1}^{2} (y^2 - 2)\,dy$$

$$= \left[\frac{y^2}{2} - \frac{y^3}{3} + 2y\right]_{-1}^{2} = \left(\frac{4}{2} - \frac{8}{3} + 4\right) - \left(\frac{1}{2} + \frac{1}{3} - 2\right)$$

$$= \frac{10}{3} + \frac{7}{6} = \frac{27}{6} = \frac{9}{2}.$$

120. (a) $\dfrac{dy}{dx} - y \log_e 2 = 2^{\sin x}(\cos x - 1)\log_e 2$

This is linear differential equation

I.F. $= e^{-\log_e 2 \int dx} = e^{-x \log_e 2} = 2^{-x}$

then general Solution is

$$y2^{-x} = \int 2^{-x} 2^{\sin x}(\cos x - 1)\log_e 2\,dx + c$$

Now let $\sin x - x = t \Rightarrow (\cos x - 1)dx = dt$

$$\therefore y2^{-x} = \log_e 2 \int 2^t\,dt + c$$

$$\therefore y2^{-x} = 2^t + c$$

$$\therefore y = 2^{x+t} + c2^x$$

$$\therefore y = 2^{\sin x} + c2^x$$

121. (d) Here we are given that

$$\overrightarrow{OA} = \vec{a}, \overrightarrow{OB} = \vec{b}, \overrightarrow{OC} = \vec{c}$$

Now P.V of D i.e $\overrightarrow{OD} = \dfrac{1 \times \overrightarrow{OB} + 3 \times \overrightarrow{OC}}{1+3}$

$$\overrightarrow{OD} = \frac{\vec{b} + 3\vec{c}}{4}$$

$$\overrightarrow{OE} = \frac{4\overrightarrow{OD} + \overrightarrow{OA}}{4+1} = \frac{\frac{4(\vec{b} + 3\vec{c})}{4} + \vec{a}}{5}$$

$$\Rightarrow \overrightarrow{OE} = \frac{\vec{a} + \vec{b} + 3\vec{c}}{5}$$

Now, $\overrightarrow{OE} = \dfrac{2\overrightarrow{OB} + 3\overrightarrow{OF}}{2+3}$

$$\Rightarrow \overrightarrow{OF} = \frac{5\overrightarrow{OE} - 2\overrightarrow{OB}}{3}$$

$$\Rightarrow \overrightarrow{OF} = \frac{\frac{5(\vec{a} + \vec{b} + 3\vec{c})}{5} - 2\vec{b}}{3}$$

$$\Rightarrow \overrightarrow{OF} = \frac{\vec{a} - \vec{b} + 3\vec{c}}{3} \Rightarrow \text{P.V. of F is } \frac{\vec{a} - \vec{b} + 3\vec{c}}{3}$$

122. (b) The given equations are

$3l + m + 5n = 0$ ....(i)

and $6mn - 2nl + 5lm = 0$ ...(ii)

From (i), we have $m = -3l - 5n$.

Putting $m = -3l - 5n$ in (ii),

we get $6(-3l - 5n)n - 2nl + 5l(-3l - 5n) = 0$

$\Rightarrow (n + l)(2n + l) = 0$

$\Rightarrow$ either $l = -n$ or $l = -2n$.

If $l = -n$, then putting $l = -n$ in (i), we obtain $m = -2n$.

If $l = -2n$, then putting $l = -2n$ in (i), we obtain $m = n$.

Thus, the direction ratios of two lines are $-n, -2n, n$ and $-2n, n, n$ i.e., $1, 2, -1$ and $-2, 1, 1$.

Hence, the direction cosines are

$\dfrac{1}{\sqrt{6}}, \dfrac{2}{\sqrt{6}}, \dfrac{-1}{\sqrt{6}}$ or $\dfrac{-2}{\sqrt{6}}, \dfrac{1}{\sqrt{6}}, \dfrac{1}{\sqrt{6}}$. The angle θ between the lines is given by

$$\cos\theta = \frac{1}{\sqrt{6}} \times \frac{-2}{\sqrt{6}} + \frac{2}{\sqrt{6}} \times \frac{1}{\sqrt{6}} + \frac{-1}{\sqrt{6}} \times \frac{1}{\sqrt{6}} = \frac{-1}{6}$$

$$\Rightarrow \theta = \cos^{-1}\left(\frac{-1}{6}\right).$$

123. (a) Let

$$I = \int_5^9 \frac{\log 3x^2\, dx}{\log 3x^2 + \log (588 - 84x + 3x^2)} \quad ...(i)$$

$$= \int_5^9 \frac{\log 3x^2\, dx}{\log 3x^2 + \log 3(14 - x)^2}$$

$$= \int_5^9 \frac{\log 3(14 - x)^2\, dx}{\log 3(14 - x)^2 + \log 3(14 - (14 - x))^2}$$

$$\left[\int_a^b f(x)\, dx = \int_a^b f(a + b - x)\, dx\right]$$

$$I = \int_5^9 \frac{\log 3(14 - x)^2\, dx}{\log 3(14 - x)^2 + \log 3x^2} \quad ...(ii)$$

