BITSAT : SOLVED PAPER 2012

(memory based)

INSTRUCTIONS

- *This question paper contains total 150 questions divided into four parts:*

  Part I : Physics Q. No. 1 to 40

  Part II : Chemistry Q. No. 41 to 80

  Part III : Mathematics Q. No. 81 to 125

  Part IV : (A) English Proficiency Q. No. 126 to 140

  (B) Logical Reasoning Q. No. 141 to 150

- *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*

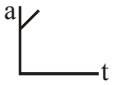
PART - I : PHYSICS

1. What is the moment of inertia of a solid sphere of density ρ and radius R about its diameter?

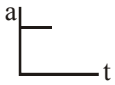
(a) $\frac{105}{176}R^5\rho$ (b) $\frac{105}{176}R^2\rho$

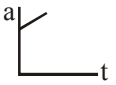
(c) $\frac{176}{105}R^5\rho$ (d) $\frac{176}{105}R^2\rho$

2. A body moves with uniform acceleration, then which of the following graph is correct ?

(a) 

(b) 

(c) 

(d) 

3. A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flight in two cases, then what is the product of two times of flight?

(a) $t_1t_2 \propto R$ (b) $t_1t_2 \propto R^2$

(c) $t_1t_2 \propto 1/R$ (d) $t_1t_2 \propto 1/R^2$

4. A horizontal overhead powerline is at height of 4m from the ground and carries a current of 100A from east to west. The magnetic field directly below it on the ground is ($\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1})

(a) 2.5×10^{-7} T southward

(b) 5×10^{-6} T northward

(c) 5×10^{-6} T southward

(d) 2.5×10^{-7} T northward

5. A man of mass 100 kg. is standing on a platform of mass 200 kg. which is kept on a smooth ice surface. If the man starts moving on the platform with a speed 30 m/sec relative to the platform then calculate with what velocity relative to the ice the platform will recoil?

(a) 5 m/sec (b) 10 m/sec

(c) 15 m/sec (d) 20 m/sec

6. If the unit of force and length be each increased by four times, then the unit of energy is increased by

(a) 16 times (b) 8 times

(c) 2 times (d) 4 times

7. Which of the following must be known in order to determine the power output of an automobile?

(a) Final velocity and height

(b) Mass and amount of work performed

(c) Force exerted and distance of motion

(d) Work performed and elapsed time of work

8. If the force is given by $F = at + bt^2$ with t as time. The dimensions of a and b are

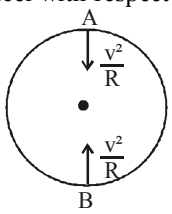
(a) $[MLT^{-4}]$ and $[MLT^{-2}]$

(b) $[MLT^{-3}]$ and $[MLT^{-4}]$

(c) $[ML^2T^{-3}]$ and $[ML^2T^{-2}]$

(d) $[ML^2T^{-3}]$ and $[ML^3T^{-4}]$

9. A wheel of radius R rolls on the ground with a uniform velocity v. The relative acceleration of topmost point of the wheel with respect to the bottom most point is



(a) $\frac{v^2}{R}$ (b) $\frac{2v^2}{R}$

(c) $\frac{v^2}{2R}$ (d) $\frac{4v^2}{R}$

10. If the radius of the earth were to shrink by one per cent, its mass remaining the same, the value of g on the earth's surface would

(a) increase by 0.5% (b) increase by 2%

(c) decrease by 0.5% (d) decrease by 2%

11. The Young's modulus of a perfectly rigid body is

(a) unity (b) zero (c) infinity

(d) some finite non-zero constant

12. An ice block floats in a liquid whose density is less than water. A part of block is outside the liquid. When whole of ice has melted, the liquid level will

(a) rise

(b) go down

(c) remain same

(d) first rise then go down

13. A large drop of oil (density 0.8 g/cm^3 and viscosity η_0) floats up through a column of another liquid (density 1.2 g/cm^3 and viscosity η_L). Assuming that the two liquids do not mix, the velocity with which the oil drop rises will depend on :

(a) η_0 only (b) η_L only

(c) both on η_0 and η_L (d) neither η_0 nor η_L

14. A solid body of constant heat capacity 1 J/°C is being heated by keeping it in contact with reservoirs in two ways :

(i) Sequentially keeping in contact with 2 reservoirs such that each reservoir supplies same amount of heat.

(ii) Sequentially keeping in contact with 8 reservoirs such that each reservoir supplies same amount of heat.

In both the cases body is brought from initial temperature 100°C to final temperature 200°C. Entropy change of the body in the two cases respectively is :

(a) *ln*2, 2*ln*2 (b) 2*ln*2, 8*ln*2

(c) *ln*2, 4*ln*2 (d) *ln*2, *ln*2

15. Which of the following process is possible according to the first law of thermodynamics?

(a) $W > 0, Q < 0$ and $dU = 0$

(b) $W > 0, Q < 0$ and $dU > 0$

(c) $W > 0, Q < 0$ and $dU < 0$

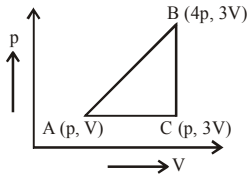
(d) $W < 0, Q > 0$ and $dU < 0$

16. For an isothermal expansion of a perfect gas, the value of $\frac{\Delta P}{P}$ is equal to

(a) $-\gamma^{1/2}\frac{\Delta V}{V}$ (b) $-\frac{\Delta V}{V}$

(c) $-\gamma\frac{\Delta V}{V}$ (d) $-\gamma^2\frac{\Delta V}{V}$

17. A sample of ideal monoatomic gas is taken round the cycle ABCA as shown in the figure. The work done during the cycle is



(a) 3pV (b) zero (c) 9pV (d) 6pV

18. The average translational kinetic energy of O_2 (molar mass 32) molecules at a particular temperature is 0.048 eV. The translational kinetic energy of N_2 (molar mass 28) molecules in eV at the same temperature is

(a) 0.0015 (b) 0.003 (c) 0.048 (d) 0.768

19. For a gas if ratio of specific heats at constant pressure and volume is γ then value of degrees of freedom is

(a) $\frac{3\gamma-1}{2\gamma-1}$ (b) $\frac{2}{\gamma-1}$

(c) $\frac{9}{2}(\gamma-1)$ (d) $\frac{25}{2}(\gamma-1)$

20. One end of a long metallic wire of length L tied to the ceiling. The other end is tied with a massless spring of spring constant K. A mass hangs freely from the free end of the spring. The area of cross section and the young's modulus of the wire are A and Y respectively. If the mass slightly pulled down and released, it will oscillate with a time period T equal to :

(a) $2\pi\sqrt{(m/K)}$

(b) $2\pi\sqrt{m(YA+KL)/(YAK)}$

(c) $2\pi\sqrt{(mYA/KL)}$

(d) $2\pi\sqrt{(mL/YA)}$

21. The transverse displacement $y(x, t)$ of a wave on a string is given by $y(x,t) = e^{-(ax^2+bt^2+2\sqrt{ab}\,xt)}$ This represents a

(a) wave moving in $-x$ direction, speed $\sqrt{\frac{b}{a}}$

(b) standing wave of frequency $\sqrt{b}$

(c) standing wave of frequency $\frac{1}{\sqrt{b}}$

(d) wave moving in $+x$ direction, speed $\sqrt{\frac{a}{b}}$

22. A sound souorce is moving towards stationary listener with $\frac{1}{10}$th of the speed of sound. The ratio of apparent to read frequency is

(a) $\left(\frac{9}{10}\right)^2$ (b) $\left(\frac{10}{9}\right)$ (c) $\left(\frac{11}{10}\right)$ (d) $\left(\frac{11}{10}\right)^2$

23. In a region of space having a uniform electric field E, a hemispherical bowl of radius r is placed. The electric flux ϕ through the bowl is

(a) $2\pi RE$ (b) $4\pi R^2E$ (c) $2\pi R^2E$ (d) πR^2E

24. The electric field intensity just sufficient to balance the earth's gravitational attraction on an electron will be: (given mass and charge of an electron respectively are 9.1×10^{-31} kg and 1.6×10^{-19} C.)

(a) -5.6×10^{-11} N/C (b) -4.8×10^{-15} N / C

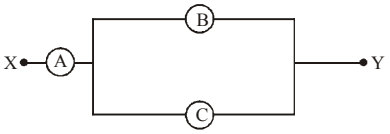
(c) -1.6×10^{-19} N/C (d) -3.2×10^{-19} N / C

25. Two capacitors C_1 and C_2 are charged to 120 V and 200 V respectively. It is found that by connecting them together the potential on each one can be made zero. Then

(a) $5C_1 = 3C_2$ (b) $3C_1 = 5C_2$

(c) $3C_1 + 5C_2 = 0$ (d) $9C_1 = 4C_2$

26. Three voltmeters A, B and C having resistances R, 1.5 R and 3R, respectively, are connected as shown. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C respectively. Then –



(a) $V_A \neq V_B = V_C$ (b) $V_A = V_B \neq V_C$

(c) $V_A \neq V_B \neq V_C$ (d) $V_A = V_B = V_C$

27. The range of the particle when launched at an angle of 15º with the horizontal is 1.5 km. What is the range of the projectile when launched at an angle of 45º to the horizontal.

(a) 1.5km (b) 3.0km (c) 6.0km (d) 0.75km

28. If m is magnetic moment and B is the magnetic field, then the torque is given by

(a) $\vec{m}.\vec{B}$ (b) $\frac{|\vec{m}|}{|\vec{B}|}$

(c) $\vec{m} \times \vec{B}$ (d) $|\vec{m}|.|\vec{B}|$

29. Magnetic moment of bar magnet is M. The work done to turn the magnet by 90° of magnet in direction of magnetic field B will be

(a) zero (b) $\frac{1}{2}$MB

(c) 2 MB (d) MB

30. The laws of electromagnetic induction have been used in the construction of a

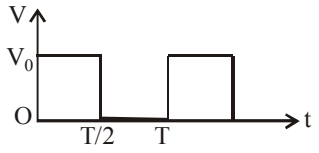
(a) galvanometer (b) voltmeter

(c) electric motor (d) generator

31. The impedance of a circuit consists of 3 Ω resistance and 4 Ω reactance. The power factor of the circuit is

(a) 0.4 (b) 0.6 (c) 0.8 (d) 1.0

32. The r.m.s. value of potential difference V shown in the figure is



(a) V_0 (b) $V_0/\sqrt{2}$

(c) $V_0/2$ (d) $V_0/\sqrt{3}$

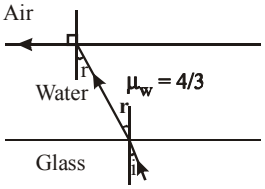
33. A ray of light is incident at the glass-water interface at an angle i, it emerges finally parallel to the surface of water, then the value of μ_g would be

(a) (4/3)sin$i$

(b) 1/sin$i$

(c) 4/3

(d) 1



34. A mica slit of thickness t and refractive index μ is introduced in the ray from the first source S_1. By how much distance of fringes pattern will be displaced ?

