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BITSAT 2009 Question Paper with Solution

Birla Institute of Technology and Science Admission Test (BITSAT)

BITSAT : SOLVED PAPER 2009

(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. Given that $\vec{A}+\vec{B}=\vec{R}$ and $A^2+B^2=R^2$. The angle between $\vec{A}$ and $\vec{B}$ is

(a) 0 (b) $\pi/4$ (c) $\pi/2$ (d) π

2. In the relation : $P=\frac{\alpha}{\beta}e^{-\frac{\alpha Z}{k\theta}}$

P is pressure, Z is distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be

(a) $[M^0L^2T^0]$ (b) $[M^1L^2T^1]$

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

3. Which of the following is most accurate?

(a) A screw gauge of least count 0.001 mm.

(b) A screw gauge having pitch 1 mm and 50 divisions on circular scale.

(c) A vernier callipers of least count 0.01 mm.

(d) Vernier callipers having 20 divisions on the sliding scale (vernier scale) coinciding 19 divisions on the main millimetre scale.

4. A projectile projected at an angle 30° from the horizontal has a range R. If the angle of projection at the same initial velocity be 60°, then the range will be-

(a) R (b) R/2 (c) 2R (d) R^2

5. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass M/2. If a force 2Mg is applied at one end of the rope, the force which the rope exerts on the block is –

(a) 2Mg/3 (b) 2Mg (c) 4Mg/3 (d) zero

6. A chain of mass M is placed on a smooth table with 1/n of its length L hanging over the edge. The work done in pulling the hanging portion of the chain back to the surface of the table is

(a) MgL/n (b) MgL/2n

(c) MgL/n^2 (d) $MgL/2n^2$

7. A particle of mass 10 kg moving eastwards with a speed 5 ms^{-1} collides with another particle of the same mass moving north-wards with the same speed 5 ms^{-1}. The two particles coalesce on collision. The new particle of mass 20 kg will move in the north-east direction with velocity

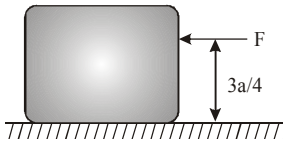
(a) 10 ms^{-1} (b) 5 ms^{-1}

(c) $(5/\sqrt{2})ms^{-1}$ (d) none of these

8. A uniform cube of side a and mass m rests on a rough horizontal table. A horizontal force F is applied normal to one of the faces at a point that is directly above the centre of the face, at a height 3a/4 above the base. The minimum value of F for which the cube begins to topple an edge is (assume that cube does not slide)

(a) $\frac{mg}{3}$ (b) $\frac{mg}{2}$

(c) $\frac{2mg}{3}$ (d) $\frac{3mg}{4}$



9. The rotation of the earth having radius R about its axis speeds upto a value such that a man at latitude angle 60^0 feels weightless. The duration of the day in such case will be :

(a) $8\pi\sqrt{\frac{R}{g}}$ (b) $8\pi\sqrt{\frac{g}{R}}$ (c) $\pi\sqrt{\frac{R}{g}}$ (d) $4\pi\sqrt{\frac{g}{R}}$

10. A metallic rod breaks when strain produced is 0.2%. The Young's modulus of the material of the rod is 7×10^9 N/m^2. What should be its area of cross-section to support a load of 10^4 N ?

(a) 7.1×10^{-8} m^2 (b) 7.1×10^{-6} m^2
(c) 7.1×10^{-4} m^2 (d) 7.1×10^{-2} m^2

11. A liquid is flowing through a non-sectional tube with its axis horizontally. If two points X and Y on the axis of tube has a sectional area 2.0 cm^3 and 25 mm^2 respectively then find the flow velocity at Y when the flow velocity at X is 10m/s.

(a) 20 m/s (b) 40 m/s (c) 80 m/s (d) 60 m/s

12. A body of length 1m having cross-sectional area 0.75m^2 has heat flow through it at the rate of 6000 Joule/sec. Then find the temperature difference if K = 200 Jm^{-1}K^{-1}.

(a) 20°C (b) 40°C (c) 80°C (d) 100°C

13. Which of the following combinations of properties would be most desirable for a cooking pot?

(a) High specific heat and low conductivity.
(b) Low specific heat and high conductivity.
(c) High specific heat and high conductivity.
(d) Low specific heat and low conductivity.

14. A particle starts moving rectilinearly at time t = 0 such that its velocity v changes with time t according to the equation $v = t^2 - t$ where t is in seconds and v is in m/s. Find the time interval for which the particle retards.

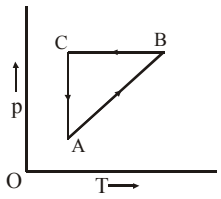
(a) $\frac{1}{2} < t < 1$ (b) $\frac{1}{2} > t > 1$

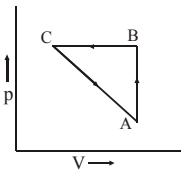
(c) $\frac{1}{4} < t < 1$ (d) $\frac{1}{2} < t < \frac{3}{4}$

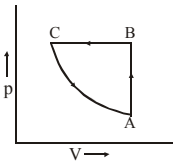
15. A sample of gas expands from volume V_1 to V_2. The amount of work done by the gas is greatest when the expansion is

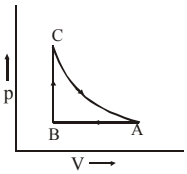
(a) isothermal (b) isobaric
(c) adiabatic (d) equal in all cases

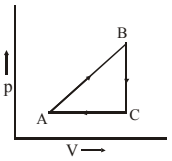
16. A cyclic process is shown in the p-T diagram. Which of the curves show the same process on a P-V diagram ?



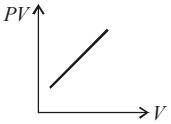
(a) 

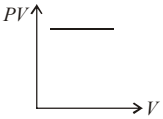
(b) 

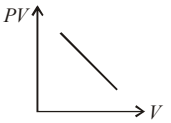
(c) 

(d) 

17. Which one the following graphs represents the behaviour of an ideal gas

(a) 

(b) 

(c) 

(d) 

18. In case of a forced vibration, the resonance wave becomes very sharp when the

(a) restoring force is small
(b) applied periodic force is small
(c) quality factor is small
(d) damping force is small

19. A pendulum bob carries a +ve charge +q. A positive charge +q is held at the point of support. Then the time period of the bob is –
[where, L = length of pendulum, g_{eff} = effective value of g]

(a) greater than $2\pi\sqrt{L/g_{eff}}$
(b) less than $2\pi\sqrt{L/g_{eff}}$
(c) equal to $2\pi\sqrt{L/g_{eff}}$
(d) equal to $2\pi\sqrt{2L/g_{eff}}$

20. Two tuning forks A and B sounded together give 6 beats per second. With an air resonance tube closed at one end, the two forks give resonance when the two air columns are 24 cm and 25 cm respectively. Calculate the frequencies of forks.
(a) 120 Hz, 124 Hz (b) 110 Hz, 114 Hz
(c) 150 Hz, 144 Hz (d) 170 Hz, 118 Hz

21. If an electron has an initial velocity in a direction different from that of an electric field, the path of the electron is
(a) a straight line (b) a circle
(c) an ellipse (d) a parabola

22. If on combining two charged bodies, the current does not flow then
(a) charge is equal on both
(b) capacitance is equal on both
(c) potential is equal on both
(d) resistance is equal on both

23. Calculate the area of the plates of a one farad parallel plate capacitor if separation between plates is 1 mm and plates are in vacuum
(a) $18 \times 10^8\ m^2$ (b) $0.3 \times 10^8\ m^2$
(c) $1.3 \times 10^8\ m^2$ (d) $1.13 \times 10^8\ m^2$

24. The length of a potentiometer wire is ℓ. A cell of emf E is balanced at a length $\ell/3$ from the positive end of the wire. If the length of the wire is increased by $\ell/2$. At what distance will be the same cell give a balance point.
(a) $2\ell/3$ (b) $\ell/2$ (c) $\ell/6$ (d) $4\ell/3$

25. A conducting circular loop of radius r carries a constant current i. It is placed in a uniform magnetic field $\vec{B}_0$ such that $\vec{B}_0$ is perpendicular to the plane of the loop. The magnetic force acting on the loop is
(a) $ir\,B_0$ (b) $2\pi ir\,B_0$
(c) zero (d) $\pi ir\,B_0$

26. An ammeter reads upto 1 ampere. Its internal resistance is 0.81ohm. To increase the range to 10 A the value of the required shunt is
(a) 0.03Ω (b) 0.3Ω (c) 0.9Ω (d) 0.09Ω

27. At the magnetic north pole of the earth, the value of horizontal component of earth's magnetic field and angle of dip are, respectively
(a) zero, maximum
(b) maximum, minimum
(c) maximum, maximum
(d) minimum, minimum

28. Lenz's law is a consequence of the law of conservation of
(a) charge (b) mass
(c) energy (d) momentum

29. The instantaneous current from an a.c. source is $I = 6 \sin 314\,t$. What is the rms value of the current?
(a) $3\sqrt{2}$ amp (b) $2\sqrt{2}$ amp
(c) $\sqrt{2}$ amp (d) 2 amp

30. A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be
(a) 4.0A (b) 8.0A (c) 7.2A (d) 2.0A

31. The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is
(a) 3 V/m (b) 6 V/m (c) 9 V/m (d) 12 V/m

32. A plano-convex lens of focal length 30 cm has its plane surface silvered. An object is placed 40 cm from the lens on the convex side. The distance of the image from the lens is
(a) 18 cm (b) 24 cm (c) 30 cm (d) 40 cm

33. When a mica sheet of thickness 7 microns and $\mu = 1.6$ is placed in the path of one of interfering beams in the biprism experiment then the central fringe gets at the position of seventh bright fringe. The wavelength of light used will be
(a) 4000 Å (b) 5000 Å
(c) 6000 Å (d) 7000 Å

34. In Young's double slit experiment, if the slit widths are in the ratio 1 : 2, the ratio of the intensities at minima and maxima will be
(a) 1 : 2 (b) 1 : 3 (c) 1 : 4 (d) 1 : 9

