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 : (A) English Proficiency Q. No. 81 to 95

(B) Logical Reasoning Q. No. 96 to 105

Part IV : Mathematics Q. No. 106 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. An organ pipe, open from both end produces 5 beats per second when vibrated with a source of frequency 200 Hz. The second harmonic of the same pipes produces 10 beats per second with a source of frequency 420 Hz. The fundamental frequency of organ pipe is

(a) 195 Hz (b) 205 Hz

(c) 190 Hz (d) 210 Hz

2. A vessel of depth 2d cm is half filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2. The apparent depth of the vessel seen perpendicularly is

(a) $\left(\frac{2\mu_1\mu_2}{\mu_1+\mu_2}\right)d$ (b) $\left(\frac{\mu_1+\mu_2}{2\mu_1\mu_2}\right)d$

(c) $\left(\frac{\mu_1+\mu_2}{2}\right)d$ (d) $\left(\frac{2\mu_1\mu_2}{\mu_1+\mu_2}\right)2d$

3. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by

(a) $2\cos\phi$ (b) $2\sin\phi$

(c) $\tan\phi$ (d) $2\tan\phi$

4. A body of density ρ' is dropped from rest at a height h into a lake of density ρ where $\rho > \rho'$ neglecting all dissipative forces, calculate the maximum depth to which the body sinks before returning to float on the surface : h $h\rho'$

(a) $\frac{h\rho'}{\rho-\rho'}$ (b) $\frac{h\rho}{\rho}$

(c) $\frac{h\rho'}{\rho-\rho'}$ (d) $\frac{h\rho}{\rho-\rho'}$

5. If the forward voltage in a semiconductor diode is changed from 0.5V to 0.7 V, then the forward current changes by 1.0 mA. The forward resistance of diode junction will be

(a) 100 W (b) 120 W

(c) 200 W (d) 240 W

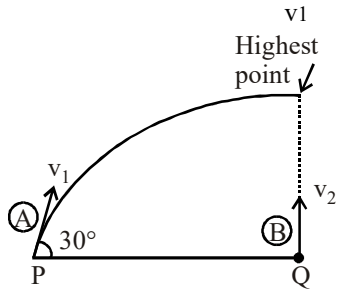
6. The heat generated in a circuit is given by $Q = I^2Rt$, where I is current, R is resistance and t is time. If the percentage errors in measuring I, R and t are 2%, 1% and 1% respectively, then the maximum error in measuring heat will be

(a) 2% (b) 3% (c) 4% (d) 6%

7. The r.m.s. velocity of oxygen molecule at 16ºC is 474 m/sec. The r.m.s. velocity in m/s of hydrogen molecule at 127ºC is

(a) 1603 (b) 1896 (c) 2230.59 (d) 2730

8. A projectile A is thrown at an angle of 30° to the horizontal from point P. At the same time, another projectile B is thrown with velocity v_2 upwards from the point Q vertically below the highest point. For B to collide with A, v_2 should be



(a) 1 (b) 2

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

9. The coefficient of friction between the rubber tyres and the road way is 0.25. The maximum speed with which a car can be driven round a curve of radius 20 m without skidding is ($g = 9.8\ m/s^2$)

(a) 5 m/s (b) 7 m/s

(c) 10 m/s (d) 14 m/s

10. A boy pushes a toy box 2.0 m along the floor by means of a force of 10 N directed downward at an angle of 60º to the horizontal. The work done by the boy is

(a) 6 J (b) 8 J (c) 10 J (d) 12 J

11. The engine of a truck moving along a straight road delivers constant power. The distance travelled by the truck in time t is proportional to

(a) t (b) t^2 (c) $\sqrt{t}$ (d) $t^{3/2}$

12. The escape velocity from a planet is v_e. A tunnel is dug along a diameter of the planet and a small body is dropped into it at the surface. When the body reaches the centre of the planet, its speed will be

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

(c) $v_e/2$ (d) zero

13. If the the earth is at one-fourth of its present distance from the sun, the duration of year will be

(a) half the present year

(b) one-eight the present year

(c) one-fourth the present year

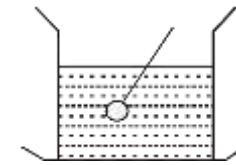
(d) one-sixth the present year

14. A vessel with water is placed on a weighing pan and it reads 600 g. Now a ball of mass 40 g and density 0.80 g cm^{-3} is sunk into the water with a pin of negligible volume, as shown in figure keeping it sunk. The weighing pan will show a reading

(a) 600 g

(b) 550 g

(c) 650 g (d) 632 g



15. In an adiabatic process, the pressure is increased by $\frac{2}{3}$%. If $g = \frac{3}{2}$, then the volume decreases by nearly

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

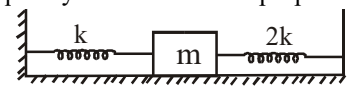
16. The equation of a projectile is $y = \sqrt{3}x - \frac{gx^2}{2}$

The angle of projection is given by

(a) $\tan q = \frac{1}{\sqrt{3}}$ (b) $\tan q = \sqrt{3}$

(c) $\frac{p}{2}$ (d) zero.