(a) $\frac{d}{D}(\mu-1)t$ (b) $\frac{D}{d}(\mu-1)t$

(c) $\frac{d}{(\mu-1)D}$ (d) $\frac{D}{d}(\mu-1)$

35. In a Young's double slit experiment the angular width of a fringe formed on a distant screen is 1°. The wavelength fo the light used is 6280 Å. What is the distance between the two coherent sources?

(a) 0.036 mm (b) 0.12 mm
(c) 6mm (d) 4mm

36. A light having wavelength 300 nm fall on a metal surface. The work function of metal is 2.54 eV, what is stopping potential ?

(a) 2.3 V (b) 2.59 V (c) 1.59 V (d) 1.29 V

37. If the total binding energies of $^{2}_{1}H$, $^{4}_{2}He$, $^{56}_{26}Fe$ & $^{235}_{92}U$ nuclei are 2.22, 28.3, 492 and 1786 MeV respectively, identify the most stable nucleus of the following.

(a) $^{56}_{26}Fe$ (b) $^{2}_{1}H$ (c) $^{235}_{92}U$ (d) $^{4}_{2}He$

38. An oscillator is nothing but an amplifer with

(a) positive feedback
(b) negative feedback
(c) large gain
(d) no feedback

39. In an experiment on photoelectric effect photons of wavelength 300 nm eject electrons from a metal of work function 2.25eV. A photon of energy equal to that of the most energetic electron corresponds to the following transition in the hydrogen atom:

(a) $n = 2$ to $n = 1$ state
(b) $n = 3$ to $n = 1$ state
(c) $n = 3$ to $n = 2$ state
(d) $n = 4$ to $n = 3$ state

40. A letter 'A' is constructed of a uniform wire with resistance 1.0 Ω per cm, The sides of the letter are 20 cm and the cross piece in the middle is 10 cm long. The apex angle is 60. The resistance between the ends of the legs is close to:

(a) 50.0 Ω (b) 10 Ω (c) 36.7 Ω (d) 26.7 Ω

PART - II : CHEMISTRY

41. Number of atoms of He in 100 amu of He (atomic wt. of He is 4) are :

(a) 25 (b) 100
(c) 50 (d) $100 \times 6 \times 10^{-23}$

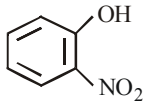
42. If the radius of H is 0.53 Å, then what will be the radius of $_3Li^{2+}$?

(a) 0.17 Å (b) 0.36 Å
(c) 0.53 Å (d) 0.59 Å

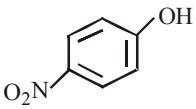
43. Which of the following does not have valence electron in 3*d*-subshell?

(a) Fe (III) (b) Mn (II)
(c) Cr (I) (d) P (0)

44. The vapour pressure of



is higher than



due to

(a) Dipole moment
(b) Dipole- dipole interaction
(c) H – bonding
(d) Lattice structure

45. An ideal gas can't be liquefied because

(a) its critical temperature is always above 0°C
(b) its molecules are relatively smaller in size
(c) it solidifies before becoming a liquid
(d) forces operated between its molecules are negligible

46. In which of the following reactions, standard entropy change (ΔS°) is positive and standard Gibb's energy change (ΔG°) decreases sharply with increasing temperature ?

(a) $C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow CO(g)$

(b) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

(c) $Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s)$

(d) $\frac{1}{2}C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow \frac{1}{2}CO_2(g)$

47. Bond enthalpies of H_2, X_2 and HX are in the ratio 2 : 1 : 2. If enthalpy of formation of HX is –50 kJ mol^{-1}, the bond enthalpy of X_2 is

(a) 100 kJ mol^{-1} (b) 300 kJ mol^{-1}
(c) 200 kJ mol^{-1} (d) 400 kJ mol^{-1}

48. The pOH value of a solution whose hydroxide ion concentration is 6.2×10^{-9} mol/litre is
(a) 8.21 (b) 6.21 (c) 7.75 (d) 7.21

49. Which of the following combinations would not result in the formation of a buffer solution?
(a) $NH_3 + HCl$ (b) $NH_4Cl + NH_3$
(c) $CH_3COOH + NaCl$ (d) $NaOH + CH_3COOH$

50. The reaction, $SO_2 + Cl_2 \longrightarrow SO_2Cl_2$ is exothermic and reversible. A mixture of SO_2 (g), Cl_2 (g) and SO_2Cl_2 (l) is at equilibrium in a closed container. Now a certain quantity of extra SO_2 is introduced into the container, the volume remaining the same. Which of the following is/ are true?
(a) The pressure inside the container will not change.
(b) The temperature will not change.
(c) The temperature will increase.
(d) The temperature will decrease.

51. In the reaction

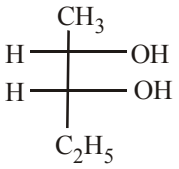
$$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$$

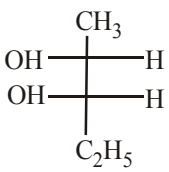
(a) Bromine is oxidised and carbonate is reduced.
(b) Bromine is reduced and water is oxidised.
(c) Bromine is neither reduced nor oxidised.
(d) Bromine is both reduced and oxidised.

52. The boiling point of water is exceptionally high because
(a) there is a covalent bond between H and O.
(b) water molecule is linear.
(c) water molecules associate due to hydrogen bonding.
(d) water molecule is not linear.

53. Which of the following has correct increasing basic strength?
(a) MgO < BeO < CaO < BaO
(b) BeO < MgO < CaO < BaO
(c) BaO < CaO < MgO < BeO
(d) CaO < BaO < BeO < MgO

54. The following two compounds are

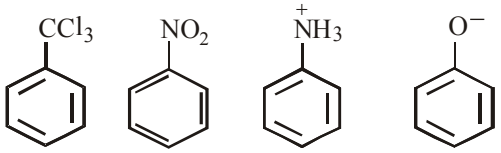




are
(a) enantiomers (b) diastereomers
(c) identical (d) epimers

55. In paper chromatography :
(a) Mobile phase is liquid and stationary phase is solid.
(b) Mobile phase is solid and stationary phase is liquid.
(c) Both phases are liquids.
(d) Both phases are solids.

56. In which case the NO_2 will attack at the meta position



(I) (II) (III) (IV)
(a) I, II, III (b) II, IV
(c) II and III only (d) II only

57. Which alkene on ozonolysis gives CH_3CH_2CHO and $CH_3\overset{\overset{O}{\|}}{C}CH_3$

(a) $CH_3CH_2CH = C(CH_3)(CH_3)$
(b) $CH_3CH_2CH = CHCH_2CH_3$
(c) $CH_3CH_2CH = CHCH_3$
(d) $CH_3 - \underset{\underset{CH_3}{|}}{C} = CHCH_3$

58. Formation of ozone in the upper atmosphere from oxygen takes place by the action of
(a) Nitrogen oxides (b) Ultraviolet rays
(c) Cosmic rays (d) Free radicals

59. CO_2 goes to air, causes green house effect and gets dissolved in water. What will be the effect on soil fertility and pH of the water?
(a) Increases (b) Decreases
(c) Remain same (d) None of these

60. The van't Hoff factor i for an electrolyte which undergoes dissociation and association in solvents are respectively
(a) greater than 1 and greater than 1
(b) less than 1 and greater than 1
(c) less than 1 and less than 1
(d) greater than 1 and less than 1

61. If the elevation in boiling point of a solution of 10 g of solute (mol. wt. = 100) in 100 g of water is ΔTb, the ebullioscopic constant of water is

(a) $\frac{\Delta T_b}{10}$ (b) ΔT_b (c) $10\Delta T_b$ (d) $100\Delta T_b$

62. The ionic conductance of Ba^{2+} and Cl^- respectively are 127 and $76\Omega^{-1}cm^2$ at infinite dilution. The equivalent conductance of $BaCl_2$ at infinite dilution will be

(a) $330\Omega^{-1}cm^2$ (b) $203\Omega^{-1}cm^2$
(c) $139\Omega^{-1}cm^2$ (d) $51\Omega^{-1}cm^2$

63. $2N_2O_5 \rightleftharpoons 4NO_2 + O_2$
If rate and rate constant for above reaction are 2.40×10^{-5} mol L^{-1} s^{-1} and 3×10^{-5} s^{-1} respectively, then calculate the concentration of N_2O_5.
(a) 1.4 (b) 1.2 (c) 0.04 (d) 0.8

64. Which of the following gas molecules have maximum value of enthalpy of physisorption?
(a) C_2H_6 (b) Ne (c) H_2O (d) H_2

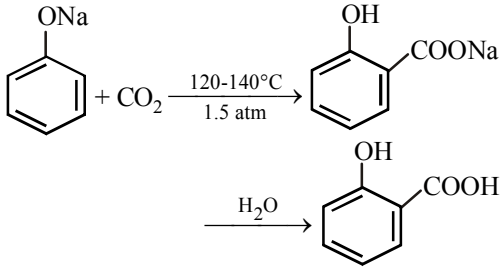
65. Which of the following will be the most effective in the coagulation of $Fe(OH)_3$ soil?
(a) $Mg_3(PO_4)_2$ (b) $BaCl_2$
(c) NaCl (d) KCN

66. When chlorine water is exposed to sunlight, O_2 is liberated. Hence,
(a) hydrogen has little affinity to O_2
(b) hydrogen has more affinity to O_2
(c) hydrogen has more affinity to chlorine
(d) it is a reducing agent

67. An extremely hot copper wire reacts with steam to give
(a) CuO (b) Cu_2O
(c) Cu_2O_2 (d) CuO_2

68. Among the following the lowest degree of paramagnetism per mole of the compound at 298 K will be shown by
(a) $MnSO_4.4H_2O$ (b) $CuSO_4.5H_2O$
(c) $FeSO_4.6H_2O$ (d) $NiSO_4.6H_2O$

69. The following reaction is known as



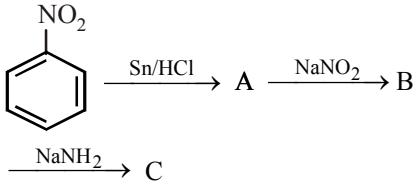
(a) Friedel-Craft's reaction
(b) Kolbe reaction
(c) Reimer-Tiemann reaction
(d) Witting reaction

70. Which of the following is process used for the preparation of acetone?
(a) Haber process
(b) Wacker process
(c) Wolff-Kishner reduction
(d) Gattermann-Koch synthesis

71. The preparation of ethyl acetoacetate involves:
(a) Wittig reaction
(b) Cannizzaro's reaction
(c) Reformatsky reaction
(d) Claisen condensation.