Adding Eqs. (i) and (ii), we get

$$2I = \int_5^9 \frac{\log 3x^2 + \log 3(14 - x)^2}{\log 3(14 - x)^2 + \log 3x^2} dx$$

$$2I = \int_5^9 dx = 9 - 5 = 4 \Rightarrow I = 2$$

124. (d) P (The electronic component fails when first used) $= P(F) = 0.10$

$\therefore\ P(\overline{F}) = 1 - P(F) = 0.90$

Let E be the event that a new component will last for one year, then

$$P(E) = P(F).P\left(\frac{E}{F}\right) + P(\overline{F})\,P\left(\frac{E}{\overline{F}}\right)$$

[Total probability theorem]

$= 0.10 \times 0 + 0.90 \times 0.99 = 0.891$

125. (b) $\hat{i} \times (\overline{a} \times \hat{i}) = (\hat{i} \cdot \hat{i})\overline{a} - (\hat{i} \cdot \overline{a})\hat{i} = \hat{j} + 2\hat{k}$

Similarly, $\hat{j} \times (\overline{a} \times \hat{j}) = 2\hat{i} + 2\hat{k}$,

$\hat{k} \times (\overline{a} \times \hat{k}) = 2\hat{i} + \hat{j}$

$\Rightarrow \therefore |\hat{j} + 2\hat{k}|^2 + |2\hat{i} + 2\hat{k}|^2 + |2\hat{i} + \hat{j}|^2$

$= 5 + 8 + 5 = 18.$

126. (d) For a distribution of random variable x,

$\alpha = P(X^6 < 3) = P(X^6 = 1) + P(X^6 = 2)$

$= \lambda + 2\lambda = 3\lambda$

and $\beta = P(X^6 < 2) = P(X^6 = 3) + P(X^6 = 4)$

$= 3\lambda + 4\lambda = 3\lambda$

$\therefore\ \alpha : \beta = 3 : 7$

127. (b) Given that $P_1 : x - 2y - 2z + 1 = 0$

$P_2 : 2x - 3y - 6z + 1 = 0$

Equation of plane bisectors

$$\left|\frac{x - 2y - 2z + 1}{\sqrt{1 + 4 + 4}}\right| = \left|\frac{2x - 3y - 6z + 1}{\sqrt{2^2 + 3^2 + 6^2}}\right|$$

$$\frac{x - 2y - 2z + 1}{3} = \pm\frac{2x - 3y - 6z + 1}{7}$$

Since $a_1a_2 + b_1b_2 + c_1c_2 = 20 > 0$

$\therefore$ Negative sign will be taken for acute bisector.

$\Rightarrow 7x - 14y - 14z + 7 = -[6x - 9y - 18z + 3]$

$\Rightarrow 13x - 23y - 32z + 10 = 0$

$\left(-2, 0, -\frac{1}{2}\right)$ satisfy it

128. (c) We note that

$$\frac{d}{dx}(x \tan x + 1) = x \sec^2 x + \tan x$$

$\therefore$ integrating by parts with x^2 as first function, we get

$$I = \int x^2 \frac{x \sec^2 x + \tan x}{(x \tan x + 1)^2} dx$$

$$= x^2\left(-\frac{1}{x \tan x + 1}\right) - \int 2x\left(-\frac{1}{x \tan x + 1}\right) dx$$

$$= -\frac{x^2}{x \tan x + 1} + 2\int \frac{x \cos x}{x \sin x + \cos x} dx$$

$$= -\frac{x^2}{x \tan x + 1} + 2 \log_e |x \sin x + \cos x| + c$$

$$\left(\because \frac{d}{dx}(x \sin x + \cos x) = x \cos x\right)$$

129. **(c)** Given equation of curve
$x = 12(t + \sin t \cos t), y = 12(1 + \sin t)^2$
Differentiate w.r.t 't',

$$\frac{dx}{dt} = 12(1 + \cos^2 t - \sin^2 t)$$

$$\frac{dx}{dt} = 12(1 + \cos 2t) \text{ and } \frac{dy}{dt}$$
$$= 24(1 + \sin t)\cos t$$

$$\frac{dy}{dx} = \frac{2(1 + \sin t) \times \cos t}{1 + \cos 2t}$$

$$\Rightarrow \frac{2(1 + \sin t)\cos t}{2\cos^2 t} = \sqrt{3}$$

$$\Rightarrow t = \frac{\pi}{6}, y_0 = 27$$

130. **(b)** Negation of given statement is
$\sim ((A \wedge C) \rightarrow B)$
$\sim (\sim (A \wedge C) \vee B)$. Using De-Morgan's law,
So, $(A \wedge C) \wedge (\sim B)$