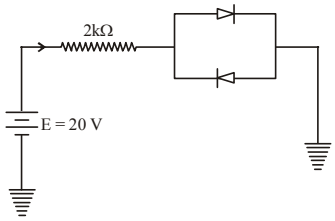
35. In a photoelectric experiment, with light of wavelength λ, the fastest electron has speed v. If the exciting wavelength is changed to 3λ/4, the speed of the fastest emitted electron will become
(a) $v\sqrt{\frac{3}{4}}$ (b) $v\sqrt{\frac{4}{3}}$
(c) less than $v\sqrt{\frac{4}{3}}$ (d) greater than $v\sqrt{\frac{4}{3}}$

36. Taking Rydberg's constant $R_H = 1.097 \times 10^7 m$, first and second wavelength of Balmer series in hydrogen spectrum is
(a) 2000 Å, 3000 Å (b) 1575 Å, 2960 Å
(c) 6529 Å, 4280 Å (d) 6552 Å, 4863 Å

37. An X-ray tube is operated at 15 kV. Calculate the upper limit of the speed of the electrons striking the target.
(a) 7.26×10^7 m/s (b) 7.62×10^7 m/s
(c) 7.62×10^7 cm/s (d) 7.26×10^9 m/s

38. Nuclear energy is released in fission since binding energy per nucleon is
(a) sometimes larger and sometimes smaller
(b) larger for fission fragments than for parent nucleus
(c) same for fission fragments and nucleus
(d) smaller for fission fragments than for parent nucleus

39. Assuming the diodes to be of silicon with forward resistance zero, the current I in the following circuit is



(a) 0 (b) 9.65 mA (c) 10 mA (d) 10.35 mA

40. The truth table given below correspond to the logic gate

A	B	X
0	0	1
1	0	0
0	1	0
1	1	0

(a) OR (b) NOR
(c) AND (d) NAND

PART - II : CHEMISTRY

41. Given the numbers : 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers are
(a) 3, 4 and 5 respectively
(b) 3, 3 and 4 respectively
(c) 3, 3 and 3 respectively
(d) 3, 4 and 4 respectively

42. Beryllium resembles much with :
(a) Zn (b) Al (c) Li (d) Ra

43. Which one of the following ions has the highest value of ionic radius?
(a) O^{2-} (b) B^{3+} (c) Li^+ (d) F^-

44. Which of the following two are isostructural ?
(a) XeF_2, IF_2^- (b) NH_3, BF_3
(c) CO_3^{2-}, SO_3^{2-} (d) PCI_5, ICI_5

45. The cooking time in a pressure cooker is less because :
(a) More heat is used
(b) High pressure cooks the food
(c) The boiling point of water increases in the cooker
(d) Heat is uniformly distributed

46. For the reaction : $N_2 + 3H_2 \rightleftharpoons 2NH_3$
Which one of the following is correct regarding ΔH :
(a) $\Delta H = \Delta E + 2RT$ (b) $\Delta H = \Delta E - 2RT$
(c) $\Delta H = \Delta E + RT$ (d) $\Delta H = \Delta E - RT$

47. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The ΔE for this process is
($R = 2$ cal mol^{-1} K^{-1})
(a) 163.7 cal (b) zero
(c) 1381.1 cal (d) 9 lit atm

48. At 25°C and 1 bar which of the following has a non-zero ΔH_f° ?
(a) $Br_2(\ell)$ (b) C (graphite)
(c) $O_3(g)$ (d) $I_2(s)$

49. If the equilibrium constant of the reaction $2HI \rightleftharpoons H_2 + I_2$ is 0.25, then the equilibrium constant for the reaction $H_2 + I_2 \rightleftharpoons 2HI$ would be
(a) 1 (b) 2 (c) 3 (d) 4

50. The oxidation states of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order
(a) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$
(b) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
(c) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$
(d) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$

51. The value of x is maximum for
(a) $MgSO_4.x\,H_2O$ (b) $CaSO_4.x\,H_2O$
(c) $BaSO_4.x\,H_2O$ (d) All have the same

52. For making good quality mirrors, plates of float glass are used. These are obtained by floating molten glass over a liquid metal which does not solidify before glass. The metal used can be
(a) tin (b) sodium
(c) magnesium (d) mercury

53. The intermediate formed during the addition of HCl to propene in the presence of peroxide is

(a) $CH_3\dot{C}HCH_2Cl$ (b) $CH_2\overset{+}{C}HCH_3$

(c) $CH_3CH_2\dot{C}H_2$ (d) $CH_3CH_2\overset{+}{C}H_2$

54. Which of the following has zero dipole moment?

(a) 1, 1-dichloromethane
(b) *cis*-1, 2-dichloroethene
(c) *trans*-1, 2-dichloroethene
(d) 1-chloroethane

55. Keto-enol tautomerism is observed in

(a) $C_6H_5-\overset{O}{\overset{\|}{C}}-H$ (b) $C_6H_5-\overset{O}{\overset{\|}{C}}-CH_3$

(c) $C_6H_5-\underset{O}{\overset{O}{\overset{\|}{C}}}-C_6H_5$ (d) None

56. Which one of the following contain isopropyl group?

(a) 2, 2, 3, 3-Tetramethylpentane
(b) 2-Methylpentane
(c) 2, 2, 3-Trimethylpentane
(d) 3, 3-Dimethylpentane

57. The statement which is not correct about control of particulate pollution is:

(a) In electrostatic precipitator, the particulates are made to acquire positive charge which are then attracted by the negative electrode and removed.
(b) Gravity settling chamber removes larger particles from the air.
(c) Cyclone collector removes fine particls in the diameter range 5-20 microns.
(d) Wet scrubbers are used to wash away all types of particulates.

58. Chief source of soil and water pollution is:

(a) Mining
(b) Agro industry
(c) Thermal power plant
(d) All of the above

59. The false statement among the followings:

(a) The average residence time of NO is one month.
(b) Limestone acts as a sink for SO_x.
(c) SO_x can be removed from flue gases by passing through a solution of citrate ions.
(d) Ammonia acts as a sink for NO_x.

60. The atomic radius of atom is r.Total volume of atoms present in a *fcc* unit cell of an element is

(a) $\frac{24}{3}\pi r^3$ (b) $\frac{12}{3}\pi r^3$

(c) $\frac{16}{3}\pi r^3$ (d) None

61. Which one of the following statements is **false?**

(a) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose.
(b) The osmotic pressure (π) of a solution is given by the equation $\pi = MRT$, where M is the molarity of the solution.
(c) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction.
(d) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression.

62. The degree of dissociation of $Ca(NO_3)_2$ in dilute aq. solution containing 7.0 g of salt per 100 g of water at 100° C is 70%. If vapour pressure of water at 100° C is 760 mm Hg. The vapour pressure of solution is

(a) 735 (b) 730 (c) 760 (d) 746

63. When the sample of copper with zinc impurity is to be purified by electrolysis, the appropriate electrodes are

	Cathode	**Anode**
(a)	Pure zinc	Pure copper
(b)	Impure sample	Pure copper
(c)	Impure zinc	Impure sample
(d)	Pure copper	Impure sample

64. The conductivity of a saturated solution of $BaSO_4$ is 3.06×10^{-6} ohm^{-1} cm^{-1} and its equivalent conductance is 1.53 ohm^{-1} cm^2 equiv^{-1}. The K_{sp} for $BaSO_4$ will be

(a) 4×10^{-12} (b) 2.5×10^{-9}
(c) 2.5×10^{-13} (d) 4×10^{-6}

65. In a cell that utilises the reaction

$$Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$$

addition of H_2SO_4 to cathode compartment, will

(a) increase the E and shift equilibrium to the right.
(b) lower the E and shift equilibrium to the right.
(c) lower the E and shift equlibrium to the left.
(d) increase the E and shift equilibrium to the left.

66. The chemical reaction $2O_3 \longrightarrow 3O_2$ proceeds as follows:

$O_3 \xrightarrow{\text{Fast}} O_2 + O$; $O + O_3 \xrightarrow{\text{Slow}} 2O_2$ the rate law expression should be

(a) $r = k[O_3]^2$ (b) $r = k[O_3]^2[O_2]^{-1}$

(c) $r = k[O_3]^2[O_2]^2$ (d) $r = k[O_3][O_2]^2$

67. Among the following statements the incorrect one is :

(a) Calamine and siderite are carbonates.

(b) Argentite and cuprite are oxides.

(c) Zinc blende and iron pyrites are sulphides.

(d) Malachite and azurite are ores of copper.

68. Cinnabar is an ore of

(a) Hg (b) Cu (c) Pb (d) Zn

69. Which of the following is used in the preparation of chlorine?

(a) Only MnO_2

(b) Only $KMnO_4$

(c) Both MnO_2 and $KMnO_4$

(d) Either MnO_2 or $KMnO_4$

70. Which of the following elements does not belong to first transition series?

(a) Fe (b) V (c) Ag (d) Cu

71. $[EDTA]^{4-}$ is a :

(a) monodentate ligand

(b) bidentate ligand

(c) quadridentate ligand

(d) hexadentate ligand

72. Which of the following order is not correct ?

(a) $MeBr > Me_2CHBr > Me_3CBr > Et_3CBr (S_N2)$

(b) $Me_3CBr > Me_2CHBr > Me_2CH.CH_2Br > MeCH_2CH_2CH_2Br.(E_2)$

(c) $PhCH_2Br > PhCHBrMe > PhCBrMe_2 > PhCBrMePh (S_N1)$

(d) $MeI > MeBr > MeCl > MeF (S_N2)$

73. When esters are hydrolysed the product gives hydrogen ions. The product which gives hydrogen ion is

(a) acid

(b) alcohol

(c) both

(d) either acid or alcohol

74. Which of the following compound can not be used in preparation of iodoform?

(a) CH_3CHO (b) CH_3COCH_3

(c) HCHO (d) 2-propanol

75. Which of the following compound is obtained by heating ammonium cyanate?

(a) Alkane

(b) Urea

(c) Ethylamine

(d) Ammonium thiocyanate

76. Which of the following statements about vitamin B-12 is incorrect?

(a) It has a cobalt atom.