17. Frequency of oscillation is proportional to



(a) $\sqrt{\frac{3k}{m}}$ (b) $\sqrt{\frac{k}{m}}$

(c) $\sqrt{\frac{2k}{m}}$ (d) $\sqrt{\frac{m}{3k}}$

18. Two wires A and B of the same material, having radii in the ratio 1 : 2 and carry currents in the ratio 4 : 1. The ratio of drift speed of electrons in A and B is

(a) 16 : 1 (b) 1 : 16 (c) 1 : 4 (d) 4 : 1

19. An instantaneous displacement of a simple harmonic oscillator is $x = A \cos(\omega t + \pi/4)$. Its speed will be maximum at time

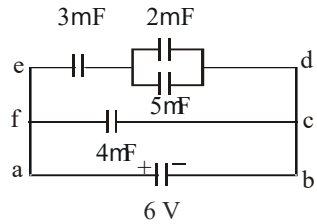
(a) $\pi/4\,\omega$ (b) $\pi/2\,\omega$ (c) π/ω (d) $2\pi/\omega$

20. The energy of electron in the nth orbit of hydrogen atom is expressed as $E_n = \frac{-13.6}{n^2}$ eV.

The shortest and longest wavelength of Lyman series will be

(a) 910 Å, 1213 Å (b) 5463 Å, 7858 Å
(c) 1315 Å, 1530 Å (d) None of these

21. In the circuit given below, the charge in mC, on the capacitor having 5 mF is



(a) 4.5 (b) 9 (c) 7 (d) 15

22. A crystal has a coefficient of expansion 13×10^{-7} in one direction and 231×10^{-7} in every direction at right angles to it. Then the cubical coefficient of expansion is

(a) 462×10^{-7} (b) 244×10^{-7}
(c) 475×10^{-7} (d) 257×10^{-7}

23. A solid cylinder and a hollow cylinder both of the same mass and same external diameter are released from the same height at the same time on an inclined plane. Both roll down without slipping. Which one will reach the bottom first?

(a) Solid cylinder
(b) Both together
(c) One with higher density
(d) Hollow cylinder

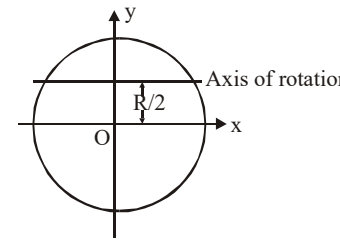
24. A whistle of frequency 1000 Hz is sounded on a car travelling towards a cliff with velocity of 18 m s^{-1} normal to the cliff. If c = 330 m s^{-1}, then the apparent frequency of the echo as heard by the car driver is nearly

(a) 1115 Hz (b) 115 Hz
(c) 67 Hz (d) 47.2 Hz

25. A thin sheet of glass ($\mu = 1.5$) of thickness 6 micron introduced in the path of one of the interfering beams in a double slit experiment shifts the central fringe to a position previously occupied by fifth bright fringe. Then the wavelength of light used is

(a) 6000 Å (b) 3000 Å
(c) 4500 Å (d) 7500 Å

26. M.I of a circular loop of radius R about the axis in figure is



(a) MR^2 (b) $(3/4)\,MR^2$
(c) $MR^2/2$ (d) $2MR^2$

27. Three charge q, Q and 4q are placed in a straight line of length l at points distant 0, $\frac{l}{2}$ and l respectively from one end. In order to make the net froce on q zero, the charge Q must be equal to

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

28. In series combination of R, L and C with an A.C. source at resonance, if R = 20 ohm, then impedence Z of the combination is

(a) 20 ohm (b) zero
(c) 10 ohm (d) 400 ohm

29. An electron moves in a circular arc of radius 10 m at a contant speed of 2×10^7 ms^{-1} with its plane of motion normal to a magnetic flux density of 10^{-5} T. What will be the value of specific charge of the electron?