72. Which one of the following pairs is not correctly matched?
(a) $>C=O \rightarrow >CH_2$ (Clemmensen reduction)
(b) $>C=O \rightarrow >CHOH$ (Wolf – Kishner reduction)
(c) $-COCl \rightarrow -CHO$ (Rosenmund reduction)
(d) $-C\equiv N \rightarrow -CHO$ (Stephen reduction)

73. Identify 'C' in the following reaction:



(a) Benzamide (b) Benzoic acid
(c) Chlorobenzene (d) Aniline

74. The helical structure of protein is stabilised by
(a) peptide bonds
(b) dipeptide bonds
(c) hydrogen bonds
(d) vander waals forces

75. Complete hydrolysis of cellulose gives
(a) D-ribose (b) D-glucose
(c) L-glucose (d) D-fructose

76. Alizarin is an example of
(a) Triayl dye
(b) Azo dye
(c) Vat dye
(d) Anthraquinone dye

77. 2,4-Dichlorophenoxyacetic add is used as
(a) Fungicide (b) Insecticide
(c) Herbicide (d) Moth repellant

78. 0.45 g of acid molecular weight 90 is neutralised by 20 ml of 0.5N caustic potash. The basicity of acid is
(a) 1 (b) 2 (c) 3 (d) 4

79. In the reaction of $KMnO_4$ with an oxalate in acidic medium, MnO_4^- is reduced to Mn^{2+} and $C_2O_4^{2-}$ is oxidised to CO_2. Hence, 50 mL of 0.02 M $KMnO_4$ is equivalent to
(a) 100 mL of 0.05 M $H_2C_2O_4$
(b) 50 mL of 0.05 M $H_2C_2O_4$
(c) 25 mL of 0.2 M $H_2C_2O_4$
(d) 50 mL of 0.10 M $H_2C_2O_4$

80. Which of the following is soluble in yellow ammonium sulphide?
(a) CuS (b) CdS (c) SnS (d) PbS

PART - III : MATHEMATICS

81. Let A and B be two sets then $(A \cup B)' \cup (A' \cap B)$ is equal to
(a) A' (b) A
(c) B' (d) None of these

82. Let x and y be two natural numbers such that $xy = 12(x + y)$ and $x \le y$. Then the total number of pairs (x, y) is
(a) 8 (b) 6 (c) 4 (d) 16

83. If $\sin^2\theta + \sin^2\phi = 1/2$, $\cos^2\theta + \cos^2\phi = 3/2$, then $\cos^2(\theta - \phi)$ is equal to
(a) 3/8 (b) 5/8 (c) 3/4 (d) 5/4

84. Let T(k) be the statement $1 + 3 + 5 + \ldots + (2k-1) = k^2 + 10$
Which of the following is correct?
(a) T(1) is true
(b) T(k) is true $\Rightarrow$ T($k+1$) is true
(c) T(n) is true for all $n \in \mathbf{N}$
(d) All above are correct

85. The amplitude of $\sin\frac{\pi}{5} + i\left(1 - \cos\frac{\pi}{5}\right)$
(a) $\pi/5$ (b) $2\pi/5$ (c) $\pi/10$ (d) $\pi/15$

86. If $x = \omega - \omega^2 - 2$, then the value of $x^4 + 3x^3 + 2x^2 - 11x - 6$ is
(a) 1 (b) –1
(c) 2 (d) None of these

87. In how many ways can 5 prizes be distributed among 4 boys when every boy can take one or more prizes ?
(a) 1024 (b) 625 (c) 120 (d) 600

88. The number of positive integral solution of $abc = 30$ is
(a) 30 (b) 27
(c) 8 (d) None of these

89. The coefficient of x^{20} in the expansion of $(1 + x^2)^{40}.\left(x^2 + 2 + \frac{1}{x^2}\right)^{-5}$ is
(a) $^{30}C_{10}$ (b) $^{30}C_{25}$
(c) 1 (d) None of these

90. If x is positive then the sum to infinity of the series
$$\frac{1}{1+3x} - \frac{1-3x}{(1+3x)^2} + \frac{(1-3x)^2}{(1+3x)^3} - \frac{(1-3x)^3}{(1+3x)^4}$$
..... ∞ is
(a) 1/2 (b) $\frac{1}{6x}$
(c) $\frac{1}{6x(1+3x)}$ (d) $\frac{1}{2(1+3x)}$

91. The nearest point on the line $3x + 4y = 12$ from the origin is
(a) $\left(\frac{36}{25}, \frac{48}{25}\right)$ (b) $\left(3, \frac{3}{4}\right)$
(c) $\left(2, \frac{3}{2}\right)$ (d) None of these

92. The length of the tangent drawn from any point on the circle $x^2 + y^2 + 2fy + \lambda = 0$ to the circle $x^2 + y^2 + 2fy + \mu = 0$, where $\mu > \lambda > 0$, is
(a) $\sqrt{\mu - \lambda}$ (b) $\sqrt{\mu + \lambda}$
(c) $\sqrt{\mu^2 - \lambda^2}$ (d) $\mu + \lambda$

93. Find the eccentricity of the conic represented by $x^2 - y^2 - 4x + 4y + 16 = 0$
(a) 2 (b) $\sqrt{2}$ (c) $2\sqrt{2}$ (d) $3\sqrt{2}$

94. $\lim\limits_{x \to \pi/2} \dfrac{\left(1 - \tan\left(\frac{x}{2}\right)\right)(1 - \sin x)}{\left(1 + \tan\left(\frac{x}{2}\right)\right)(\pi - 2x)^3} = ?$
(a) 1/8 (b) 0 (c) 1/32 (d) ∞

95. Let $f(x+y) = f(x) \cdot f(y)$ for all x, y where $f(0) \neq 0$. If $f(5) = 2$ and $f'(0) = 3$, then $f'(5)$ is equal to –

(a) 6 (b) 0

(c) 1 (d) None of these

96. If sample A contains 100 observations 101, 102, ... 200 and sample B contains 100 obsections 151, 152, ... 250, then ratio of variance v_A/v_B =

(a) 1 (b) $\frac{9}{4}$ (c) $\frac{4}{9}$ (d) $\frac{2}{3}$

97. The probability of simultaneous occurrence of atleast one of two events *A* and *B* is *p*. If the probability that exactly one of *A, B* occurs is *q*, then $P(A') + P(B')$ is equal to

(a) $2 - 2p + q$ (b) $2 + 2p - q$

(c) $3 - 3p + q$ (d) $2 - p + q$

98. If f is an even function and g is an odd function, then the function fog is

(a) an even function

(b) an odd function

(c) neither even nor odd

(d) a periodic function

99. $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{2}{9}\right)$ equal to –

(a) $\frac{1}{2}\cos^{-1}\left(\frac{3}{5}\right)$ (b) $\frac{1}{2}\sin^{-1}\left(\frac{3}{5}\right)$

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

100. If $k \leq \sin^{-1} x + \cos^{-1} x + \tan^{-1} x \leq K$, then –

(a) $k = 0, K = \pi$. (b) $k = 0, K = \pi/2$

(c) $k = \pi/2, K = \pi$ (d) None of these

101. The equations $2x + 3y + 4 = 0$; $3x + 4y + 6 = 0$ and $4x + 5y + 8 = 0$ are

(a) consistent with unique solution

(b) inconsistent

(c) consistent with infinitely many solutions

(d) None of the above

102. The value of the determinant

$$\begin{vmatrix} 265 & 240 & 219 \\ 240 & 225 & 198 \\ 219 & 198 & 181 \end{vmatrix}$$ is

(a) 1000 (b) 779 (c) 679 (d) 0

103. If $x = a \sin\theta$ and $y = b \cos\theta$, then $\frac{d^2y}{dx^2}$ is

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

(c) $\frac{-b}{a^2}\sec^3\theta$ (d) $\frac{b}{a^2}\sec^3\theta$

104. If $f(x) = x^\alpha \log x$ and $f(0) = 0$, then the value of α for which Rolle's theorem can be applied in [0, 1] is

(a) –2 (b) –1 (c) 0 (d) 1/2

105. If the function $f(x) = \begin{cases} 1 & , \quad x \leq 2 \\ ax + b & , \quad 2 < x < 4 \\ 7 & , \quad x \geq 4 \end{cases}$

is continuous at x = 2 and 4, then the values of a and b are

(a) 3, 5 (b) 3, – 5 (c) 0, 3 (d) 0, 5

106. If $f(x) = \frac{a^2 - 1}{a^2 + 1}x^3 - 3x + 5$ is a decreasing function of x in **R**, then the set of possible values of a (independent of x) is

(a) $(1, \infty)$ (b) $(-\infty, -1)$

(c) $[-1, 1]$ (d) None of these

107. The diagonal of a square is changing at the rate of 0.5 cm/sec. Then the rate of change of area, when the area is 400 cm^2, is equal to

(a) $20\sqrt{2}$ cm^2/sec (b) $10\sqrt{2}$ cm^2/sec

(c) $\frac{1}{10\sqrt{2}}cm^2/sec$ (d) $\frac{10}{\sqrt{2}}cm^2/sec$

108. If the normal to the curve $y = f(x)$ at the point (3, 4) makes an angle $3\pi/4$ with the positive x-axis, then $f'(3)$ =

(a) –1 (b) – 3/4 (c) 4/3 (d) 1

109. Evaluate: $\int \sqrt{\frac{x}{4 - x^3}}\,dx$

(a) $\frac{2}{3}\sin^{-1}\left(\frac{x^{3/2}}{2}\right) + c$ (b) $\frac{2}{3}\sin^{-1}\left(x^{3/2}\right) + c$

(c) $2\sin^{-1}\left(\frac{x^{3/2}}{2}\right) + c$ (d) $\frac{1}{3}\sin^{-1}\left(\frac{x^{3/2}}{2}\right) + c$

110. $\int_0^{\pi/2} \frac{2^{\sin x}}{2^{\sin x} + 2^{\cos x}}\,dx$ equals

(a) 2 (b) π (c) $\pi/4$ (d) $\pi/2$

111. The area bounded by the curve $y = \sin x$, x-axis and the ordinates $x = 0$ and $x = \pi/2$ is

(a) π (b) $\pi/2$ (c) 1 (d) 2

112. The differential equation whose solution is $Ax^2 + By^2 = 1$ where A and B are arbitrary constants is of
(a) second order and second degree
(b) first order and second degree
(c) first order and first degree
(d) second order and first degree

113. The unit vector perpendicular to the vectors $6\hat{i}+2\hat{j}+3\hat{k}$ and $3\hat{i}-6\hat{j}-2\hat{k}$ is –

(a) $\frac{2\hat{i}-3\hat{j}+6\hat{k}}{7}$ (b) $\frac{2\hat{i}-3\hat{j}-6\hat{k}}{7}$

(c) $\frac{2\hat{i}+3\hat{j}-6\hat{k}}{7}$ (d) $\frac{2\hat{i}+3\hat{j}+6\hat{k}}{7}$

114. If $a.b = a.c$ and $a \times b = a \times c$, then correct statement is

(a) $a \parallel (b-c)$ (b) $a \perp (b-c)$

(c) $a = 0$ or $b = c$ (d) None of these

115. What is the value of *n* so that the angle between the lines having direction ratios (1, 1, 1) and (1, –1, *n*) is 60°?