(b) It also occurs in plants.

(c) It is also present in rain water.

(d) It is needed for human body in very small amounts.

77. Ammonia forms the complex ion $[Cu(NH_3)_4]^{2+}$ with copper ions in alkaline solutions but not in acidic solutions. What is the reason for it ?

(a) In acidic solutions protons coordinate with ammonia molecules forming NH_4^+ ions and NH_3 molecules are not available.

(b) In alkaline solutions insoluble $Cu(OH)_2$ is precipitated which is soluble in excess of any alkali.

(c) Copper hydroxide is an amphoteric substance.

(d) In acidic solutions hydration protects copper ions.

78. An aqueous solution of a substance gives a white precipitate on treatment with dil. HCl which dissolves on heating. When H_2S is passed through the hot acidic solution, a black precipitate is obtained. The substance is a

(a) Hg_2^{2+} salt (b) Cu^{2+} salt

(c) Ag^+ salt (d) Pb^{2+} salt

79. The one which is least basic is

(a) NH_3 (b) $C_6H_5NH_2$

(c) $(C_6H_5)_3N$ (d) $(C_6H_5)_2NH$

80. Interparticle forces present in nylon 66 are

(a) van der Waal's

(b) hydrogen bonding

(c) dipole-dipole interactions

(d) None of the above

PART - III : MATHEMATICS

81. If A = {1, 2, 3, 4, 5}, then the number of proper subsets of A is
(a) 31 (b) 38 (c) 48 (d) 54

82. The range of the function $f(x)=\frac{x^2-x+1}{x^2+x+1}$ where $x \in R$, is
(a) $(-\infty, 3]$ (b) $(-\infty, \infty)$
(c) $[3, \infty)$ (d) $\left[\frac{1}{3}, 3\right]$

83. If $y=\frac{2\sin\alpha}{1+\cos\alpha+\sin\alpha}$, then value of $\frac{1-\cos\alpha+\sin\alpha}{1+\sin\alpha}$ is
(a) $\frac{y}{3}$ (b) y (c) 2y (d) $\frac{3}{2}y$

84. Period of $\frac{\sin\theta+\sin 2\theta}{\cos\theta+\cos 2\theta}$ is
(a) 2π (b) π (c) $\frac{2\pi}{3}$ (d) $\frac{\pi}{3}$

85. The general solution of $8\tan^2\frac{x}{2}=1+\sec x$ is
(a) $2n\pi\pm\cos^{-1}\left(\frac{-1}{3}\right)$ (b) $2n\pi\pm\frac{\pi}{6}$
(c) $2n\pi\pm\cos^{-1}\left(\frac{1}{3}\right)$ (d) None of these

86. $10^n+3(4^{n+2})+5$ is divisible by $(n \in N)$
(a) 7 (b) 5 (c) 9 (d) 17

87. If the expression $x^2-11x+a$ and $x^2-14x+2a$ must have a common factor and $a \neq 0$, then, the common factor is
(a) $(x-3)$ (b) $(x-6)$
(c) $(x-8)$ (d) None of these

88. For the equation $\frac{1}{x+a}-\frac{1}{x+b}=\frac{1}{x+c}$, if the product of roots is zero, then the sum of roots is
(a) 0 (b) $\frac{2ab}{b+c}$ (c) $\frac{2bc}{b+c}$ (d) $\frac{-2bc}{b+c}$

89. If $\arg(\bar{z}_1)=\arg(z_2)$, then
(a) $z_2=kz_1^{-1}(k>0)$ (b) $z_2=kz_1(k>0)$
(c) $|z_2|=|\bar{z}_1|$ (d) None of these

90. If $\frac{2x+3}{5}<\frac{4x-1}{2}$, then x lies in the interval
(a) $\left[0, \frac{11}{16}\right)$ (b) $\left[\frac{11}{16}, \infty\right)$
(c) $\left(0, \frac{11}{16}\right)$ (d) $\left(\frac{11}{16}, \infty\right)$

91. The letters of the word TOUGH are written in all possible orders and these words are written out as in a dictionary, then the rank of the word TOUGH is
(a) 120 (b) 88 (c) 89 (d) 90

92. If in the expansion of $\left(2^x+\frac{1}{4^x}\right)^n$, $T_3=7T_2$ and sum of the binomial coefficients of second and third terms is 36, then the value of x is –
(a) –1/3 (b) – 1/2 (c) 1/3 (d) 1/2

93. The 100^{th} term of the sequence 1, 2, 2, 3, 3, 3, 4, 4, 4, 4,... is
(a) 12 (b) 13 (c) 14 (d) 15

94. The line 3x – 4y + 7 = 0 is rotated through an angle $\frac{\pi}{4}$ in the clockwise direction about the point (–1, 1). The equation of the line in its new position is
(a) $7y+x-6=0$ (b) $7y-x-6=0$
(c) $7y+x+6=0$ (d) $7y-x+6=0$

95. Find the vertex of the parabola $x^2-8y-x+19=0$.
(a) $\left(\frac{1}{2}, \frac{75}{32}\right)$ (b) $\left(\frac{1}{5}, \frac{65}{32}\right)$
(c) $\left(\frac{1}{3}, \frac{65}{22}\right)$ (d) $\left(\frac{1}{3}, \frac{35}{12}\right)$

96. If $f(t)=\frac{1-t}{1+t}$, then f' (1/t) is equal to
(a) $\frac{1}{(1+t)^2}$ (b) $\frac{1}{(t-1)^2}$
(c) $\frac{-2t^2}{(t+1)^2}$ (d) $\frac{2}{(t-1)^2}$

97. If : p Raju is tall and q: Raju is intelligent, then the symbolic statement $\sim p \vee q$ means
(a) Raju is not tall or he is intelligent.
(b) Raju is tall or he is intelligent
(c) Raju is not tall and he is intelligent
(d) Raju is not tall implies he is intelligent

98. Given below is a frequency distribution with median 46. In this distribution, some of the frequencies are missing : Determine the missing frequencies.

Marks	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Total
No. of students	12	30	?	65	?	25	18	229

(a) 34, 45 (b) 25, 40
(c) 12, 18 (d) 30, 35

99. If the function $f : (-\infty, \infty) \to B$ defined by $f(x) = -x^2 + 6x - 8$ is bijective, then B =
(a) $[1, \infty)$ (b) $(-\infty, 1]$
(c) $(-\infty, \infty)$ (d) None of these

100. Find the value of
$$2\tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{2} + 2\tan^{-1}\frac{1}{8}$$
(a) $\pi/4$ (b) $\pi/2$
(c) $3\pi/4$ (d) None of these

101. If A and B are 2×2 matrices, then which of the following is true ?
(a) $(A+B)^2 = A^2 + B^2 + 2AB$
(b) $(A-B)^2 = A^2 + B^2 - 2AB$
(c) $(A-B)(A+B) = A^2 + AB - BA - B^2$
(d) $(A-B)(A+B) = A^2 - B^2$

102. If $a > 0$, $b > 0$, $c > 0$ are respectively the pth, qth, rth terms of G.P., then the value of the determinant
$$\begin{vmatrix} \log a & p & 1 \\ \log b & q & 1 \\ \log c & r & 1 \end{vmatrix}$$ is
(a) 0 (b) 1
(c) –1 (d) None of these

103. The digits A, B and C are such that the three digit numbers A88, 6B8, 86C are divisible by 72 then the determinant $\begin{vmatrix} A & 6 & 8 \\ 8 & B & 6 \\ 8 & 8 & C \end{vmatrix}$ is divisible by
(a) 72 (b) 144 (c) 288 (d) 216

104. If $M(\alpha) = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$;
$M(\beta) = \begin{bmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{bmatrix}$ then $[M(\alpha)M(\beta)]^{-1}$ is equal to -
(a) $M(\beta)M(\alpha)$ (b) $M(-\alpha)M(-\beta)$
(c) $M(-\beta)M(-\alpha)$ (d) $-M(\beta)M(\alpha)$

105. If $y = e^{-x}\cos x$ and $y_4 + ky = 0$, where $y_4 = \frac{d^4y}{dx^4}$, then k =
(a) 4 (b) –4 (c) 2 (d) –2

106. The set of points of discontinuity of the function $1/\log|x|$ is –
(a) $\{-1, 0, 1\}$ (b) $\{0\}$
(c) $\{0, 1\}$ (d) None of these

107. The minimum value of the function $y = x^4 - 2x^2 + 1$ in the interval $\left[\frac{1}{2}, 2\right]$ is
(a) 0 (b) 2 (c) 8 (d) 9

108. The value of a in order that $f(x) = \sin x - \cos x - ax + b$ decreases for all real values is given by
(a) $a \geq \sqrt{2}$ (b) $a < \sqrt{2}$ (c) $a \geq 1$ (d) $a < 1$

109. The equation of tangent to the curve $y = \sin x$ at the point $(\pi, 0)$ is
(a) $x + y = 0$ (b) $x + y = \pi$
(c) $x - y = \pi$ (d) $x - y = 0$

110. If $\int \frac{2\cos x - \sin x + \lambda}{\cos x + \sin x - 2} dx$
$= A\ln|\cos x + \sin x - 2| + Bx + C$.
Then the ordered triplet A, B, λ is –
(a) $\left(\frac{1}{2}, \frac{3}{2}, -1\right)$ (b) $\left(\frac{3}{2}, \frac{1}{2}, -1\right)$
(c) $\left(\frac{1}{2}, -1, \frac{3}{2}\right)$ (d) $\left(\frac{3}{2}, -1, \frac{1}{2}\right)$

111. Evaluate: $\int x\tan^{-1}x\,dx$
(a) $\frac{1}{2}(x^2+1)\tan^{-1}x - \frac{1}{2}x + c$
(b) $\frac{1}{2}(x^2+1)\tan^{-1}x + \frac{1}{2}x + c$
(c) $\frac{1}{2}(x^2-1)\tan^{-1}x - \frac{1}{2}x + c$
(d) None of these