(a) 2×10^4 C kg^{-1} (b) 2×10^5 C kg^{-1}
(c) 5×10^6 C kg^{-1} (d) 2×10^{11} C kg^{-1}

30. From a 200 m high tower, one ball is thrown upwards with speed of 10 ms^{-1} and another is thrown vertically downwards at the same

speeds simultaneously. The time difference of their reaching the ground will be nearest to

(a) 12 s (b) 6 s (c) 2 s (d) 1 s

31. A wheel is rotating at 900 r.p.m. about its axis. When power is cut off it comes to rest in 1 minute.

The angular retardation in rad/s^2 is

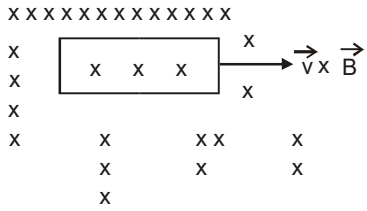
(a) p/2 (b) p/4 (c) p/6 (d) p/8

32. A particle executing simple harmonic motion along y-axis has its motion described by the equation $y = A\sin(\omega t) + B$. The amplitude of the simple harmonic motion is

(a) A (b) B

(c) A + B (d) $\sqrt{A+B}$

33. A conducting square loop of side L and resistance R moves in its plane with a uniform velocity v perpendicular to one of its side. A magnetic induction B constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere.



The current induced in the loop is

(a) $\frac{B\ell v}{R}$ clockwise

(b) $\frac{B\ell v}{R}$ anticlockwise

(c) $\frac{2B\ell v}{R}$ anticlockwise

(d) zero

34. A body of mass 2 kg is placed on a horizontal surface having kinetic friction 0.4 and static friction 0.5. If the force applied on the body is 2.5 N, then the frictional force acting on the body will be [g = 10 ms^{-2}]

(a) 8 N (b) 10 N (c) 20 N (d) 2.5 N

35. A nucleus splits into two nuclear parts which have their velocity ratio equal to 2 : 1. What will be the ratio of their nuclear radius?

(a) $2^{1/3} : 1$ (b) $1 : 2^{1/3}$

(c) $3^{1/2} : 1$ (d) $1 : 3^{1/2}$

36. A charge +q is at a distance L/2 above a square of side L. Then what is the flux linked with the surface?

(a) $\frac{q}{4\epsilon_0}$ (b) $\frac{2q}{3\epsilon_0 q}$

(c) $\frac{6q}{6\epsilon_0}$ (d) $\frac{}{\epsilon_0}$

37. A plane electromagnetic wave is incident on a plane surface of area A, normally and is perfectly reflected. If energy E strikes the surface in time t then average pressure exerted on the surface is

(c = speed of light)

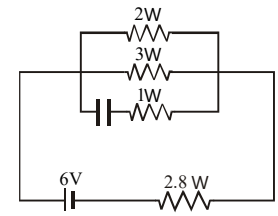
(a) zero (b) E/Atc

(c) 2E/Atc (d) E/c

38. There are two wire of same material and same length while the diameter of second wire is two times the diameter of first wire, then the ratio of extension produced in the wires by applying same load will be

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

39. Determine the current in 2W resistor.



(a) 1 A (b) 1.5 A (c) 0.9 A (d) 0.6 A

40. The potential energy of a satellite of mass m and revolving at a height R_e above the surface of earth where R_e = radius of earth, is

(a) $-mgR_e$ (b) $\frac{-mgR_e}{2}$

(c) $\frac{-mgR_e}{3}$ (d) $\frac{-mgR_e}{4}$

PART - II : CHEMISTRY

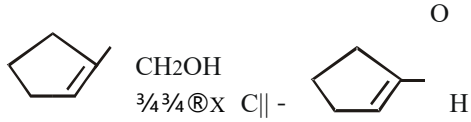
41. If 0.2 gram of an organic compound containing carbon, hydrogen and oxygen on combustion, yielded 0.147 gram carbon dioxide and 0.12 gram water. What will be the content of oxygen in the substance ?