(a) $\sqrt{3}$ (b) $\sqrt{6}$

(c) 3 (d) None of these

116. The foot of the perpendicular from the point (7, 14, 5) to the plane $2x + 4y - z = 2$ are

(a) (1, 2, 8) (b) (3, 2, 8)

(c) (5, 10, 6) (d) (9, 18, 4)

117. Find the coordinates of the point where the line joining the points (2, –3, 1) and (3, – 4, – 5) cuts the plane $2x + y + z = 7$.

(a) (1, 2, – 7) (b) (1, – 2, 7)

(c) (–1, – 2, 7) (d) (1, 2, 7)

118. A boy is throwing stones at a target. The probability of hitting the target at any trial is $\frac{1}{2}$. The probability of hitting the target 5th time at the 10th throw is :

(a) $\frac{5}{2^{10}}$ (b) $\frac{63}{2^9}$ (c) $\frac{{}^{10}C_5}{2^{10}}$ (d) None

119. Two dice are thrown together 4 times. The probability that both dice will show same numbers twice is -

(a) $\frac{1}{3}$ (b) $\frac{25}{36}$

(c) $\frac{25}{216}$ (d) None of these

120. In a triangle ABC, if $a = 2$, $B = 60°$ and $C = 75°$, then b equals

(a) $\sqrt{3}$ (b) $\sqrt{6}$ (c) $\sqrt{9}$ (d) $1+\sqrt{2}$

121. Prabhat wants to invest the total amount of ₹ 15,000 in saving certificates and national saving bonds. According to rules, he has to invest at least ₹ 2000 in saving certificates and ₹ 2500 in national saving bonds. The interest rate is 8% on saving certificate and 10% on national saving bonds per annum. He invest ₹ x in saving certificate and ₹ y in national saving bonds. Then the objective function for this problem is

(a) $0.08x + 0.10y$ (b) $\frac{x}{2000} + \frac{y}{2500}$

(c) $2000x + 2500y$ (d) $\frac{x}{8} + \frac{y}{10}$

122. For the function

$f(x) = \frac{x^{100}}{100} + \frac{x^{99}}{99} + ... \frac{x^2}{2} + x + 1,$

$f'(1) = mf'(0)$, where m is equal to

(a) 50 (b) 0 (c) 100 (d) 200

123. Let $A = \begin{bmatrix} 0 & \alpha \\ 0 & 0 \end{bmatrix}$ and $(A + I)^{50} - 50A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, find abc + abd + bcd + acd

(a) 0 (b) –1

(c) 1 (d) None of these

124. If the line $x \cos \alpha + y \sin \alpha = p$ represents the common chord of the circles $x^2 + y^2 = a^2$ and $x^2 + y^2 + b^2$ (a > b), where A and B lie ont he first circle and P and Q lie on the second circle, then AP is equal to

(a) $\sqrt{a^2+p^2} + \sqrt{b^2+p^2}$

(b) $\sqrt{a^2-p^2} + \sqrt{b^2-p^2}$

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

(d) $\sqrt{a^2+p^2} - \sqrt{b^2+p^2}$

125. Let a_1, a_2, a_3..... be terms on A.P. If

$\frac{a_1 + a_2 + ...a_p}{a_1 + a_2 + ...+ a_q} = \frac{p^2}{q^2}$, $p \neq q$, then $\frac{a_6}{a_{21}}$ equals

(a) $\frac{41}{11}$ (b) $\frac{7}{2}$ (c) $\frac{2}{7}$ (d) $\frac{11}{41}$

PART - IV : ENGLISH

DIRECTIONS (Qs. 126-128): In the following questions choose the word opposite in meaning to the given word.

126. Florid

(a) Weak (b) Pale

(c) Monotonous (d) Ugly

127. Verity
(a) Sanctity (b) Reverence
(c) Falsehood (d) Rarity

128. Perspicuity
(a) Vagueness (b) Dullness
(c) Unfairness (d) Unwillingness

DIRECTIONS (Qs. 129 - 131): In question out of the four alternative, choose the one which best expresses the meaning of the given word.

129. Disgrace
(a) Disrespect (b) Jealousy
(c) Disregard (d) Shame

130. Striking
(a) Attractive (b) Violent
(c) Funny (d) Hateful

131. Fiasco
(a) Festival (b) Failure
(c) Fortune (d) Feast

DIRECTIONS (Qs. 132 & 133): In the following questions a part of the sentence is bold. Below are given alternatives to the bold part at (a), (b) and (c) which may improve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is (d).

132. Power got with money is the most **craved for** today.
(a) sought after (b) wished for
(c) welcomed for (d) No improvement

133. You are asked to copy this letter **word by word.**
(a) word for word (b) word with word
(c) word to word (d) No improvement

DIRECTIONS (Qs. 134 & 135) : Sentences are given with blanks to be filled in with an appropriate word(s). Four alternatives are suggested for each question. Choose the correct alternative out of the four:

134. Let us quickly _____.
(a) muddle (b) huddle
(c) hurdle (d) puddle

135. Rajesh's car wasn't _____ Ramesh's, so we were too exhausted by the time we reached home.
(a) such comfortable
(b) as comfortable as
(c) comfortable enough
(d) so comfortable that

DIRECTIONS (Qs. 136 & 137) : In the following questions, the 1st and the last sentences of the passage are numbered 1 and 6. The rest of the passage is split into four parts and named P, Q, R and S. These four parts are not given in their proper order. Read the sentence and find out which of the four combinations is correct. Then find the correct answer.

136. 1. The most vulnerable section of the society are the students.
P. Revolutionary and new fledged ideas have a great appeal to them.
Q. Agitations may be non-violent methods of protest.
R. They cannot resist the charm of persuasion.
S. They are to be taught that without discipline they cannot get proper education.
6. However if these become violent, the antisocial elements get encouraged and they put all proper working out of gear.
(a) PRSQ (b) RSQP (c) SRPQ (d) RPQS

137. 1. Venice is a strange city.
P. There are about 400 odd bridges connecting the islands of Venice.
Q. There are no motor cars, no horses and no buses there.
R. These small islands are close to one another.
S. It is not one island but a hundred islands.
6. This is because Venice has no streets.
(a) SRPQ (b) PSRQ (c) RQPS (d) QSRP

DIRECTIONS (Qs. 138 - 140) : In question number 138 to 140, you have two passages with 5 questions in each passage. Read the passages carefully and choose the best answer to each question out of the four alternatives.

The World health Organisation is briefly called W.H.O. It is a specialised agency of the United Nations and was established in 1948.

International health workers can be seen working in all kinds of surroundings in deserts, jungles, mountains, coconut groves, and rice fields. They help the sick to attain health and the healthy to maintain their health.

This global health team assists the local health workers in stopping the spread of what are called communicable diseases, like cholera. These diseases can spread from one country to another and so can be a threat to world health.

W.H.O. assists different national health authorities not only in controlling diseases but also in preventing them altogether. Total prevention of diseases is possible in a number so ways. Everyone knows how people, particularly children, are vaccinated against one disease or another. Similarly, most people are familiar with the spraying of houses with poisonous substances which kill disease-carrying insects.

138. "It is a specialised agency of the United Nations and was established in 1948". Here specialised means :
(a) made suitable for a particular purpose
(b) expert
(c) extraordinary
(d) uncommon

139. "International health workers can be seen working in all kinds of surroundings: in deserts, jungles, mountains, coconout groves, and rice fields". Here International means:
(a) belonging to the whole world
(b) drawn from all countries of the world
(c) believing in cooperation among nations
(d) belonging to an organisation which has something to do with different nations.

140. They help the sick to attain health and the healthy to maintain their health. here they stands for:
(a) deserts
(b) rice fields
(c) international health workers
(d) jungles

141. In a code language, if SUMMER is coded as SDNLVR, then the word WINTER will be coded as:
(a) SDUMJV (b) SDMUJV
(c) SUUMVJ (d) VJMUDS

DIRECTION (Q. 142): In question number, select the missing number from the given responses.

142.

	2	
1	41	5
	3	

	3	
4	159	6
	2	

	9	
4	?	8
	3	

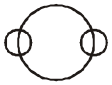
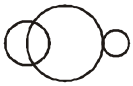
(a) 888 (b) 788 (c) 848 (d) 842

143. Today is Monday. After 61 days, it will be:
(a) Wednesday (b) Saturday
(c) Tuesday (d) Thursday

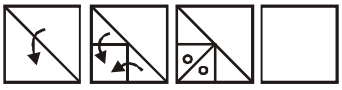
144. Rahul and Nitesh are standing in a row of persons. Rahul is 12th from left side and Nitesh is 18th from the right side of the row. If they interchanged their positions Rahul becomes 25th from left. Find the new position of Nitesh from right side?
(a) 38 (b) 32 (c) 42 (d) 31

145. One of the numbers does not fit into the series. Find the wrong number.
52, 152, 414, 1312, 5348, 26840
(a) 152 (b) 414 (c) 1312 (d) 5348

146. In the following question and Δ stands for any of Mathematical signs at different places, which are given as choices under each question. Select the choice with the correct sequence of signs which when substituted makes the question as correct equation? 24 Δ 4 Δ 5 Δ 4
(a) × + = (b) = × +
(c) + × = (d) = + ×

147. Which represents carrot, food, vegetable?
(a)  (b) 
(c)  (d) 

148. "All the members of the Tennis club are members of the badminton club too". No woman plays badminton?
(a) Some women play Tennis
(b) No member of Tennis club plays badminton
(c) Some women are members of the Tennis club
(d) No woman is a member of Tennis club

149. 
(a)  (b) 
(c)  (d) 

150. Which answer figure is the exact mirror image of the given figure when the mirror held form the right at PQ?

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

SOLUTIONS

PART - I : PHYSICS

1. (c) For solid sphere

$$I = \frac{2}{5} M R^2 = \frac{2}{5}\left(\frac{4}{3}\pi R^3 \rho\right) R^2$$

$$\rho = \frac{176}{105} R^5 \rho$$

2. (c) An object is said to be moving with a uniform acceleration, if its velocity changes by equal amount in equal intervals of time. The velocity-time graph of uniformly accelerated motion is a straight line inclined to time axis. Acceleration of an object in a uniformly accelerated motion in one dimension is equal to the slope of the velocity-time graph with time axis.