112. Evaluate : $\int_0^1 \frac{dx}{\sqrt{2-x^2}}$.
(a) $\pi/4$ (b) π (c) $\pi/2$ (d) $\pi/3$

113. If $\int_0^n [x]dx = 66$, then $n =$

(a) 24 (b) 9 (c) 12 (d) 7

114. Area of the triangle formed by the line $x + y = 3$ and angle bisectors of the pair of straight lines $x^2 - y^2 + 2y = 1$ is

(a) 2 sq. units (b) 4 sq. units
(c) 6 sq. units (d) 8 sq. units

115. Solution of the differential equation

$\frac{dy}{dx} + \frac{y}{x} = \sin x$ is

(a) $x(y + \cos x) = \cos x + C$
(b) $x(y - \cos x) = \sin x + C$
(c) $x(y + \cos x) = \sin x + C$
(d) None of these

116. If the line $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-k}{2}$ lies in the plane $2x - 4y + z = 7$, then the value of k is

(a) 4 (b) -7
(c) 7 (d) No real value

117. A line segment has length 63 and direction ratios are 3, –2, 6. If the line makes an obtuse angle with x–axis, the components of the line vector are

(a) $27, -18, 54$ (b) $-27, 18, 54$
(c) $-27, 18, -54$ (d) $27, -18, -54$

118. It is given that the events A and B are such that $P(A) = \frac{1}{4}, P(A \mid B) = \frac{1}{2}$ and $P(B \mid A) = \frac{2}{3}$. Then $P(B)$ is

(a) $\frac{1}{6}$ (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $\frac{1}{2}$

119. The random variable X has the following probability distribution

x	0	1	2	3	4
P(X = x)	k	3k	5k	2k	k

Then the value of $P(X \geq 2)$ is

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

120. In a triangle ABC, $\angle C = 90°$, then $\frac{a^2 - b^2}{a^2 + b^2}$ is equal to :

(a) $\sin(A + B)$ (b) $\sin(A - B)$
(c) $\cos(A + B)$ (d) $\sin\left(\frac{A - B}{2}\right)$

121. A person standing on the bank of a river observes that the angle subtended by a tree on the opposite bank is 60°. when he retreats 20 feet from the bank, he finds the angle to be 30°. The breadth of the river in feet is :

(a) 15 (b) $15\sqrt{3}$ (c) $10\sqrt{3}$ (d) 10

122. The minimum value of the function $z = 4x + 3y$ subject to the constraints $3x + 2y \geq 160, 5x + 2y \geq 200, x + 2y \geq 80, x \geq 0, y \geq 0$ is

(a) 320 (b) 300 (c) 220 (d) 200

123. If $|r| > 1$ and $x = a + \frac{a}{r} + \frac{a}{r^2} + \ldots$ to ∞,

$y = b - \frac{b}{r} + \frac{b}{r^2} - \ldots$ to ∞

and $z = c + \frac{c}{r^2} + \frac{c}{r^4} + \ldots$ to ∞, then $\frac{xy}{z} =$

(a) $\frac{ab}{c}$ (b) $\frac{ac}{b}$ (c) $\frac{bc}{a}$ (d) 1

124. Two tangents PQ and PR drawn to the circle $x^2 + y^2 - 2x - 4y - 20 = 0$ from point P (16, 7). If the centre of the circle is C then the area of quadrilateral PQCR is

(a) 75 sq. unit (b) 73 sq. unit
(c) 72 sq. unit (d) 74 sq. unit

125. The value of $\lim_{x \to 0} \frac{(4^x - 1)^3}{\sin\frac{x^2}{4}\log(1 + 3x)}$, is

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

PART - IV : ENGLISH

DIRECTIONS (Qs. 126 - 128): In each of the following questions, choose the alternatives which can be substituted for the given word.

126. Agnostic

(a) One who is not sure about God's existence.
(b) One who believes in God's existence.
(c) One having different style of living.
(d) None of above.

127. Bohemian

(a) waves in the sea.
(b) fresh mood.
(c) irritatation.
(d) an unconventional style of living.

128. Cacographist
(a) One who is having ego.
(b) One who has unique style.
(c) One who is bad in spelling.
(d) One who is good in spelling.

DIRECTIONS (Qs. 129 - 131): Which one of the following word is correctly spelt?

129. Spelling test-find correct spelling :
(a) Vetarinary (b) Veterinary
(c) Veteninary (d) Vetinary

130. Spelling test-find correct spelling:
(a) Rigerous (b) Rigorous
(c) Regerous (d) Rigourous

131. Spelling test-find correct spelling :
(a) Itinerary (b) Itinarary
(c) Itnerary (d) Itinerory

DIRECTIONS (Qs. 132 - 134) : In each of the following questions, choose the alternative which is opposite in meaning to the word given in capital letters.

132. REPRIMAND
(a) Reward (b) Appreciate
(c) Encourage (d) Praise

133. IMPERTINENT
(a) Polite (b) Indifferent
(c) Unpleasant (d) Stubborn

134. EQUIVOCAL
(a) Mistaken (b) Quaint
(c) Clear (d) Universal

DIRECTIONS (Q. 135 - 137): In each of the following questions, choose the most appropriate altarnative to fill in the blank.

135. It is difficult to believe what he tells us because his account of any event is always full of ..... of all sorts.
(a) discrepancies (b) differences
(c) discretions (d) distinctions

136. The bank clerk tried to ..... money from his friend's account.
(a) empower (b) embellish
(c) embroil (d) embezzle

137. Eight scientists have ..... the national awards for outstanding contribution and dedication to the profession.
(a) bestowed (b) picked
(c) bagged (d) conferred

DIRECTIONS (Q. 138 - 140): In the following questions, some parts have been jumbled up. You are required to rearrange these parts, which are labelled P, Q, R and S to produce the correct sentence.

138. Freedom, is the restricted kind in the sense/(P), the rich and poor woman/(Q), that a wide gulf separates/(R), which a modern woman enjoys (S)
(a) P S R Q (b) S R Q P
(c) R Q P S (d) S P R Q

139. In life, some rules are/(P), as in business/(Q), they seem almost instinctive/(R), learnt so early that/(S)
(a) R S P Q (b) Q P S R
(c) R P S Q (d) Q S P R

140. Kapil, left in an aeroplane/(P), after reading a sailing magazine/(Q), had decided/(R), to build his own boat nine years earlier/(S)
(a) P R Q S (b) R S Q P
(c) R Q P S (d) P S R Q

DIRECTION (Qs. 141) : In each of the following question, select the related letter/word/number from the given alternatives.

141. Distance : Odometer :: ? : Barometer
(a) Humidity (b) Pressure
(c) Thickness (d) Wind

142. One of the, numbers does not fit into the series. Find the wrong number
13, 16, 38, 124, 504, 2535
(a) 16 (b) 38 (c) 124 (d) 504

DIRECTION (Q. 143): In each question below is given a statement followed by three assumptions numbered I, II and III. You have to consider the statement and the following assumptions, decide which of the assumptions is implicit in the statement and choose your answer accordingly.

143. Statement: In order to reduce the gap between income and expenditure, the company has decided to increase the price of its product from next month.
Assumptions:
I. The rate will remain more or less same after the increase.
II. The expenditure will more or less remain the same in near future.
III. The rival companies will also increase the price of the similar product.
(a) Only I and II are implicit
(b) Only II and III are implicit
(c) Only III is implicit
(d) None of these

DIRECTION (Q. 144): In each of the following question, select the related letter/word/number from the given alternatives.

144. FLMO : ? : : BFEN : ARSO

(a) BZYS (b) CZYS (c) SZYB (d) YZBC

145. If A denotes '+'

B denotes '-'

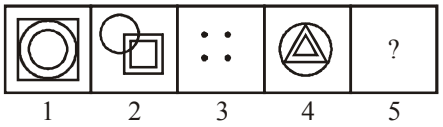
C denotes '×'

Then what is the value of (10 C 4) A (4 C 4) B 6?

(a) 60 (b) 50 (c) 56 (d) 46

DIRECTION (Q. 146): In this questions, two figure/ words are given to the left of the sign and one the sign:: with four alternatives under it out. of which one of the alternatives has the same relationship with the figures/words to the right of the sign:: as between the two figures/words to the left of the sign (::). Find the correct alternative.

146.



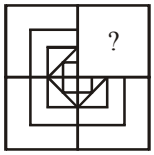
(a) 

(b) 

(c) 

(d) 

147. Identify the missing part of the figure and select it from the given alternatives.



(X)

(a) 

(b) 

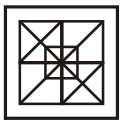
(c) 

(d) 

148. Figure (x) is embedded in anyone of the four alternative figures.

Choose the alternative which contains figure (x).

(X)

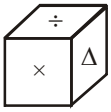
(a) 

(b) 

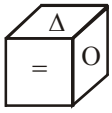
(c) 

(d) 

149. Which symbol will appear on the opposite surface to the symbol x?



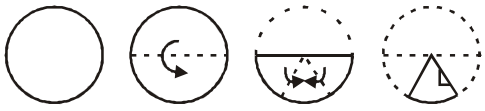
(i)



(ii)

(a) '÷' (b) '×' (c) '+' (d) '–'

150. The three figures marked X, Y, Z show the manner in which a paper is folded step by step and then cut. From the answer figures (a), (b), (c), (d), select the one, showing the unfolded position of the Paper after the cut.



P X Y Z

(a) 

(b) 

(c) 

(d) 

SOLUTIONS

PART - I : PHYSICS

1. (c) $\cos\theta = \dfrac{R^2 - A^2 - B^2}{2AB} = \dfrac{R^2 - R^2}{2AB} = 0$

$\therefore \theta = \pi/2$

2. (a) **3. (a)**

4. (a) If sum of angle of projection = 90° for given speed then range for that angle of projection is same.