(a) 73.29% (b) 78.45%

(c) 83.23% (d) 89.50%

42. The Lassaigne's extract is boiled with dil. HNO_3 before testing for halogens because
(a) silver halides are soluble in HNO_3
(b) Na_2S and NaCN are decomposed by HNO_3
(c) Ag_2S is soluble in HNO_3
(d) AgCN is soluble in HNO_3

43. What is X in the following conversion ?



(a) $K_2Cr_2O_7$, H_2SO_4/H_2O
(b) HIO_4
(c) PCC/CH_2Cl_2
(d) OsO_4, $(CH_3)_3C.COOH$, $(CH_3)_3COH$, OH^-

44. Maleic acid and fumaric acids are
(a) Chain isomers
(b) Functional isomers
(c) Tautomers
(d) Geometrical isomers

45. For which one of the processes represented by the following equations the enthalpy (heat) change is likely to be negative

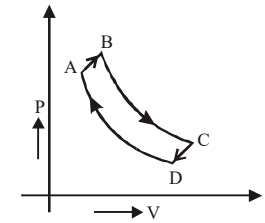
(a) $Cl(g)^- + aq \rightarrow Cl(aq)^-$

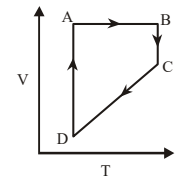
(b) $Cl(g) \rightarrow Cl^+(g) + e^-$

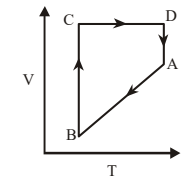
(c) $1/2Cl_2(g) \rightarrow Cl(g)$

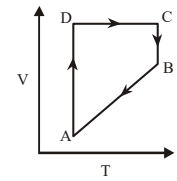
(d) $Cl_2(l) \rightarrow Cl(g)_2$

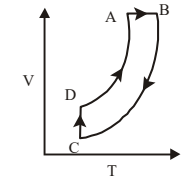
46. A cyclic process ABCD is shown in P–V diagram for an ideal gas. Which of the following diagram represents the same process?



(a) 

(b) 

(c) 

(d) 

47. In a monoclinic unit cell, the relation of sides and angles are respectively: (a) $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$
(b) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$
(c) $a \neq b \neq c$ and $\beta = \gamma = 90° \neq \alpha$
(d) $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90°$

48. Phosphine is not obtained by which of the following reaction?
(a) White P is heated with NaOH.
(b) Red P is heated with NaOH.
(c) Ca_3P_2 reacts with water. (d) Both (a) and (c).

49. An ideal gaseous mixture of ethane (C_2H_6) and ethene (C_2H_4) occupies 28 litre at 1 atm and 273 K. The mixture reacts completely with 128 g O_2 to produce CO_2 and H_2O. Mole fraction at C_2H_6 in the mixture is:

(a) 0.6 (b) 0.4 (c) 0.5 (d) 0.8

50. What is the maximum wavelength line in the Lyman series of He^+ ion?

(a) $\frac{3}{R}$ (b) $\frac{1}{\quad}$

1 3R

(c) — (d) None of these R

51. The correct order of acidic strength :

(a) $Cl_2O_7 > SO_2 > P_4O_{10}$

(b) $K_2O > CaO > MgO$

(c) $CO_2 > N_2O_5 > SO_3$

(d) $Na_2O > MgO > Al_2O_3$

52. In the reaction $2PCl_5 \rightleftharpoons PCl_4^+ + PCl_6^-$, the change in hybridisation is from

(a) sp^3d to sp^3 and sp^3d^2

(b) sp^3d to sp^2 and sp^3

(c) sp^3d to sp^3d^2 and sp^3d^3

(d) sp^3d^2 to sp^3 and sp^3d

53. Arrange the following ions in the order of decreasing X – O bond length, where X is the central atom

(a) ClO-4 ,SO24- , PO34- ,SiO-4

(b) SiO44-,PO34-,SO24-,ClO-4

(c) SiO44-,PO34-,ClO4-,SO42-

(d) SiO44-,SO42-,PO34-,ClO-4

54. Two vessels of volumes 16.4 L and 5 L contain two ideal gases of molecular existence at the respective temperature of 27 °C and 227 °C and exert 1.5 and 4.1 atmospheres respectively. The ratio of the number of molecules of the former to that of the later is

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

55. For the combustion reaction at 298 K

2Ag(s) +1/ 2O (g2) ¾¾®2Ag O(s2)

Which of the following alternatives is correct?

(a) DH = DU

(b) DH > DU

(c) DH < DU

(d) DH and DU has no relation with each other

K_p

56. The ratio K_c for the reaction

$CO(\ )g + \frac{1}{2}O(\ )_2 g \rightleftharpoons CO(\ )_2 g$ is:

$\frac{1}{\sqrt{RT}}$ (a)(b) $(RT)^{1/2}$

(c) RT (d) 1

57. A solution of NH_4Cl and NH_3 has pH = 8.0. Which of the following hydroxides may be precipitated when this solution is mixed with equal volume of 0.2 M of metal ion.