3. (a) $t_1 = \frac{2u \sin\theta}{g}$ and

$$t_2 = \frac{2u \sin(90-\theta)}{g} = \frac{2u \cos\theta}{g}$$

$$\therefore \quad t_1 t_2 = \frac{4u^2 \cos\theta \sin\theta}{g^2} = \frac{2}{g}\left[\frac{u^2 \sin 2\theta}{g}\right]$$

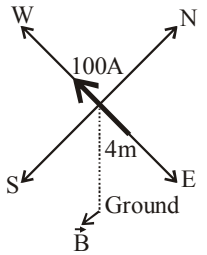
$$= \frac{2}{g} R,$$

where R is the range.

Hence $t_1 t_2 \propto R$

4. (c) The magnetic field is

$$B = \frac{\mu_0}{4\pi}\frac{2I}{r} = 10^{-7} \times \frac{2 \times 100}{4} = 5 \times 10^{-6}\ T$$



According to right hand palm rule, the magnetic field is directed towards south.

5. (b)

6. (a) Since unit of energy = (unit of force).(unit of length) so if we increase unit of length and force, each by four times, then unit of energy will increase by sixteen times.

7. (d) Power is defined as the rate of doing work. For the automobile, the power output is the amount of work done (overcoming friction) divided by the length of time in which the work was done.

8. (b) Dimension of at = Dimension of F

$$[at] = [F] \Rightarrow [a] = \left[\frac{F}{t}\right]$$

$$[b] = \left[\frac{MLT^{-2}}{T}\right] \Rightarrow [a] = [MLT^{-3}]$$

Dimension of bt^2 = Dimension of F

$$[bt^2] = [F] \Rightarrow [b] = \left[\frac{F}{t^2}\right]$$

$$[b] = \left[\frac{MLT^{-4}}{T^2}\right] \Rightarrow [b] = \left[MLT^{-4}\right]$$

9. (b) As $a_{CM} = 0$ $[v_{CM} = \text{constant}]$, Tangential acceleration of each point $|\vec{a}_{AB}| = \frac{2v^2}{R}$

10. (b) $g = \frac{GM}{R^2} \Rightarrow \frac{dg}{g} = -2\frac{dR}{R}$

$$\frac{dR}{R} = -1\% \Rightarrow \frac{dg}{g} = 2\%$$

11. (c) For a perfectly rigid body strain produced is zero for the given force applied, so Y = stress/strain = ∞

12. (b) Ice is lighter than water. When ice melts, the volume occupied by water is less than that of ice. Due to which the level of water goes down.

13. (b)

14. (d) The entropy change of the body in the two cases is same as entropy is a state function.

15. (c)

16. (b) Differentiate PV = constant w.r.t V

$$\Rightarrow P\Delta V + V\Delta P = 0 \quad \Rightarrow \frac{\Delta P}{P} = -\frac{\Delta V}{V}$$

17. (a) ΔW = area under the p – V curve

$$= \frac{1}{2} \times 3p \times 2V = 3pV$$

18. (c)

19. (b) $\gamma = 1 + \frac{2}{f}, \Rightarrow \gamma - 1 = \frac{2}{f}$

$$\Rightarrow \frac{f}{2} = \frac{1}{\gamma - 1} \Rightarrow f = \frac{2}{\gamma - 1}$$

20. (b)

21. (a) $y(x,t) = e^{-(ax^2+bt^2+2\sqrt{ab}\,xt)} = e^{-(\sqrt{a}x+\sqrt{b}t)^2}$

It is a function of type $y = f(\omega t + kx)$

$\therefore$ $y(x, t)$ represents wave travelling along $-x$ direction.

Speed of wave $= \frac{\omega}{k} = \frac{\sqrt{b}}{\sqrt{a}} = \sqrt{\frac{b}{a}}$.

22. (b) $v_S = \frac{v}{10}$ $\quad n' = n\frac{v}{v - v_S}$

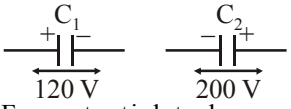
$$\frac{n'}{n} = \frac{v}{\left(v - \frac{v}{10}\right)} = \frac{10}{9}$$

23. (c) $\phi = E(ds)\cos\theta = E(2\pi r^2)\cos 0° = 2\pi r^2 E.$

24. (a) $-eE = mg$

$$\vec{E} = -\frac{9.1\times10^{-31}\times10}{1.6\times10^{-19}} = -5.6\times10^{-11}\ \text{N/C}$$

25. (b)



For potential to be made zero, after connection

$$120\,C_1 = 200\,C_2 \qquad \left[\because C = \frac{q}{v}\right]$$

$$\Rightarrow \quad 3C_1 = 5C_2$$

26. (d) $V_A = IR$

$$V_B = \left(\frac{2I}{3}\right)1.5\,R = IR \quad V_C = \left(\frac{I}{3}\right)3R = IR$$

$\therefore$ $V_A = V_B = V_C$

27. (b) $1.5 = \frac{u^2\sin 30}{g}$; $R = \frac{u^2\sin 90}{g} = 3\text{km}$

28. (c) $\vec{\tau} = \vec{m}\times\vec{B}$

29. (d) Work done, $W = MB(1 - \cos\theta)$

$\theta = 90°$

$W = MB$

30. (d)

31. (b) $\tan\phi = \frac{X}{R}\times\frac{4}{3}$

Power factor $= \cos\phi = \frac{3}{5} = 0.6$

32. (b) $V_{rms} = \sqrt{\frac{(T/2)V_0^2 + 0}{T}} = \frac{V_0}{\sqrt{2}}$.

33. (b) $\mu_g \sin i = \mu_{air}\sin 90° \Rightarrow \mu_g = \frac{1}{\sin i}$

34. (b)

35. (a) The angular fringe width is given by $\alpha = \frac{\lambda}{d}$ where λ is wavelength and d is the distance between two coherent sources. Thus

$$d = \frac{\lambda}{\alpha}$$

Given, $\lambda = 6280$ Å, $\alpha = 1° = \frac{\pi}{180}$ radian.

Thus $d = \frac{6280\times10^{-10}}{3.14}\times180$

$= 3.6\times10^{-5}\ \text{m} = 0.036\ \text{mm}$

36. (c)

37. (a) $B.E_H = \frac{2.22}{2} = 1.11$

$B.E_{He} = \frac{28.3}{4} = 7.08$

$B.E_{Fe} = \frac{492}{56} = 8.78 = \text{maximum}$

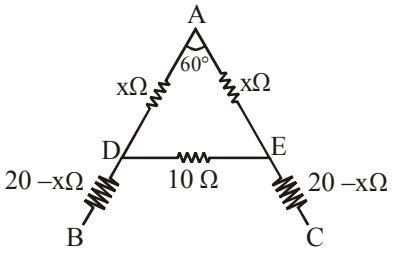
$B.E_U = \frac{1786}{235} = 7.6$

$^{56}_{26}Fe$ is most stable as it has maximum binding energy per nucleon.

38. (a) A positive feedback from output to input in an amplifier provides oscillations of constant amplitude.

39. (c)

40. (d)



For ADE $\frac{1}{R'} = \frac{1}{2x} + \frac{1}{10}$ or $R' = \frac{20x}{10+2x}$

$$R_{BC} = \frac{20x}{10+2x} + 20 - x + 20 - x \quad \ldots \text{(i)}$$

or $\frac{20x}{10+2x} + 40 = 2x$

Solving we get

$x = 10\ \Omega$

Putting the value of $x = 10\ \Omega$ in equation (i)

We get

$$R_{BC} = \frac{20\times10}{10+2\times10} + 20 - 10 + 20 - 10$$

$$= \frac{80}{3} = 26.7\Omega$$

PART - II : CHEMISTRY

41. (a) 100 amu of He $= \frac{100}{4}$ atoms of He

$= 25$ atoms.

[1 a.m.u. = mass of one proton (approx.)]

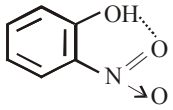
42. (a) Radius of orbit $= \frac{n^2 a_o}{z}$ $(a_o = 0.529\text{Å})$

$$\text{Radius of H} = \frac{(1)^2 \times 0.529\text{Å}}{1} = 0.53\ \text{Å}$$

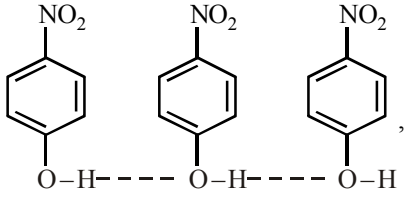
Thus, the radius of $_3Li^{2+}$ will be :

$$= \frac{(1)^2 \times 0.529}{3} = 0.17\ \text{Å}$$

43. (d) P (At no. 15) has electronic configuration $1s^2$, $2s^2$ p^6, $3s^2$ p^3, hence no electron in *d*-subshell.

44. (c) Ortho-nitrophenol has intramolecular H-bonding 

and paranitrophenol has intermolecular H-bonding.



Hence former is more volatile than latter.

45. (d) In an ideal gas, the intermolecular forces of attraction are negligible and hence it cannot be liquefied.

46. (a) Since, in the first reaction gaseous products are forming from solid carbon hence entropy will increase i.e. $\Delta S = +ve$.

$$C\,(gr.) + \frac{1}{2}\,O_2(g) \rightarrow CO(g);\ \Delta S^\circ = +\,ve$$

Since, $\Delta G^\circ = \Delta H^\circ - T\Delta S$ hence the value of ΔG decrease on increasing temperature.

47. (a) $\frac{1}{2}H_2 + \frac{1}{2}X_2 \longrightarrow HX$

Let the bond enthalpy of $X - X$ bond be *x*.

$$\Delta H_f\,(HX) = -50$$

$$= \frac{1}{2}\Delta H_{H-H} + \frac{1}{2}\Delta H_{X-X} - \Delta H_{H-X}$$

$$= \frac{1}{2}2x + \frac{1}{2}x - 2x = \frac{-x}{2}$$

$$\therefore\ x = 50 \times 2 = 100\ \text{kJ mol}^{-1}$$

48. (a) $-\log (OH) = pOH$; $-\log 6.2 \times 10^{-9} = pOH$;

$\therefore\ pOH = 8.21$

49. (d) Combination of NaOH and CH_3COOH is the mixture of alkali and acetic acid. Therefore this combination can not be buffer forming solution.

50. (c) By addition of SO_2, equilibrium will shift to RHS which is exothermic. Hence temp, will increase.

51. (d) $3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow$

$$5Br^- + BrO_3^- + 6HCO_3^-$$

O.N. of Br_2 changes from 0 to –1 and +5, hence it is reduced as well as oxidised.