5. (c)

6. (d) W = change in PE of COM of hanging part

$= \dfrac{M}{n} g \dfrac{L}{2n} = \dfrac{MgL}{2n^2}$

7. (c) Here $\hat{i}mv + \hat{j}mv = 2m\vec{V}$

That is $\vec{V} = \dfrac{v}{2}(\hat{i} + \hat{j})$

Hence $V = \dfrac{v}{2} \times \sqrt{2} = \dfrac{v}{\sqrt{2}}$. [Here $v = 5\ ms^{-1}$]

So, $V = \dfrac{5}{\sqrt{2}} ms^{-1}$

8. (c) For toppling about edge xx'

At the moment of toppling the normal force pass through axis xx'.

$F_{min} \dfrac{3a}{4} = mg \dfrac{a}{2}$ or $F_{min} = \dfrac{2mg}{3}$

9. (c)

10. (c) Maximum possible strain = 0.2/100

$\therefore A = \dfrac{F}{Y \times strain}$

$= \dfrac{10^4 \times 100}{(7 \times 10^9) \times 0.2} = 7.1 \times 10^{-4}\ m^2$

11. (c) According to principle of continuity

$v_y = \dfrac{v_x A_x}{A_y} = \dfrac{10(m/s) \times 2(cm^2)}{25 \times 10^{-2}(cm^2)} = 80\ m/s$

12. (b) $\dfrac{Q}{t} = \dfrac{KA\Delta\theta}{\ell} \Rightarrow 6000 = \dfrac{200 \times 0.75 \times \Delta\theta}{1}$

$\therefore \Delta\theta = \dfrac{6000 \times 1}{200 \times 0.75} = 40°C$

13. (b)

14. (a) Acceleration of the particle $a = 2t - 1$

The particle retards when acceleration is opposite to velocity.

$\Rightarrow a \,.\, v < 0 \Rightarrow (2t-1)(t^2 - t) < 0 \Rightarrow t(2t-1)(t-1) < 0$

Now t is always positive

$\therefore (2t-1)(t-1) < 0$

or $2t - 1 < 0$ and $t - 1 > 0 \Rightarrow t < \dfrac{1}{2}$ and $t > 1$.

This is not possible

or $2t - 1 > 0$ & $t - 1 < 0 \Rightarrow 1/2 < t < 1$

15. (a) **16. (b)**

17. (b) For an ideal gas PV = constant i.e., PV does not vary with V.

18. (d)

19. (a) Effective $g' = g - \dfrac{kq^2}{d^2 m}$, $T \propto \dfrac{1}{\sqrt{g_{eff.}}}$

20. (c) Let the frequency of the first fork be f_1 and that of second be f_2.

We then have, $f_1 = \dfrac{v}{4 \times 24}$ and $f_2 = \dfrac{v}{4 \times 25}$

We also see that $f_1 > f_2$

$\therefore f_1 - f_2 = 6$ ...(i)

and $\dfrac{f_1}{f_2} = \dfrac{24}{25}$ ...(ii)

Solving (i) and (ii), we get

$f_1 = 150$ Hz and $f_2 = 144$ Hz

21. (d) The path is a parabola, because initial velocity can be resolved into two rectangular components, one along $\vec{E}$ and other $\perp$ to $\vec{E}$. The former decreases at a constant rate and latter is unaffected. The resultant path is therefore a parabola.

22. (c)

23. (d) For a parallel plate capacitor $C = \dfrac{\varepsilon_0 A}{d}$

$\therefore A = \dfrac{Cd}{\varepsilon_0} = \dfrac{1 \times 10^{-3}}{8.85 \times 10^{-12}}$

$= 1.13 \times 10^8\ m^2$

This corresponds to area of square of side 10.6 km which shows that one farad is very large unit of capacitance.

24. (b) Potential gradient in the first case $= \dfrac{E_0}{\ell}$

$\therefore \quad E = \left(\frac{\ell}{3}\right).\left(\frac{E_0}{\ell}\right) = \frac{E_0}{3}$ ...(i)

Potential gradient in second case

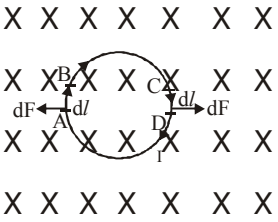
$= \frac{E_0}{3\ell/2} \quad (x)\frac{2E_0}{3\ell}$ ...(ii)

From equations (i) and (ii),

$\frac{E_0}{3} = \left(\frac{2E_0}{3\ell}\right) x \Rightarrow x = \frac{\ell}{2}$

25. (c) The magnetic field is perpendicular to the plane of the paper. Let us consider two diametrically opposite elements. By Fleming's Left hand rule on element AB the direction of force will be Leftwards and the magnitude will be

$dF = Idl\, B \sin 90° = IdlB$



On element CD, the direction of force will be towards right on the plane of the papper and the magnitude will be $dF = IdlB$.

26. (d)

27. (a) At the magnetic north pole, the magnetic needle will point vertically. There is no component of earth's magnetic field in the horizontal direction and the angle of dip (the angle that the resultant magnetic field at the place makes with the horizontal) is 90°.

$H = 0, \ \delta = 90°$ (maximum)

28. (c)

29. (a) $I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{6}{\sqrt{2}} = 3\sqrt{2}$ amp.

30. (a) If $\omega = 50 \times 2\pi$ then $\omega L = 20\Omega$

If $\omega' = 100 \times 2\pi$ then $\omega' L = 40\Omega$

Current flowing in the coil is

$I = \frac{200}{Z} = \frac{200}{\sqrt{R^2 + (\omega' L)^2}} = 4A$

31. (b) $\vec{E}_0 = \vec{B}_0 \times \vec{C}$

$|\vec{E}_0| = |B_0| \cdot |\vec{C}| = 20 \times 10^{-9} \times 3 \times 10^8 = 6 V/m.$

32. (b)

33. (c) $\lambda = \frac{(\mu - 1)t}{n}$ .....(1)

According to question

$n = 7 \, . \, \mu = 1.6, \ t = 7 \times 10^{-6}$ meter .....(2)

From eqs. (1) and (2), $\lambda = 6 \times 10^{-7}$ meter

34. (d)

35. (d) $\frac{1}{2}mv^2 = \frac{hc}{\lambda} - \phi$

$\frac{1}{2}m' = \frac{hc}{(3\lambda/4)} - \phi = \frac{4hc}{3\lambda} - \phi$

Clearly, $v' > \sqrt{\frac{4}{3}}v$

36. (d) $\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$. For first wavelength, $n_1 = 2, n_2 = 3$

$\Rightarrow \lambda_1 = 6563$ Å. For second wavelength, $n_1 = 2, n_2 = 4 \Rightarrow \lambda_2 = 4861$ Å

37. (a) The maximum kinetic energy of an electron accelerated through a potential difference of V volt is $\frac{1}{2}mv^2 = eV$

$\therefore$ maximum velocity $v = \sqrt{\frac{2eV}{m}}$

$v = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 15000}{9.1 \times 10^{-31}}}$

$v = 7.26 \times 10^7$ m/s

38. (b) Nuclear energy is relased in fission because BE/nucleon is larger for fission fragments than for parent nucleus.

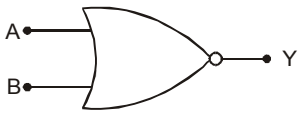
39. (c) $I = \frac{V}{R} = \frac{20}{2 \times 10^3} = 10 \times 10^{-3} A = 10$ mA

40. (b) The given gate is a NOR gate. The output is high, when all inputs are low.

Truth Table:

A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

Logic Symbols



Boolean expression : $\overline{A + B} = Y$

PART - II : CHEMISTRY

41. **(c)** Each has three significant figures. When zero is used to locate the decimal point, it is not considered as significant figure.

42. **(b)** Beryllium resembles with aluminium due to similarity in the size of ions and similarity in electropositive character. This type of resemblance between first element of a group in second period with second element of the next group is termed as diagonal relationship.

43. **(a)** The ionic radii follows the order
$O^{2-} > F^{-} > Li^{+} > B^{3+}$

44. **(a)** XeF_2 and IF_2^- both are linear and have hybridisation sp^3d.

45. **(c)** In pressure cooker, pressure is high thus, the boiling point of water increases, resulting cooking time is less than other open pots.

46. **(b)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$

According to thermodynamics's Ist law

$$\Delta H = \Delta E + nRT$$

Where ΔH = enthalpy of reaction at constant pressure
ΔE = heat of reaction at constant volume
R = molar gas constant
T = temperature of the reaction
n = (no. of moles of product) – (no. of moles of reactant.)

From reaction, $n = n_P - n_R = 2 - 4 = -2$

Hence, $\Delta H = \Delta E - 2RT$.

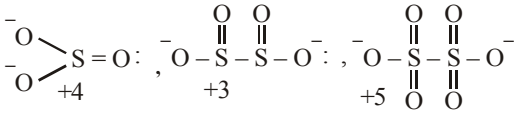
47. **(b)** For isothermal process, $\Delta E = 0$

48. **(c)** Ozone is allotropic form of oxygen and is of higher energy (by 68 K Cal mol^{-1}) than O_2. Hence it can not be taken as the reference in standard state.

49. **(d)** When the reaction is reversed,

$$K' = \frac{1}{K} = \frac{1}{0.25} = 4$$

50. **(d)** According to chemical bond method:



51. **(a)** Because of smaller size, Mg^{2+} ions are extensively hydrated.

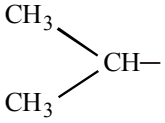
52. **(d)** It is mercury, because mercury exists as liquid at room temperature.

53. **(b)** The addition of HCl to propene proceeds by ionic mechanism and not by free radical mechanism. Hence it forms intermediate carbonium ion.

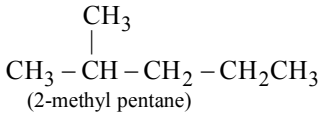
54. **(c)**

55. **(b)** $C_6H_5-\underset{\text{Keto}}{\overset{O}{\overset{\|}{C}}}-CH_3 \rightleftharpoons C_6H_5-\underset{\text{enol}}{\overset{OH}{\overset{|}{C}}}=CH_2$

56. **(b)**



Isopropyl group



(2-methyl pentane)

It contains isopropyl group.