(a) Ba(OH) ($K_{2\ sp}$ =1.1 10´ -4)

(b) Mg(OH) ($K_{2\ sp}$ = 3.5´10^{-4}) (c) Fe(OH)$_2$ (K_{sp} = 8.1 10´ -16)

(d) Ca(OH)$_2$ (K_{sp} = 2.1´ 10^{-5}).

58. Which of the following is not a disproportionation reaction?

(a) P_4 + 5OH - ¾¾® H PO_2 $_2^-$ + PH_3

(b) Cl_2+OH-¾¾®Cl-+ClO-

(c) 2H O22 ¾¾®2H O2 + O2

(d) PbO2 + H O2 ¾¾®PbO+ H O2 2

59. The amount of H_2O_2 present in 1 litre of 1.5 N H_2O_2 solution, is :

(a) 25.5 g (b) 3.0 g (c) 8.0 g (d) 2.5 g

60. BeF_2 is soluble in water whereas fluorides of other alkaline earth metals are insoluble because of (a) ionic nature of BeF_2.

(b) covalent nature of BeF_2.

(c) greater hydration energy of Be^{2+} ion as compared to its lattice energy. (d) none of these.

61. Identify the incorrect statement :

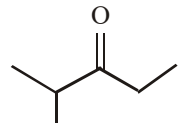
(a) In $(Si_3O_9)^{6-}$, tetrahedral SiO_4 units share two oxygen atoms.

(b) Trialkylchlorosilane on hydrolysis gives R_3SiOH.

(c) $SiCl_4$ undergoes hydrolysis to give H_4SiO_4.

(d) $(Si_3O_9)^{6-}$ has cyclic structure.

62. The alcohol product(s) of the reduction of 2-methyl-3-pentanone with $LiAlH_4$ is (are)



¾¾¾¾¾¾¾¾¾¾®(i)
LiAlH4 diethyl ether
(ii) H O2

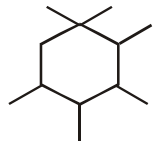
(a) a single enantiomer

(b) racemic mixture

(c) two diastereoisomers

(d) two structural isomers

63. CH_3 H_a H_b



+ Br• ®
HdOH

CH_2¾ H^c

Br• will abstract which of the hydrogen most readily?

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

64. The vapour pressure of two pure liquids *A* and *B*

that form an ideal solution, are 400 and 800 mm of Hg respectively at a temperature *t*°C. The mole fraction of *A* in a solution of *A* and *B* whose boiling point is *t*°C will be

(a) 0.4 (b) 0.8 (c) 0.1 (d) 0.2

65. On reaction with sodium, 1 mol of a compound X gives 1 mol of H_2. Which one of the following compounds might be X?

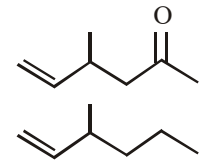
(a) $CH_3CH_2CH = CH_2$

(b) $CH_3COOCH_2CH_3$

(c) $CH_3CH_2CH_2OH$

(d) $CH_2(OH)CH_2CH_2CH_2OH$

66. The following change can be carried out with



OH ¾¾®?

OH

(a) $NaBH_4$ (b) $LiAlH_4$

(c) H /Pt2 (d) PCC/CH Cl2 2

67. The greenhouse effect is because of the

(a) presence of gases, which in general are strong infrared absorbers, in the atmosphere (b) presence of CO_2 only in the atmosphere

(c) pressure of O_3 and CH_4 in the atmosphere

(d) N_2O and chlorofluorohydrocarbons in the atmosphere

68. Methylene blue, from its aqueous solution, is adsorbed on activated charcoal at 25°C. For this process, which of the following statement is correct? (a) The adsorption requires activation at 25°C

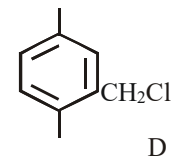
(b) The adsorption is accompanied by a decrease in enthalpy

(c) The adsorption increases with increase of temperature

(d) The adsorption is irreversible

69. The final product obtained in the reaction

Br

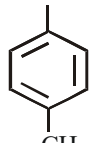


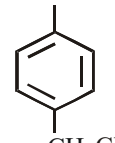
CH_2Cl

D OD

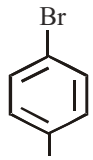
¾¾¾¾¾¾®Mg / ether A ¾¾¾¾¾¾®Heavy water

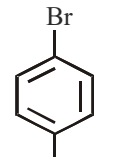
(a)(b)



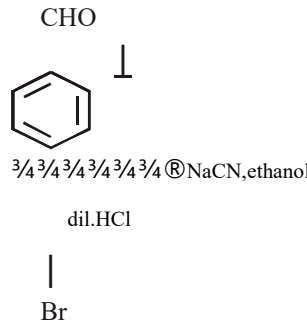


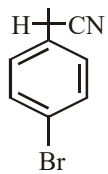
(c)(d)

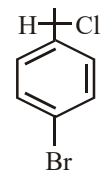


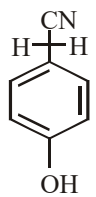


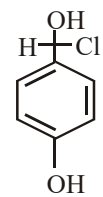
70. What is the product of the following reaction ?