52. (c) The high boiling point of water is due to H-bonding.

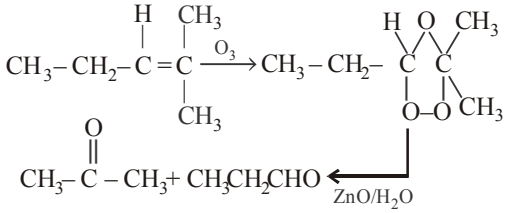
53. (b) The basic character of oxides increases down the group.

54. (a) The given two structures are optical isomers but as these are mirror image of each other, hence they represent enantiomers of each other.

55. (c) Paper chromatography is a special case of partition chromatography where the special quality paper containing water trapped in it acts as a stationary phase and solvent as a mobile phase. Thus, both phases are liquids.

56. (a) $-CCl_3, -NO_2$ and $-\overset{+}{N}H_3$ are *m*-directing in nature.

57. (a)



58. (b) In presence of U.V. rays O_2 is converted into O_3.

59. (b) $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightarrow H^+ + HCO_3^-$

Here $[H^+]$ increases hence, pH decreases due to which soil fertility will also decreases.

60. (d) When an electrolyte dissociates van't Hoff factor i is greater than 1 and when it associates the i is less than 1.

61. **(b)** $m = \frac{1000 \times k_b \times w}{W \times \Delta T_b}$

or $k_b = \frac{m \times W \times \Delta T_b}{1000 \times w} = \frac{100 \times 100 \times \Delta T_b}{1000 \times 10}$

$= \Delta T_b$

62. **(c)** λ_m° for $BaCl_2 = \lambda_m^\circ Ba^{2+} + \lambda_m^\circ Cl^-$

$= \frac{1}{2} \times 127 + 76 = 139.5 \Omega^{-1} cm^2$

63. **(d)** The reaction is of first and for a first order reaction, rate, $R = k[N_2O_5]$

$2.4 \times 10^{-5} = 3 \times 10^{-5} \times [N_2O_5]$

$[N_2O_5] = \frac{2.4 \times 10^{-5}}{3 \times 10^{-5}} = 0.8 \text{ mol } L^{-1}$

64. **(c)** The more the liquifiable nature of a gas, the more is the enthalpy of adsorption. Water is more liquifiable.

65. **(a)** According to Hardy-Schulze rule, coagulation power of ions is directly proportional to charge on ion.

$\because$ $Fe(OH)_3$ is positively charged colloid.

$\therefore$ It will be coagulated by anion.

(a) $Mg_3(PO_4)_2 \rightleftharpoons 3Mg^{2+} + 2PO_4^{3-}$

(b) $BaCl_2 \rightleftharpoons Ba^{2+} + 2Cl^-$

(c) $NaCl \rightleftharpoons Na^+ + Cl^-$

(d) $KCN \rightleftharpoons K^+ + CN^-$

Because PO_4^{3-} has highest charge among the given anions, therefore, $Mg_3(PO_4)_2$ is the most effective in the coagulation of $Fe(OH)_3$ solution.

66. **(c)** $Cl_2 + H_2O \rightarrow 2HCl + \frac{1}{2}O_2$

Hydrogen has more affinity for chlorine.

67. **(b)** $\underset{\text{Hot}}{2Cu} + \underset{\text{Steam}}{H_2O} \longrightarrow Cu_2O + H_2 \uparrow$.

68. **(b)**

Ion	Mn^{2+}	Cu^{2+}	Fe^{2+}	Ni^{2+}
EC	$3d^5$	$3d^9$	$3d^6$	$3d^8$
Number of unpaired electron	5	1	4	2

Hence lowest paramagnetism is shown by $CuSO_4.5H_2O$

69. **(b)** At 120-140°C temperature and 1.5 atm pressure, sodium phenoxide reacts with CO_2 to yield sodium salicylate which on further hydrolysis give to salicylic acid. This reaction is known as Kolbe's reaction.

70. **(b)** In Wacker process, when mixture of propene and air is passed through mixture of Pd and $CuCl_2$ at high pressure acetone is formed.

$Pd + CuCl_2 \longrightarrow PdCl_2 + 2CuCl$

$4CuCl + HCl + O_2 \longrightarrow 4CuCl_2 + 2H_2O$

$\underset{\text{Propane}}{CH_3CH = CH_2} + PdCl_2 + H_2O \longrightarrow$

$CH_3COCH_3 + Pd + 2HCl$

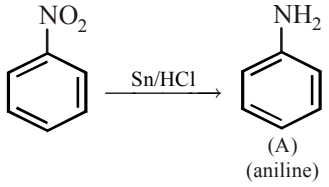
71. **(d)** In Claisen condensation intermolecular condensation of esters containing α-hydrogen atom in presence of strong base produce β-keto ester.

$\underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H.CH_2.CO.OC_2H_5$

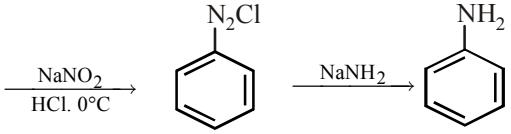
$\underset{\text{Ethyl acetoacetate (β-ketoester)}}{\overset{C_2H_5ONa}{\rightleftharpoons} CH_3\overset{O}{\overset{\|}{C}}.CH_2COOC_2H_5} + C_2H_5OH$

72. **(b)** Like clemmensen reduction, Wolf-Kishner reduction involves reduction of $> C = O$ to $> CH_2$, of course by different reagent.

73. **(d)**



(A) (aniline)

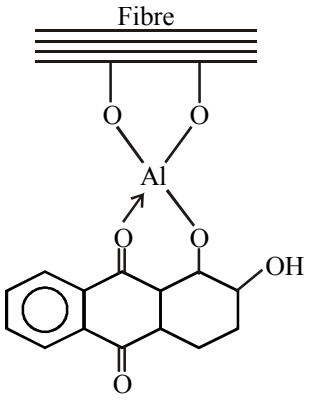


(B) (diazonium salt) (C) (aniline)

74. **(c)** Fibrous proteins have thread like molecules which lie side by side to form fibres. The various molecules are held together by hydrogen bonds.

75. **(b)** $(C_6H_{10}O_5)_n + nH_2O \xrightarrow{H^+} \underset{\text{D–Glucose}}{nC_6H_{12}O_6}$

76. **(d)** Alizarin is an anthraquinone dye. It gives a bright red colour with aluminium and a blue colour with barium.



77. **(c)** 2,4-dichlorophenoxyacetic acid is used as a herbicide.

78. **(b)** Eq. of acid = Eq of base,

$$\therefore \frac{0.45}{\text{E.wt}} = \frac{20\times 0.5}{1000} = \text{E.wt} = 45$$

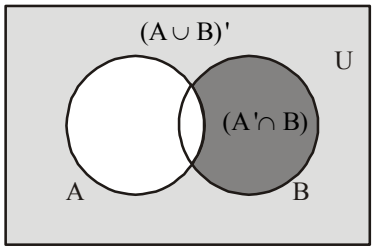
$$\text{Basicity} = \frac{\text{M.wt}}{\text{E.wt}} = \frac{90}{45} = 2$$

79. **(b)**

80. **(c)** $SnS + (NH_4)_2S_2 \rightarrow (NH_4)_2SnS_3$ soluble

PART - III : MATHEMATICS

81. **(a)** From Venn-Euler's Diagram.



$\therefore (A \cup B)' \cup (A' \cap B) = A'$

82. **(a)** $xy - 12x - 12y = 0 \Rightarrow (x-12)(y-12) = 144$

Now 144 can be factorised into two factors x and y where $x \le y$ and the factors are (1, 144), (2, 72), (3, 48), (4, 36), (6, 24), (8, 18), (9, 16), (12, 12).

Thus there are eight solutions.

83. **(b)** Using cosine formula

$2\sin(\theta+\phi)\cos(\theta-\phi) = 1/2$ .....(i)

$2\cos(\theta+\phi)\cos(\theta-\phi) = 3/2$ .....(ii)

Squaring (1) and (2) and then adding

$$4\cos^2(\theta-\phi) = \frac{1}{4}+\frac{9}{4} = \frac{5}{2} \Rightarrow \cos^2(\theta-\phi) = \frac{5}{8}$$

84. **(b)** When k = 1, LHS = 1 but RHS = 1 + 10 = 11

$\therefore$ T(1) is not true

Let T(k) is true. That is

$1+3+5+.....+(2k-1) = k^2+10$

Now, $1+3+5+.....+(2k-1)+(2k+1)$

$= k^2+10+2k+1 = (k+1)^2+10$

$\therefore T(k+1)$ is true.

That is T(k) is true $\Rightarrow T(k+1)$ is true.

But T(n) is not true for all $n \in \mathbf{N}$, as T(1) is not true.

85. **(c)** $\sin\frac{\pi}{5} + i\left(1-\cos\frac{\pi}{5}\right)$

$= 2\sin\frac{\pi}{10}\cos\frac{\pi}{10} + i2\sin^2\frac{\pi}{10}$

$= 2\sin\frac{\pi}{10}\left(\cos\frac{\pi}{10} + i\sin\frac{\pi}{10}\right)$

For amplitude, $\tan\theta = \frac{\sin\frac{\pi}{10}}{\cos\frac{\pi}{10}} = \tan\frac{\pi}{10}$

$\Rightarrow \theta = \frac{\pi}{10}$

86. **(a)** We have, $x = \omega - \omega^2 - 2$ or $x+2 = \omega - \omega^2$

Squaring, $x^2+4x+4 = \omega^2+\omega^4-2\omega^3$

$= \omega^2+\omega^3\omega.-2\omega^3 = \omega^2+\omega-2$ $[\omega^3 = 1]$

$= -1-2 = -3 \Rightarrow$ $x^2+4x+7 = 0$

Dividing $x^4+3x^3+2x^2-11x-6$ by x^2+4x+7, we get

$x^4+3x^3+2x^2-11x-6 = (x^2+4x+7)(x^2-x-1)+1$

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

87. **(a)** First prize may be given to any one of the 4 boys, hence first prize can be distributed in 4 ways.

similarly every one of second, third, fourth and fifth prizes can also be given in 4 ways.

$\therefore$ the number of ways of their distribution

$= 4\times4\times4\times4\times4 = 4^5 = 1024$

88. **(b)** We have : 30 = 2 × 3 × 5. So, 2 can be assigned to either a or b or c i.e. 2 can be assigned in 3 ways. Similarly, each of 3 and 5 can be assigned in 3 ways. Thus, the number of solutions is 3 × 3 × 3 = 27.