57. **(a)** Particulates acquire negative charge and are attracted by the positive electrode.

58. **(d)**

59. **(a)** The average residence time of NO is 4 days.

60. **(c)** 4 atom are present in *fcc*.

$$\text{So, } V = 4\left[\frac{4}{3}\pi r^3\right] = \frac{16}{3}\pi r^3$$

61. **(d)** $\Delta T_f = K_f \times m \times i$. Since K_f has different values for different solvents, hence even if the m is the same ΔT_f will be different.

62. **(d)** $Ca(NO_3)_2 \rightleftharpoons Ca^{2+} + 2\,NO_3^-$

$1 - 0.71 \qquad 0.7 \qquad 2 \times 0.7$

$$(\because \alpha = \frac{70}{100} = 0.7)$$

$$\therefore\ i = 1 - 0.7 + 0.7 + 2 \times 0.7 = 2.4$$

$$n_2 = \frac{7}{164} = 0.042$$

$$n_1 = \frac{100}{18} = 5.55$$

$$\frac{p^0 - p_s}{p^0} = \frac{n_2 \times i}{n_1 + n_2}, \quad \frac{760 - p_s}{760}$$

$$= \frac{0.042 \times 2.4}{5.55 + 0.042}$$

$$\therefore\ p_s = 746 \text{ mm Hg.}$$

63. (d) In electrolytic purification cathode is of pure metal and anode is of impure metal.

At anode : $M \rightarrow M^{n+} + n\bar{e}$

At cathode : $M^{n+} + n\bar{e} \rightarrow M$.

The pure metal is thus deposited at cathode.

64. (d) $\text{Solublity} = \dfrac{\text{conductivity} \times 1000}{\Lambda_{eq}}$

$$= \frac{3.06 \times 10^{-6} \times 1000}{1.53} = 2 \times 10^{-3}$$

$K_{sp} = S^2 = 4 \times 10^{-6}$

65. (a) $Zn(s) + 2H^+ + (aq) \rightleftharpoons Zn^{2+}(aq) + H_2(g)$

$$E_{cell} = E°_{cell} - \frac{0.059}{2} \log \frac{[Zn^{2+}][H_2]}{[H^+]^2}$$

Addition of H_2SO_4 will increase $[H^+]$ and E_{cell} will also increase and the equilibrium will shift towards RHS.

66. (b) $O_3 \xrightarrow{\text{Fast}} O_2 + O,$

$O + O_3 \xrightarrow{\text{Slow}} 2O_2$

$$k = \frac{[O_2][O]}{[O_3]} \quad \ldots(i)$$

$\text{Rate} = k'[O_3][O] \quad \ldots(ii)$

put [O] from (ii)

$$r = \frac{k'[O_3]k[O_3]}{[O_2]} = k[O_3]^2[O_2]^{-1}$$

Note: Intermediates are never represented in rate law equation.

67. (b) Cuprite is Cu_2O and Argentite is Ag_2S.

68. (a) Cinnabar (HgS) is an ore of Hg.

69. (c) Both MnO_2 and $KMnO_4$ used for the preparation of chlorine by the action of conc. HCl

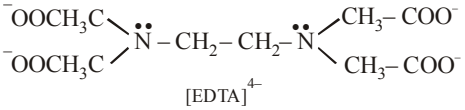
$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

$$2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$$

Chlorine is not obtained by dil. HCl

$$Ag_2S_2O_3 + H_2O \rightarrow \underset{\text{Black ppt.}}{Ag_2S} + H_2SO_4$$

70. (c)

71. (d) 

[EDTA]$^{4-}$

It can act as hexadentate ligand as it has six donar atoms (2 nitrogen atoms and 4 oxygen atom).

72. (c) The more is the stability of intermediate carbonium ion, the more is the chance of S_N1 mechanism. The intermediates obtained will be

$Ph\overset{+}{C}H_2$ (i), $Ph\overset{+}{C}H - Me$ (ii),

$Ph\overset{+}{C} - Me_2$ (iii), $Ph\overset{+}{C}MePh$ (iv).

The stabilty is of the order iv > iii > ii > i.

73. (a) When esters are hydrolysed , then acid and alcohol are formed, where acid gives hydrogen ion.

$$\underset{\text{Ester}}{R - \overset{\overset{O}{\|}}{C} - O - R} + HOH \xrightarrow{(\text{Conc.}H_2SO_4)} R\overset{\delta^-}{C}OO^{+\delta}H + R - OH$$

74. (c) Formaldehyde can not produce iodoform, as only those compound which contains either $CH_3 - \underset{\underset{OH}{|}}{CH} -$ group or $CH_3 - \underset{\underset{O}{\|}}{CH} -$ group on reaction with potassium iodide and sod. hypochlorite yield iodoform.

75. (b) Urea is obtained by heating ammonium cyanate

$$\underset{\text{Ammonium cyanate}}{NH_4CNO} \xrightarrow{\Delta} \underset{\text{Urea}}{NH_2CONH_2}$$

76. (b) Vitamin B_{12} does not occur in plants.

77. (a) $\dot{N}H_3 + H^+$ (acidic medium) $\rightleftharpoons NH_4^+$

78. (d) $PbCl_2$ is insoluble in cold water, soluble in hot water and PbS is black ppt in acidic medium.

79. (c) More the electron density on N, higher will be the basicity. Density on N is influenced by the (i) nature of the group (+I or –I) present in alkyl group or benzene nucleus and (ii) resonance (delocalisation of the

electron present on N). In $(C_6H_5)_3$ N: electron pair is delocalised to the maximum extent due to three benzene rings and hence least available for protonation, thus it will be least basic.

80. (b)

PART - III : MATHEMATICS

81. (a) Number of proper subsets of $A = 2^n - 1$
Given : $A = \{1, 2, 3, 4, 5\}$
Here $n = 5$
$\therefore$ no. of proper subsets $= 2^5 - 1$

82. (d) Let $y = \dfrac{x^2 - x + 1}{x^2 + x + 1}$

$\Rightarrow x^2(y-1) + x(y+1) + (y-1) = 0$

$\Rightarrow x = \dfrac{-(y+1) \pm \sqrt{(y+1)^2 - 4(y-1)^2}}{2(y-1)}$

$= \dfrac{-(y+1) \pm \sqrt{-3y^2 + 10y - 3}}{2(y-1)}$ is real iff

$y - 1 \neq 0 \Rightarrow y \neq 1$

If $y = 1$ then original equation gives $x = 0$, so taking $y = 1$

Also $3y^2 - 10y + 3 \leq 0$

$\Rightarrow (3y - 1)(y - 3) \leq 0$

$\Rightarrow y \in \left[\dfrac{1}{3}, 3\right]$ $\therefore$ Range is $\left[\dfrac{1}{3}, 3\right]$

83. (b) $\dfrac{1 - \cos\alpha + \sin\alpha}{1 + \sin\alpha}$

$= \dfrac{1 - \cos\alpha + \sin\alpha}{1 + \sin\alpha} \cdot \dfrac{1 + \cos\alpha + \sin\alpha}{1 + \cos\alpha + \sin\alpha}$

$= \dfrac{(1 + \sin\alpha)^2 - \cos^2\alpha}{(1 + \sin\alpha)(1 + \cos\alpha + \sin\alpha)}$

$= \dfrac{2\sin\alpha(1 + \sin\alpha)}{(1 + \sin\alpha)(1 + \cos\alpha + \sin\alpha)}$

$= \dfrac{2\sin\alpha}{1 + \cos\alpha + \sin\alpha} = y$

84. (c) $\dfrac{\sin\theta + \sin 2\theta}{\cos\theta + \cos 2\theta} = \dfrac{2\sin\left(\dfrac{3\theta}{2}\right)\cos\left(\dfrac{\theta}{2}\right)}{2\cos\left(\dfrac{3\theta}{2}\right)\cos\left(\dfrac{\theta}{2}\right)} = \tan\left(\dfrac{3\theta}{2}\right)$

Hence period $= \dfrac{2\pi}{3}$

85. (c) We have, $8\tan^2\dfrac{x}{2} = 1 + \sec x$

$\Rightarrow 8\left(\dfrac{1 - \cos x}{1 + \cos x}\right) = 1 + \dfrac{1}{\cos x} = \dfrac{1 + \cos x}{\cos x}$

$\Rightarrow 8\cos x - 8\cos^2 x = (1 + \cos x)^2$

$\Rightarrow 9\cos^2 x - 6\cos x + 1 = 0$

$\Rightarrow (3\cos x - 1)^2 = 0 \Rightarrow 3\cos x - 1 = 0$

$\Rightarrow \cos x = \dfrac{1}{3} = \cos\alpha$ (say) $\Rightarrow x = 2n\pi \pm \alpha$

$\therefore x = 2n\pi \pm \cos^{-1}\left(\dfrac{1}{3}\right)$, where $n \in I$

86. (c) $10^n + 3(4^{n+2}) + 5$ Taking $n = 2$;

$10^2 + 3 \times 4^4 + 5 = 100 + 768 + 5 = 873$

Therefore this is divisible by 9.