(a)(b)

(c)(d)

Br Br

71. The *d*-electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and Co^{2+} are d^4, d^5, d^6 and d^7 respectively. Which one of the following will exhibit the lowest paramagnetic behaviour? (Atomic no. Cr = 24, Mn = 25, Fe = 26, Co = 27).

(a) $[Co(H_2O)_6]^{2+}$ (b) $[Cr(H_2O)_6]^{2+}$

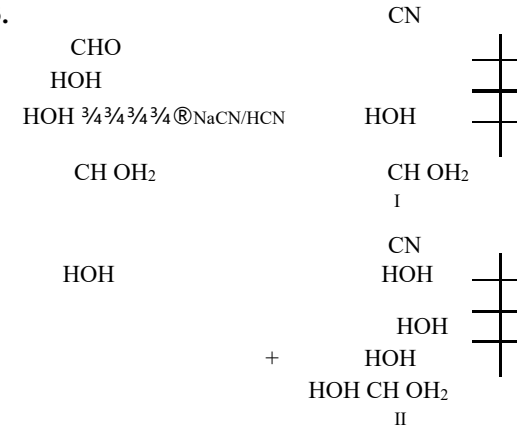
(c) $[Mn(H_2O)_6]^{2+}$ (d) $[Fe(H_2O)_6]^{2+}$

72. An organic compound with the formula $C_6H_{12}O_6$ forms a yellow crystalline solid with phenylhydrazine and gives a mixture of sorbitol and mannitol when reduced with sodium. Which among the following could be the compound?

(a) fructose (b) glucose

(c) mannose (d) sucrose

73.



Compounds I and II may be grouped as

(a) diastereomers (b) epimers (c) C–2 epimers (d) all of the three.

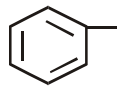
74. Which is not the correct statement? (At. nos. Ce = 58, Lu = 71, La = 57, Yb = 70) (a) Colour of Yb^{3+} ion is pink. (b) La^{3+} is diamagnetic.

(c) Ce^{4+} has f^0 configuration.

(d) Lu^{3+} had f^{14} configuration.

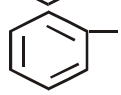
75. Which of the following reactions will not give N, N- dimethyl benzamide ?

¾®



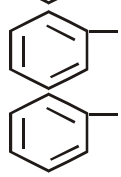
$COOC H_{25}$ + $(CH) NH_{3 2}$

(a)



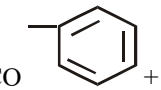
(b)$CONH_2$ + $CH MgI_3$

¾¾®



(c)COCl + $(CH) NH_{3 2}$ ¾¾®

(d)



$COOCO$ +

$(CH_{3 2})$ NH

¾¾®

¾¾¾¾¾¾¾¾¾®Benzoyl peroxide or X

76. $n(CF2 = CF2)$ $(NH) S O4 2 2 8$

Here, X is :

(a) RMMA (b) PVC

(c) PAN (d) None of these

77. Select the incorrect statement.

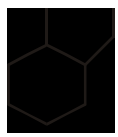
(a) Equanil is used to control depression and hypertension.

(b) Mifepristone is a synthetic steroid used as "morning after pill".

(c) 0.2 per cent solution of phenol is an antiseptic while its 1.0 per cent solution is a disinfectant.

(d) A drug which kills the organism in the body is called bacteriostatic.

78.



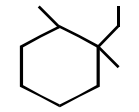
OH OH

¾¾®PCC (A) ¾¾¾®OH

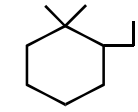
OHH+ (B)

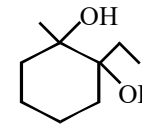
(1) MeMgBr

¾¾¾¾®(2) $H O^{3+}$ (C) ¾¾¾¾®$NaBH_4$, EtOH (D) Product (D) in above reaction is:



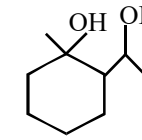
OH





OH

OH



OH OH

OH OH OH

(a)(b)

(c)(d)

79. $D_r G^-$ vs T plot in the Ellingham diagram slopes downward for the reaction

(a) $Mg + \frac{1}{2} O_2$ ® MgO

(b) $2Ag + \frac{1}{2} O_2$ ® $Ag O_2$

(c) $C + \frac{1}{2} O_2$ ® CO

(d) $CO + \frac{1}{2} O_2$ ® CO_2

80. A radioactive isotope having a half - life period of 3 days was received after 12 days. If 3g of the isotope is left in the container, what would be the initial mass of the isotope?