89. **(b)** $\text{Expression} = (1+x^2)^{40}\cdot\left(x+\frac{1}{x}\right)^{-10}$

$= (1+x^2)^{30}.x^{10}$

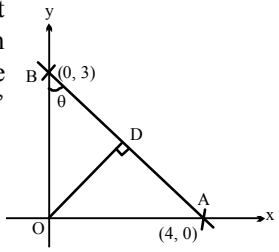
The coefficient of x^{20} in $x^{10}(1+x^2)^{30}$

= the coefficient of x^{10} in $(1+x^2)^{30}$

$= {}^{30}C_5 = {}^{30}C_{30-5} = {}^{30}C_{25}$

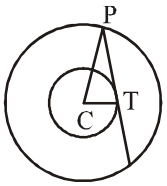
90. **(a)** The series is a G.P. with common ratio $= \left(\frac{1-3x}{1+3x}\right)$ and $|r| = \left|\frac{1-3x}{1+3x}\right|$ is less than 1 since x is positive $S_\infty = \frac{a}{1-r} = \frac{\frac{1}{1+3x}}{1-\left\{-\left(\frac{1-3x}{1+3x}\right)\right\}} = \frac{1}{2}$

91. **(a)** If 'D' be the foot of altitude, drawn from origin to the given line, then 'D' is the required point.



Let $\angle OBA = \theta$
$\Rightarrow \tan\theta = 4/3$
$\Rightarrow \angle DOA = \theta$
we have $OD = 12/5$.
If D is (h, k) then $h = OD\cos\theta$, $k = OD\sin\theta$
$\Rightarrow h = 36/25, k = 48/25$.

92. **(a)** Let the radius of the first circle be $CT = r_1$. Also, let the radius of the second circle be $CP = r_2$.
In the triangle PCT, T is a right angle



So, $PT = \sqrt{PC^2 - CT^2} = \sqrt{r_1^2 - r_2^2}$
$= \sqrt{\left(f^2 - \lambda\right) - \left(f^2 - \mu\right)} = \sqrt{\mu - \lambda}$

93. **(b)** We have $x^2 - y^2 - 4x + 4y + 16 = 0$
$\Rightarrow (x^2 - 4x) - (y^2 - 4y) = 16$
$\Rightarrow (x^2 - 4x + 4) - (y^2 - 4y + 4) = -16$
$\Rightarrow (x-2)^2 - (y-2)^2 = -16$
$\Rightarrow \frac{(x-2)^2}{4^2} - \frac{(y-2)^2}{4^2} = 1$
This is rectangular hyperbola, whose eccentricity is always $\sqrt{2}$.

94. **(c)** Put $x = \frac{\pi}{2} - h$ as $x \to \frac{\pi}{2}, h \to 0$
$\therefore$ Given limit
$= \lim_{h\to 0} \frac{1 - \tan\left(\frac{\pi}{4} - \frac{h}{2}\right)}{1 + \tan\left(\frac{\pi}{4} - \frac{h}{2}\right)} \cdot \frac{(1 - \cosh)}{(2h)^3}$
$= \lim_{h\to 0} \tan\frac{h}{2} \frac{2\sin^2\frac{h}{2}}{8h^3}$
$= \lim_{h\to 0} \frac{1}{4} \cdot \frac{\tan\frac{h}{2}}{\frac{h}{2}\times 2}\left(\frac{\sin\frac{h}{2}}{\frac{h}{2}}\right)^2 \times \frac{1}{4}$
$= \lim_{h\to 0} \frac{1}{32} \cdot \left(\frac{\tan\frac{h}{2}}{\frac{h}{2}\times 2}\right)\left(\frac{\sin\frac{h}{2}}{\frac{h}{2}}\right)^2 = \frac{1}{32}$

95. **(a)** $f'(5) = \lim_{h\to 0} \frac{f(5+h) - f(5)}{h}$
$= \lim_{h\to 0} \frac{f(5+h) - f(5+0)}{h}$
$= \lim_{h\to 0} \frac{f(5).f(h) - f(5) + f(0)}{h}$
$(\because f(x+y) = f(x).f(y)$ for all x, y)
$= \left(\lim_{h\to 0} \frac{f(h) - f(0)}{h}\right).f(5) = f'(0).f(5)$
$= 3 \times 2 = 6$

96. **(a)** $\because \quad \delta_x^2 = \frac{\Sigma d^2 i}{n}$
But both A and B have 100 observations, then both the sample A and B have same standard deviation and the same variance.
Hence, $\frac{V_A}{V_B} = 1$

97. **(a)** Since, P (exactly one of A, B occurs) $= q$.
$\therefore \quad P(A \cup B) - P(A \cap B) = q$
$\Rightarrow \quad p - P(A \cap B) = q \Rightarrow P(A \cap B) = p - q$
$\Rightarrow \quad 1 - P(A' \cup B') = p - q \Rightarrow P(A' \cup B') = 1 - p + q$
$\Rightarrow \quad P(A') + P(B') - P(A' \cap B') = 1 - p + q$
$\Rightarrow \quad P(A') + P(B') = (1 - p + q) + [1 - P(A \cup B)]$
$= (1 - p + q) + (1 - p) = 2 - 2p + q$

98. **(a)** We have, $fog(-x) = f[g(-x)] = f[-g(x)]$
$(\because g$ is odd)
$= f[g(x)] \quad (\because f$ is even)
$= fog(x) \ \forall\, x \in R$.
$\therefore$ fog is an even function.

99. (d) $\tan^{-1}\left(\frac{1}{4}\right)+\tan^{-1}\left(\frac{2}{9}\right)$

$=\tan^{-1}\left[\frac{\frac{1}{4}+\frac{2}{9}}{1-\frac{1}{4}\times\frac{2}{9}}\right]=\tan^{-1}\left[\frac{1}{2}\right]$

100. (d) $\sin^{-1}x+\cos^{-1}x+\tan^{-1}x=\frac{\pi}{2}+\tan^{-1}x$

Since domain of the function $x\in[-1,1]$

$\therefore\ -\frac{\pi}{4}\le\tan^{-1}x\le\frac{\pi}{4}$.

Hence, $k=\frac{\pi}{4}$ and $K=\frac{3\pi}{4}$

101. (a) Consider first two equations :

$2x+3y=-4$ and $3x+4y=-6$

We have $\Delta=\begin{vmatrix}2&3\\3&4\end{vmatrix}=-1\neq0$

$\Delta_x=\begin{vmatrix}-4&3\\-6&4\end{vmatrix}=2$ and $\Delta_y=\begin{vmatrix}2&-4\\3&-6\end{vmatrix}=0$

$\therefore\ x=-2$ and $y=0$

Now this solution satisfies the third, so the equations are consistent with unique solution.

102. (d) Applying C_1-C_2 and C_2-C_3, we get

$$\text{Det.}=\begin{vmatrix}25&21&219\\15&27&198\\21&17&181\end{vmatrix}=\begin{vmatrix}4&21&9\\-12&27&-72\\4&17&11\end{vmatrix}$$

[by C_1-C_2, C_3-10C_2]

$$=\begin{vmatrix}4&21&9\\0&90&-45\\0&-4&2\end{vmatrix}\ [\text{By } R_2+3R_1, R_3-R_1]$$

$=4(180-180)=0$

103. (b) Given $x=a\sin\theta$ and $y=b\cos\theta$

$\Rightarrow\frac{dx}{d\theta}=a\cos\theta$ and $\frac{dy}{d\theta}=-b\sin\theta$

$\therefore\ \frac{dy}{dx}=\frac{dy}{d\theta}\times\frac{d\theta}{dx}=-\frac{b}{a}\tan\theta\Rightarrow\frac{d^2y}{dx^2}=\frac{-b}{a}\sec^2\theta$

104. (d) For Rolle's theorem in [a, b], f(a) = f(b),

In $[0,1]\Rightarrow f(0)=f(1)=0$

$\because$ the function has to be continuous in [0, 1]

$\Rightarrow f(0)=\lim_{x\to0^+}f(x)=0$

$\Rightarrow\lim_{x\to0}x^{\alpha}\log x=0\ \Rightarrow\lim_{x\to0}\frac{\log x}{x^{-\alpha}}=0$

Applying L.H. Rule $\lim_{x\to0}\frac{1/x}{-\alpha x^{-\alpha-1}}=0$

$\Rightarrow\lim_{x\to0}\frac{-x^{\alpha}}{\alpha}=0\Rightarrow\alpha>0$

105. (b) Since f(x) is continuous at x = 2

$\therefore\ f(2)=\lim_{x\to2^+}f(x)\Rightarrow1=\lim_{x\to2^+}(ax+b)$

$\therefore\ 1=2a+b$ .....(1)

Again f(x) is continuous at x = 4,

$\therefore\ f(4)=\lim_{x\to4^-}f(x)\Rightarrow7=\lim_{x\to4^-}(ax+b)$

$\therefore\ 7=4a+b$ ....(2)

Solving (1) and (2), we get a = 3, b = – 5

106. (c) $f'(x)=3\left(\frac{a^2-1}{a^2+1}\right)x^2-3$

$f'(x)<0$ for all x if $a^2-1\le0\Rightarrow-1\le a\le1$

107. (b) Diagonal $D=\sqrt{2}.a$

Differentiating w.r.t. t: $\frac{dD}{dt}=\sqrt{2}\frac{da}{at}$

or $\frac{da}{dt}=\frac{1}{\sqrt{2}}\frac{da}{dt}=\frac{1}{\sqrt{2}}\times0.5$ cm/s

Let Area is denoted by A

$\frac{dA}{dt}=2a\frac{da}{dt}$ ...(i)

when area A is 400 cm^2 then a = 20

$\therefore\ \frac{dA}{dt}=2\times20\times\frac{0.5}{\sqrt{2}}=10\sqrt{2}\ cm^2/sec$

108. (d) Slope of normal to y = f(x) at (3, 4) is $\frac{-1}{f'(3)}$.