87. (c) Here Let $x - \alpha$ is the common factor
then $x = \alpha$ is root of the corresponding equation $\therefore \alpha^2 - 11\alpha + a = 0$
$\alpha^2 - 14\alpha + 2a = 0$
Subtracting $3\alpha - a = 0 \Rightarrow \alpha = a/3$

Hence $\dfrac{a^2}{9} - 11\dfrac{a}{3} + a = 0$, $a = 0$ or $a = 24$

since $a \neq 0$, $a = 24$

$\therefore$ the common factor of $\begin{cases} x^2 - 11x + 24 \\ x^2 - 14x + 48 \end{cases}$ is

clearly $x - 8$

88. (d) $\dfrac{1}{x+a} - \dfrac{1}{x+b} = \dfrac{1}{x+c}$

or $x^2 + (a+b)x + ab = (b-a)x + (b-a)c$
or $x^2 + 2ax + ab + ca - bc = 0$
Since product of the roots $= 0$

$ab + ca - bc = 0$; $a = \dfrac{bc}{b+c}$

Thus sum of roots $= -2a = \dfrac{-2bc}{b+c}$

89. (a) $\overline{z}_1 = \dfrac{z_1\overline{z}_1}{z_1} = |z_1|^2 z_1^{-1}$

$\Rightarrow \arg(z_1^{-1}) = \arg(\overline{z}_1) \Rightarrow \arg(z_2)$

$\Rightarrow z_2 = kz_1^{-1}$ $(k > 0)$

90. (d) $\frac{2x+3}{5} < \frac{4x-1}{2} \Rightarrow -16x < -11$

$\Rightarrow 16x > 11 \Rightarrow x > \frac{11}{16}$

Hence, $x \in \left(\frac{11}{16}, \infty\right)$

91. (c) Rank $= (4! \times 3) + (3! \times 2) + (2! \times 2) + 1$
$= 72 + 12 + 4 + 1 = 89$

92. (a) ${}^{n}C_1 + {}^{n}C_2 = 36 \Rightarrow n = 8$

$T_3 = 7\,T_2 \Rightarrow (2^x)^3 = 1/2$

$3x = -1 \Rightarrow x = -\frac{1}{3}$

93. (c) 1^{st} term $\to 1$, 2^{nd} term $= 2$, 4^{th} term $\to 3$,
7^{th} term $\to 4$, 11^{th} term $\to 5$,...
Series is 1, 2, 4, 7, 11,...

$a_n = 1 + \frac{n(n-1)}{2} = \frac{n^2 - n + 2}{2}$

If $n = 14$, then $a_n = 92$, If $n = 15$, then $a_n = 106$.

94. (a) As (–1, 1) is a point on $3x - 4y + 7 = 0$, the rotation is possible. Slope of the given line = 3/4. Slope of the line in its new position

$= \frac{\frac{3}{4} - 1}{1 + \frac{3}{4}} = -\frac{1}{7}$

The required equation is

$y - 1 = -\frac{1}{7}(x + 1)$ or $7y + x - 6 = 0$.

95. (a) The given equation of Parabola can be written as

$\left(x - \frac{1}{2}\right)^2 - 8y + 19 - \frac{1}{4} = 0$

$\left(x - \frac{1}{2}\right)^2 = 8y - \frac{76 - 1}{4}$

$\Rightarrow \left(x - \frac{1}{2}\right)^2 = 8\left(y - \frac{75}{32}\right)$ $\therefore$ vertex $= \left(\frac{1}{2}, \frac{75}{32}\right)$

96. (c) $f'(t) = \frac{d}{dt}\left[\frac{1-t}{1+t}\right] = \frac{(1+t)(-1) - (1-t) \times (1)}{(1+t)^2}$

$= \frac{-1 - t - 1 + t}{(1+t)^2} = \frac{-2}{(1+t)^2}$

$f'[1/t] = \frac{-2}{\left(1 + \frac{1}{t}\right)^2} = \frac{-2t^2}{(t+1)^2}$

97. (a) $\sim p \vee q$: Raju is not tall or he is intelligent.

98. (a)

Marks	No. of students	c.f.
10-20	12	12
20-30	30	42
30-40	?	42+x
40-50	65	107+x
50-60	?	107+x+y
60-70	25	132+x+y
70-80	18	150+x+y
Total	**229**	

$\frac{n}{2} = \frac{229}{2} = 114.5$, Median $= 46$

$\therefore$ Median class $= 40 - 50$

$\therefore$ $\ell = 40$, c.f. $= 42 + x$, $f = 65$, $h = 10$

Median $= \ell + \left(\frac{\frac{n}{2} - \text{c.f.}}{f}\right) \times h$

$46 = 40 + \frac{114.5 - (42 + x)}{65} \times 10$

or $46 - 40 = \frac{(114.5 - 42 - x)}{13} \times 2$

$6 = \frac{(72.5 - x)}{13} \times 2$ or $78 = 145 - 2x$

$2x = 145 - 78 = 67$ or $x = \frac{67}{2} = 33.5$

$\therefore$ $x = 34$ ($\because$ Number of students cannot be in fraction) Now $\Sigma f_i = 29$ $\therefore$ $x + y + 150 = 229$
$x + y = 229 - 150 = 79$ ..... (i)
Putting the value of x in (i), we get
$34x + y = 79 \Rightarrow y = 79 - 34 = 45$
$\therefore$ $x = 34, y = 45$

99. (b) Since the function f is bijective, therefore f is onto. Therefore range of f = B.
Let $y = -x^2 + 6x - 8$
$\Rightarrow x^2 - 6x + (8 + y) = 0$

$\Rightarrow x = \frac{6 \pm \sqrt{36 - 4(8+y)}}{2} = \frac{6 \pm \sqrt{4 - 4y}}{2}$

For x to be real, $4 - 4y \geq 0 \Rightarrow y \leq 1$
$\therefore$ B = range of F $= (-\infty, 1]$

100. (a) $2\tan^{-1}\frac{1}{5}+\tan^{-1}\frac{1}{2}+2\tan^{-1}\frac{1}{8}$

$=2\tan^{-1}\frac{\frac{1}{5}+\frac{1}{8}}{1-\frac{1}{5}\cdot\frac{1}{8}}+\tan^{-1}\frac{1}{7}$

$=2\tan^{-1}\frac{1}{3}+\tan^{-1}\frac{1}{7}=\tan^{-1}\frac{2\cdot\frac{1}{3}}{1-\frac{1}{9}}+\tan^{-1}\frac{1}{7}$

$=\tan^{-1}\frac{3}{4}+\tan^{-1}\frac{1}{7}=\tan^{-1}\frac{\frac{3}{4}+\frac{1}{7}}{1-\frac{3}{4}\cdot\frac{1}{7}}$

$=\tan^{-1}\frac{25}{25}=\tan^{-1}1=45°=\frac{\pi}{4}$

101. (c) For two 2×2 matrices, A & B

$(A-B)\times(A+B)$

$=A\times A+A\times B-B\times A-B\times B$

$=A^2-B^2+AB-BA$

Hence, $(A-B)(A+B)=A^2+AB-BA-B^2$

102. (a) Let A be the 1st term and R the common ratio of G.P., then

$a=T_p=AR^{p-1}$

$\therefore \log a=\log A+(p-1)\log R$

Similarly, $\log b=\log A+(q-1)\log R$

and $\log c=\log A+(r-1)\log R$

$\therefore \Delta=\begin{vmatrix}\log A+(p-1)\log R & p & 1\\ \log A+(q-1)\log R & q & 1\\ \log A+(r-1)\log R & r & 1\end{vmatrix}$

Split into two determinants and in the first take logA common and in the second take log R common

$\Delta=\log A\begin{vmatrix}1 & p & 1\\ 1 & q & 1\\ 1 & r & 1\end{vmatrix}+\log R\begin{vmatrix}p-1 & p & 1\\ q-1 & q & 1\\ r-1 & r & 1\end{vmatrix}$

Apply $C_1\to C_2\to C_3$ in the second

$\Delta=0+\log R\begin{vmatrix}0 & p & 1\\ 0 & q & 1\\ 0 & r & 1\end{vmatrix}=0$

103. (a) $R_3\to 100R_1+10R_2+R_3$

$\Rightarrow\begin{vmatrix}A & 6 & 8\\ 8 & B & 6\\ 8 & 8 & C\end{vmatrix}=\begin{vmatrix}A & 6 & 8\\ 8 & B & 6\\ A88 & 6BC & 86C\end{vmatrix}$

which is divisible by 72.

104. (c) $[M(\alpha)\,M(\beta)]^{-1}=M(\beta)^{-1}\,M(\alpha)^{-1}]$

Now $M(\alpha)^{-1}=\begin{bmatrix}\cos\alpha & \sin\alpha & 0\\ -\sin\alpha & \cos\alpha & 0\\ 0 & 0 & 1\end{bmatrix}$

$=\begin{bmatrix}\cos(-\alpha) & -\sin(-\alpha) & 0\\ \sin(-\alpha) & \cos(-\alpha) & 0\\ 0 & 0 & 1\end{bmatrix}=M(-\alpha)$

$M(\beta)^{-1}=\begin{bmatrix}\cos\beta & 0 & -\sin\beta\\ 0 & 1 & 0\\ \sin\beta & 0 & \cos\beta\end{bmatrix}$

$=\begin{bmatrix}\cos(-\beta) & 0 & \sin(-\beta)\\ 0 & 1 & 0\\ -\sin(-\beta) & 0 & \cos(-\beta)\end{bmatrix}=M(-\beta)$

$[M(\alpha)\,M(\beta)]^{-1}=M(-\beta)\,M(-\alpha)$

105. (a) Let $y=e^{-x}\cos x$

$y_1=-e^{-x}\sin x-e^{-x}\cos x=-e^{-x}\sin x-y$

$y_2=-e^{-x}\cos x+e^{-x}\sin x-y_1$

$\Rightarrow\quad y_2=-y-y_1+e^{-x}\sin x=-2(y+y_1)$

$\Rightarrow\quad y_3=-2(y_1+y_2)=-2(e^{-x}\sin x-y)$

$\Rightarrow\quad y_4=4y_1+2y_2=4y_1-4y-4y_1$ or $y_4+4y=0$

$\Rightarrow\quad k=4$

106. (a) Let $f(x)=\frac{1}{\log|x|}$

The points of disconinuity of f(x) are those points where

f(x) is undefined or infinite. It is undefined when x = 0 and is infinite when

$\log|x|=0,\ |x|=1$, i.e. $x=\pm1$.

$\therefore$ Set of points of discontinuity = {–1, 0, 1}.