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

PART - III (A): ENGLISH PROFICIENCY

DIRECTIONS (Qs. 81-82) : *Select the most appropriate option to fill in the blank.*

81. One of them would keep a look-out on the road behind to warn us _____ approaching vehicles.
(a) for (b) of
(c) against (d) with

82. The top-ranking manager _____ his success in the profession to his managing director's guidance.
(a) accounts (b) attributes
(c) agrees (d) consider

DIRECTIONS (Qs.83-85) : *Some parts of the sentences have errors and some are correct. Find out which part of a sentence has an error.*

83. Mother Teresa asked a building where she and her workers could care for the poor people always.
(a) Mother Teresa asked a building (b) where she and her workers
(c) could care for the poor people always.
(d) No error

84. You may not realize it but the weather in Barbados during Christmas is like New York in June. (a) You may not realize it
(b) but the weather in Barbados during Christmas (c) is like New York in June.
(d) No error

85. The parents decided it was worth the risk because these children would have succumbed their disease before adulthood. (a) The parents decided it was worth the risk
(b) because these children would have succumbed their
(c) disease before adulthood
(d) No error

DIRECTIONS (Qs. 86-89) : *Read the following passage carefully and choose the best answer to each question out of the four given alternatives.*

Harold, a professional man who had worked in an office for many years, had a fearful dream. In it, he found himself in a land where small slug-like animals with slimy tentacles lived on people's bodies. The people tolerated the loathsome creatures because after many years they grew into elephants which then became the nation's system of transport, carrying everyone wherever he wanted to go. Harold suddenly realized that he himself was covered with these things, and he woke up screaming. In a vivid sequence of pictures his dream dramatized for Harold what he had never been able to put into words; he saw himself as letting society feed on his body in his early years so that it would carry him when he retired. He later threw off the 'security bug' and took up freelance work.

86. The statement that 'he later threw off the security bug' means that
(a) Harold succeeded in overcoming the need for security.
(b) Harold stopped giving much importance to dreams.
(c) Harold started tolerating social victimization. (d) Harold killed all the bugs troubling him.

87. Which one of the following phrases best helps to bring out the precise meaning of 'loathsome creatures'?
(a) security bug and slimy tentacles
(b) fearful dream and slug-like animals
(c) slimy tentacles and slug-like animals
(d) slug-like animals and security bug

88. In his dream, Harold found the loathsome creatures
(a) in his village (b) in his own house
(c) in a different land (d) in his office

89. Harold's dream was fearful because
(a) It brought him face to face with reality
(b) It was full of vivid pictures of snakes
(c) He saw huge elephants in it
(d) In it he saw slimy creatures feeding on people's bodies

DIRECTIONS (Qs. 90-92) : *In questions, choose the word opposite in meaning to the given word and mark it in.*

90. Subdued
(a) dim (b) boisterous
(c) solemn (d) crestfallen

91. Fervent

(a) Partial (b) Dispassionate
(c) Ardent (d) Decent

92. Scrupulous
(a) Careless (b) Wise
(c) Caring (d) Careful

DIRECTIONS (Qs. 93-95) : *In questions no. 26 to 28, out of the four alternatives, choose the one which best expresses the meaning of the given word and mark it.*

---

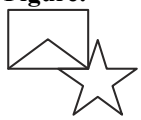
93. Onslaught
(a) Counterattack (b) Resistance
(c) Defense (d) Invasion

94. Ignominy
(a) Exposure (b) Stupidity
(c) Disgrace (d) Trial

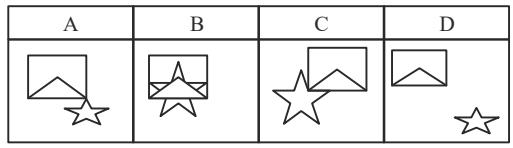
95. Tryst
(a) severance (b) rendezvous
(c) annul (d) disparate