Thus, $\frac{-1}{f'(3)}=\tan\left(\frac{3\pi}{4}\right)=\tan\left(\frac{\pi}{2}+\frac{\pi}{4}\right)$

$=-\cot\frac{\pi}{4}=-1\Rightarrow f'(3)=1.$

109. (a) $I=\int\sqrt{\frac{x}{4-x^3}}dx=\int\frac{\sqrt{x}\,dx}{\sqrt{4-x^3}}$

Here integral of $\sqrt{x}=\frac{2}{3}x^{3/2}$ and

$4-x^3=4-(x^{3/2})^2$

Put $x^{3/2}=t\ \Rightarrow\sqrt{x}\,dx=\frac{2}{3}dt$

So $I=\frac{2}{3}\int\frac{dt}{\sqrt{4-t^2}}=\frac{2}{3}\sin^{-1}\left(\frac{x^{3/2}}{2}\right)+c$

110. (c) $I=\int_0^{\pi/2}\frac{2^{\sin x}}{2^{\sin x}+2^{\cos x}}dx$

$$I=\int_0^{\pi/2}\frac{2^{\sin(\pi/2-x)}}{2^{\sin(\pi/2-x)}+2^{\cos(\pi/2-x)}}dx$$

$$=\int\frac{2^{\cos x}}{2^{\cos x}+2^{\sin x}}dx \Rightarrow 21=\int_0^{\pi/2}dx=\frac{\pi}{2}\Rightarrow 1=\frac{\pi}{4}$$

111. (c) $\text{Area}=\int_0^{\pi/2} y\,dx=\int_0^{\pi/2}\sin x\,dx=[-\cos x]_0^{\pi/2}=1$

112. (d) $Ax^2+By^2=1$ .....(1)

$$Ax+By\frac{dy}{dx}=0 \quad ...(2)$$

$$A+By\frac{d^2y}{dx^2}+B\left(\frac{dy}{dx}\right)^2=0 \quad ...(3)$$

From (2) and (3)

$$x\left\{-By\frac{d^2y}{dx^2}-B\left(\frac{dy}{dx}\right)^2\right\}+By\frac{dy}{dx}=0$$

Dividing both sides by –B, we get

$$xy\frac{d^2y}{dx^2}+x\left(\frac{dy}{dx}\right)^2-y\frac{dy}{dx}=0$$

Which is a DE of order 2 and degree 1

113. (c) Unit vector perpendicular to both the given vectors is,

$$\frac{(6\hat{i}+2\hat{j}+3\hat{k})\times(3\hat{i}-6\hat{j}-2\hat{k})}{|(6\hat{i}+2\hat{j}+3\hat{k})\times(3\hat{i}-6\hat{j}-2\hat{k})|}=\frac{2\hat{i}+3\hat{j}-6\hat{k}}{7}$$

114. (c) $a.b.=a.c\Rightarrow a.(b-c)=0$

$\Rightarrow a=0$ or $b-c=0$ or $a\perp(b-c)$

$\Rightarrow a=0$ or $b=c$ or $a\perp(b-c)$ ...(1)

Also $a\times b=a\times c\Rightarrow a\times(b-c)=0$

$\Rightarrow a=0$ or $b-c=0$ or $a\parallel(b-c)$

$\Rightarrow a=0$ or $b=c$ or $a\parallel(b-c)$ ...(2)

Observing to (1) and (2) we find that

$a=0$ or $b=c$

115. (b) If (l_1, m_1, n_1) and (l_2, m_2, n_2) are the direction ratios then angle between the lines is

$$\cos\theta=\frac{l_1l_2+m_1m_2+n_1n_2}{\sqrt{l_1^2+m_1^2+n_1^2}\sqrt{l_2^2+m_2^2+n_2^2}}$$

Here $l_1=1, m_1=1, n_1=1$ and

$l_2=1, m_2=-1, n_2=n$ and $\theta=60^\circ$

$$\therefore \cos 60^\circ=\frac{1\times1+1\times(-1)+1\times n}{\sqrt{1^2+1^2+1^2}\times\sqrt{1^2+1^2+n^2}}$$

$$\Rightarrow \frac{1}{2}=\frac{n}{\sqrt{3}\sqrt{2+n^2}}\Rightarrow 3(2+n^2)=4n^2$$

$$\Rightarrow n^2=6\Rightarrow n=\pm\sqrt{6}$$

116. (a) We know that the length of the perpendicular from the point (x_1, y_1, z_1) to the plane $ax+by+cz+d=0$ is

$$\frac{|ax_1+by_1+cz_1+d|}{\sqrt{a^2+b^2+c^2}}$$

and the co-ordinate (α,β,γ) of the foot of the $\perp$ are given by

$$\frac{\alpha-x_1}{a}=\frac{\beta-y_1}{b}=\frac{\gamma-z_1}{c}$$

$$=-\left(\frac{ax_1+by_1+cz_1+d}{a^2+b^2+c^2}\right) \quad ...(1)$$

In the given ques,, $x_1=7, y_1=14, z_1=5,$

$a=2$ $b=4, c=-1, d=-2$

By putting these values in (1), we get

$$\frac{\alpha-7}{2}=\frac{\beta-14}{4}=\frac{\gamma-5}{-1}=-\frac{63}{21}$$

$\Rightarrow \alpha=1, \beta=2$ and $\gamma=8$

Hence, foot of $\perp$ is (1, 2, 8)

117. (b) The direction ratios of the line are $3-2, -4-(-3), -5-1$ i.e. $1, -1, -6$

Hence equation of the line joining the given points is $\frac{x-2}{1}=\frac{y+3}{-1}=\frac{z-1}{-6}=r$(say)

Coordinates of any point on this line are $(r+2, -r-3, -6r+1)$

If this point lies on the given plane $2x+y+z=7$, then $2(r+2)+(-r-3)+(-6r+1)=7\Rightarrow r=-1$

Coordinates of any point on this line are $(-1+2, -(-1)-3, -6(-1)+1)$ i.e. $(1, -2, 7)$

118. (b) The probability of hitting the target 5th time at the 10th throw = P(the probability of hitting the target 4 times in the first 9 throws) × P(the probability of hitting the target at the 10th throw) =

$$\left[{}^9C_4\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^5\right]\left(\frac{1}{2}\right)=\frac{9!}{4!5!}\times\left(\frac{1}{2}\right)^{10}=\frac{63}{2^9}$$

119. (c) The probability of showing same number by both dice $p=\frac{6}{36}=\frac{1}{6}$

In binomial distribution here $n=4, r=2, p=\frac{1}{6}, q=\frac{5}{6}$

$$\therefore \text{req. probability}={}^nC_r q^{n-r}p^r={}^4C_2\left(\frac{5}{6}\right)^2\left(\frac{1}{6}\right)^2$$

$$=6\left(\frac{25}{36}\right)\left(\frac{1}{36}\right)=\frac{25}{216}$$

120. (b) $A = 180° - 60° - 75° = 180° - 135° = 45°$

Now, $\frac{a}{\sin A} = \frac{b}{\sin B}$

$\Rightarrow \frac{2}{\sin 45°} = \frac{b}{\sin 60°} \Rightarrow b = \frac{2.(\sqrt{3}/2)}{1/\sqrt{2}} = \sqrt{6}$

121. (a) The function is given by profit function

$= x.\frac{8}{100} + y \times \frac{10}{100} = 0.08 + 0.10y.$

122. (c) Given,

$f(x) = \frac{x^{100}}{100} + \frac{x^{99}}{99} + ... + \frac{x^2}{2} + x + 1$

$\Rightarrow \quad f'(x) = \frac{100x^{99}}{100} + \frac{99x^{98}}{99} + ... + \frac{2x}{2} + 1 + 0$

$[\because f(x) = x^n \Rightarrow f'(x) = nx^{n-1}]$

$\Rightarrow \quad f'(x) = x^{99} + x^{98} + ... + x + 1 \quad ...(i)$

Putting x = 1, we get

$f'(1) = \underbrace{(1)^{99} + 1^{98} + ... + 1 + 1}_{100 \text{ times}} = \underbrace{1 + 1 + 1 ... + 1 + 1}_{100 \text{ times}}$

$\Rightarrow \quad f'(1) = 100 \quad ...(ii)$

Again, putting x = 0, we get

$f'(0) = 0 + 0 + ... + 0 + 1 \quad \Rightarrow f'(0) = 1 \quad ...(iii)$

From eqs. (ii) and (iii), we get; $f'(1) = 100f'(0)$

Hence, m = 100

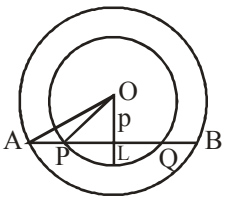
123. (a) As $A^2 = 0, A^k = 0 \ \forall \ k \geq 2.$

Thus, $(A + I)^{50} = I + 50A \Rightarrow (A + I)^{50} - 50A = I$

$\therefore \quad a = 1, b = 0, c = 0, d = 1$

abc + abd + bcd + acd = 0

124. (c) The given circles are concentric with centre at (0, 0) and the length of the perpendicular from (0, 0) on the given line is p. Let OL = p



then, $AL = \sqrt{OA^2 - OL^2} = \sqrt{a^2 - p^2}$

and $PL = \sqrt{OP^2 - OL^2} = \sqrt{b^2 - p^2}$

$\Rightarrow AP = \sqrt{a^2 - p^2} - \sqrt{b^2 - p^2}$

125. (d) $\frac{\frac{p}{2}[2a_1 + (p-1)d]}{\frac{q}{2}[2a_1 + (q-1)d]} = \frac{p^2}{q^2}$

$\Rightarrow \frac{2a_1 + (p-1)d}{2a_1 + (q-1)d} = \frac{p}{q}$

$\frac{a_1 + \left(\frac{p-1}{2}\right)d}{a_1 + \left(\frac{q-1}{2}\right)d} = \frac{p}{q}$ For $\frac{a_6}{a_{21}}, \ p = 11, \ q = 41$

$\Rightarrow \frac{a_6}{a_{21}} = \frac{11}{41}$

PART - IV : ENGLISH

126. (b) The word Florid (Adjective) means : rosy; gaudy; ornated; red; having too much decoration or detail.
The word Pale (Adjective) means : light in colour; not strong or bright; having skin that is almost white because of illness.
Hence, the words florid and pale are antonymous.

127. (c) The word Verity (Noun) means : a belief or principle about life that is accepted as true; truth.
Hence, the words verity and falsehood are antonymous.

128. (a) The word Perspicuity (Noun) means : clarity.
The word vagueness (Noun) means : no clarity in a person's mind.
Hence, the words perspicuity and Vagueness are antonymous.

129. (d) Disgrace means a state of shame.

130. (a) Striking means extraordinary, attractive.

131. (b) Fiasco means a complete failure.

132. (d)

133. (a) Word for word means : in exactly the same words or when translated exactly equivalent words.

134. (b) Huddle : come close in a group

135. (b) Right use of as - as comparison

136. (a) **137. (a)** **138. (a)** **139. (a)**

140. (c) **141. (a)**

142. (a) $(1 \times 2 \times 3 \times 5) + (1 + 2 + 3 + 5) = 41$
$(3 \times 4 \times 2 \times 6) + (3 + 4 + 2 + 6) = 159$
$(9 \times 8 \times 3 \times 4) + (9 + 8 + 3 + 4) = 888$

143. (b) Each day of the week is repeated after 7 days.
So, after 63 days, it will be Monday.
After 61 days, it will be Saturday.

144. (d)

145. (b) The number should be 404.
$\times 1 + 100, \times 2 + 100, \times 3 + 100$……

146. (b) After putting sign
$24 = 4 \times 5 + 4$
$24 = 24$
Hence, (b) is correct choice.

147. (a) **148. (d)** **149. (d)** **150. (c)**