107. (a) $\frac{dy}{dx}=\frac{d}{dx}(x^4-2x^2+1)=4x(x^2-1)$

For max. or min, $\frac{dy}{dx}=0$

$4x(x^2-1)=0$; either $x=0$ or $x=\pm1$

$x=0$ and $x=-1$ does not belong to $\left[\frac{1}{2},2\right]$

$\frac{d^2y}{dx^2}=12x^2-4\ \therefore\left(\frac{d^2y}{dx^2}\right)_{x=1}$

$=12(1)^2-4=8>0$

$\therefore$ there is minimum value of function at x = 1

$\therefore$ minimum value is

$y(1)=1^4-2(1)^2+1=1-2+1=0$

108. (a) We have ; $f(x) = \sin x - \cos x - ax + b$

$\Rightarrow f'(x) = \cos x + \sin x - a$

$\Rightarrow f'(x) < 0 \ \forall \ x \in R$

$\Rightarrow (\cos x + \sin x) < a \ \forall \ x \in R$

As the max. value of $(\cos x + \sin x)$ is $\sqrt{2}$

The above is possible when $a \geq \sqrt{2}$

109. (b) $y = \sin x \Rightarrow \dfrac{dy}{dx} = \cos x \Rightarrow \left(\dfrac{dy}{dx}\right)_{(\pi, 0)} = -1$

Therefore the equation of tangent at $(\pi, 0)$ is given by

$y - 0 = -1(x - \pi) \Rightarrow x + y = \pi$

110. (b) $\dfrac{d}{dx}(A \ln|\cos x + \sin x - 2| + Bx + C)$

$= A\dfrac{\cos x - \sin x}{\cos x + \sin x - 2} + B$

$= \dfrac{A\cos x - A\sin x + B\cos x + B\sin x - 2B}{\cos x + \sin x - 2}$

$\therefore 2 = A + B$ or $-1 = -A + B; \lambda = -2B$

$\therefore A = 3/2, B = 1/2, \lambda = -1$

111. (a) $\int x\tan^{-1}x\,dx = \dfrac{x^2}{2}\tan^{-1}x - \dfrac{1}{2}\int\dfrac{x^2}{1+x^2}dx$

$= \dfrac{x^2}{2}\tan^{-1}x - \dfrac{1}{2}\int\left[1 - \dfrac{1}{1+x^2}\right]dx$

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

112. (a) $\int\dfrac{dx}{\sqrt{2-x^2}} = \sin^{-1}\dfrac{x}{\sqrt{2}} + c$

So $\int_0^1\dfrac{dx}{\sqrt{2-x^2}} = \sin^{-1}\dfrac{x}{\sqrt{2}}\Big|_0^1$

$= \sin^{-1}\left(\dfrac{1}{\sqrt{2}}\right) + c - \sin^{-1}(0) - c = \dfrac{\pi}{4} - 0 = \dfrac{\pi}{4}$

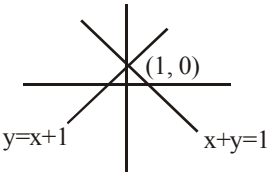
113. (c) $\int_0^n [x]\,dx = \int_0^1 0\,dx + \int_1^2 1\,dx + \int_2^3 2\,dx + \ldots\ldots + \int_{n-1}^n (n-1)\,dx$

$= 1 + 2 + 3 + \ldots\ldots + (n-1) = \dfrac{(n-1)n}{2} = 66$

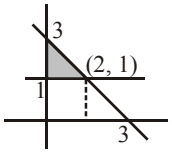
$\Rightarrow n(n-1) = 132 \Rightarrow n = 12$

114. (a) $x^2 - y^2 + 2y = 1 \Rightarrow x = \pm(y-1)$

Bisectors of above line are $x = 0$ & $y = 1$



So area between $x = 0$, $y = 1$ & $x + y = 3$ is shaded Region shown in figure.



Area = ½ × 2 × 2 = 2 sq. units

115. (c) $\dfrac{dy}{dx} + \dfrac{1}{x}.y = \sin x \quad \left[\text{Type } \dfrac{dy}{dx} + Py = Q\right]$

$e^{\int P dx} = e^{\int\frac{1}{x}dx} = e^{\log x} = x$

$\therefore$ Sol. is $y\,x = \int x\sin x\,dx + C$

$= x(-\cos x) - \int 1.(-\cos x)dx + C$

$= -x\cos x + \sin x + C \Rightarrow x(y + \cos x) = \sin x + C$

116. (c) The point $(4, 2, k)$ on the line also lies on the plane $2x - 4y + z = 7$.

So, $8 - 8 + k = 7 \ \Rightarrow \ k = 7$

117. (c) Let the components of the line vector be a, b, c.

Then $a^2 + b^2 + c^2 = (63)^2$ ... (i)

Also $\dfrac{a}{3} = \dfrac{b}{-2} = \dfrac{c}{6} = \lambda$ (say), then $a = 3\lambda$, $b = -2\lambda$ and $c = 6\lambda$ and from (i) we have

$9\lambda^2 + 4\lambda^2 + 36\lambda^2 = (63)^2$

$\Rightarrow \quad 49\lambda^2 = (63)^2$

$\Rightarrow \quad \lambda = \pm\dfrac{63}{7} = \pm 9$

Since $a = 3\lambda < 0$ as the line makes an obtuse angle with x-axis, $\lambda = -9$ and the required components are $-27, 18, -54$.

118. (b) $P(A) = 1/4, P(A/B) = \dfrac{1}{2}, P(B/A) = 2/3$

By conditional probability,

$P(A \cap B) = P(A)\,P(B/A) = P(B)P(A/B)$

$\Rightarrow \dfrac{1}{4}\times\dfrac{2}{3} = P(B)\times\dfrac{1}{2} \Rightarrow P(B) = \dfrac{1}{3}$

119. (b) Since, $\Sigma P_i(X = x) = 1$

$\therefore k+3k+5k+2k+k=1 \therefore 12k=1 \therefore k=\frac{1}{12}$

Now, $P(X\geq 2)=P(X=2)+P(X=3)+P(X=4)$

$=5k+2k+k=8k=8\left(\frac{1}{12}\right)=\frac{2}{3}$

120. (b) $A+B=180°-C=90°$

$a=2R\sin A,\ b=2R\sin B,\ c=2R\sin C$

$$\therefore \frac{a^2-b^2}{a^2+b^2}=\frac{\sin^2 A-\sin^2 B}{\sin^2 A+\sin^2 B}$$

$$=\frac{\sin(A+B)\sin(A-B)}{\sin^2 A+\sin^2(90°-A)}$$

$[\because A+B=90°]$

$$=\frac{\sin 90°\sin(A-B)}{\sin^2 A+\cos^2 A}=\sin(A-B)$$

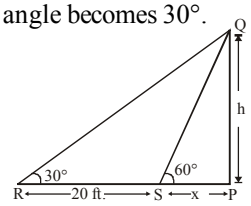
121. (d) Let h be the height of tree PQ and breadth of river PS be x ft. Angle of elevation subtended by a tree is 60°. Also, when he retreats 20 feet, the angle becomes 30°.

Also, in ΔPQS,

$\tan 60°=\frac{h}{x}$

$\Rightarrow h=\sqrt{3}x$

and in ΔPQR,



$$\tan 30°=\frac{h}{x+20} \Rightarrow \frac{1}{\sqrt{3}}=\frac{h}{x+20}$$

$\Rightarrow x+20=\sqrt{3}h$

$\Rightarrow x+20=3x \Rightarrow 2x=20 \Rightarrow x=10$

Hence breadth of river is 10 ft.

122. (c)

123. (a) Since $|r|>1,\ \frac{1}{|r|}<1$

$$\therefore\ x=\frac{a}{1-\frac{1}{r}}=\frac{ar}{r-1}$$

Similarly, $y=\frac{b}{1-\left(-\frac{1}{r}\right)}=\frac{br}{r+1}$ and

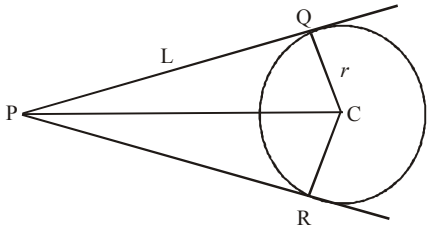
$$z=\frac{c}{1-\frac{1}{r^2}}=\frac{cr^2}{r^2-1} \quad ...(1)$$

$$\therefore\ xy=\frac{ar}{r-1}\times\frac{br}{r+1}=\frac{abr^2}{r^2-1} \quad ...(2)$$

Dividing (2) by (1), we get

$$\frac{xy}{z}=\frac{abr^2}{r^2-1}\times\frac{r^2-1}{cr^2}=\frac{ab}{c}$$

124. (a) Area PQCR $=2\Delta PQC=2\times\frac{1}{2}L\times r$



where L = length of tangent and r = radius of circle.

$L=\sqrt{S_1}=15$ and $r=\sqrt{1+4+20}=5$

Hence the required area = 75 sq. units.

125. (b)

$$\lim_{x\to 0}\frac{(4^x-1)^3}{\sin\frac{x^2}{4}\log(1+3x)}$$

$$=\lim_{x\to 0}\frac{(4^x-1)^3}{x^3}\cdot\frac{(x/2)^2}{\sin x^2/4}\cdot\frac{3x}{\log(1+3x)}\cdot\frac{4}{3}$$

$$=\frac{4}{3}(\log_e 4)^3.1.\log_e(e)=\frac{4}{3}(\log_e 4)^3.$$

PART - IV : ENGLISH

126. (a) **127. (d)** **128. (c)** **129. (b)**
130. (b) Rigorous **131. (a)** **132. (b)**
133. (a) **134. (c)** **135. (a)** **136. (d)**
137. (c) **138. (d)** **139. (b)** **140. (b)**

141. (b) Distance is measured by Odometer. Similarly, Pressure is measured by Barometer.

142. (c) The number should be 123.
$\times 1+3, \times 2+6, \times 3+9\ldots\ldots$

143. (d) Clearly, the company intends to reduce the gap between income and expenditure by increasing the price of its product i.e. by keeping the expenditure unaltered and increasing the income only. So, II is implicit while I is not. However, the rival companies may or may not follow the same pursuit. So, III is not implicit.

144. (a)

145. (b) Using correct symbols we have:
$(10\times 4)+(4\times 4)-6=40+16-6=50$

146. (d) **147. (b)** **148. (b)** **149. (d)**
150. (b)