PART - III (B) : LOGICAL REASONING

96. Which of the option figures bears the closest resemblance to the question figure? **Question Figure:**

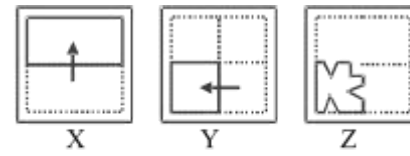


Option Figures:

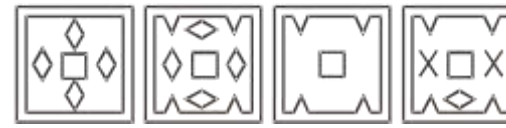


(a) A (b) C (c) B (d) D

97. In the following questions a piece of paper is folded and punched as shown in problem figures and four answer figure marked (a), (b), (c), (d) are given. Select the answer figure which indicates how the paper will appear when open (unfolded). **Question Figure:**



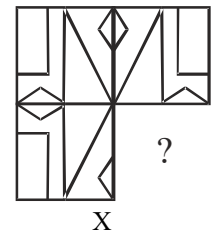
Answer Figures:



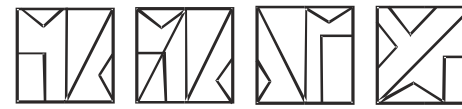
(a) (b) (c) (d)

98. Which answer figure complete the form in question figure ?

Question Figure:

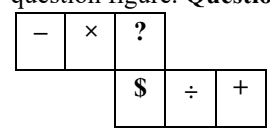


Answer Figures:

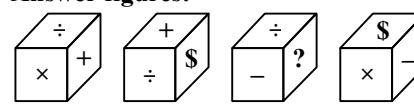


(a) (b) (c) (d)

99. From the answer figure choose the box that is similar to the box formed by folding the question figure. **Question figure:**



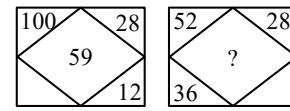
Answer figures:



(A) (B) (C) (D)

(a) 1 and 2 only (b) 2, 3 and 4 only
(c) 4 only (d) 3 and 4 only

100. In each of the following question select the missing number from the given responses.



(a) 50 (b) 90 (c) 218 (d) 64

101. A clock with only dot markings 3, 6, 9 and 12 positions has been kept upside down in front of a mirror. A person reads the time in the reflections of the clock as 12 : 30 the actual that will be

(a) 12 O'clock (b) 12 : 30
(c) 6 O' clock (d) 03 : 45

102. Six friends - A, B, C, D, E and F are sitting in a circlefacing center. F is to the immediate left of A and B is sitting opposite to F, E and D are sitting opposite to each other. Who is sitting third right to A?

(a) F (b) E (c) C (d) A

103. Ganesh cycles towards South-West a distance of 8 m. Then he moves towards East a distance of 20 m. From there he moves towards North-East a distance of 8 m, then he moves towards West a distance of 6m. From there he moves towards North-East a distance of 2 m. Then he moves towards West a distance of 4 m and then towards South-West 2 m and stops at that point. How far is he from the starting point ?

(a) 12 m. (b) 10 m. (c) 8 m. (d) 6 m.

104. If in a code language, LAPTOP is written as PNSOZL and NOTEBOOK and KNNADSNN, then which letter will be there in first and seventh letter from left after coding MEDICINE in the same way?

(a) ED (b) BD (c) HM (d) DM

105. Find the next term in the following series: X24C, V22E, T20G, _____

(a) RI19 (b) R19I (c) R18I (d) RI18

PART - IV : MATHEMATICS

106. Let [x] denote the greatest integer £ x. If f (x) = [x] and g (x) = |x|, then the value of

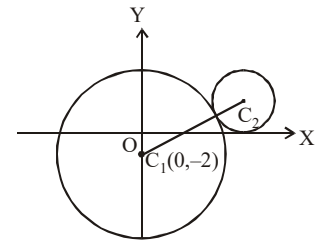
f çæèçg ç ÷æ öè ø58 ÷öø- g çæèf èæç- _85 øö÷ö÷ø is

(a) 2 (b) – 2 (c) 1 (d) –1

107. If a chord of the circle $x^2 + y^2 = 8$ makes equal intercets of length a on the coordinate axes, then

(a) $|a| < 8$ (b) $|a| < \sqrt{4}\ 2$
(c) $|a| < 4$ (d) $|a| > 4$

108. In the given figure, the equation of the larger circle is $x^2 + y^2 + 4y - = 5\ 0$ and the distance between centres is 4. Then the equation of smaller circle is



(a) $(x - \sqrt{7})^2 + (y - 1)^2 = 1$

(b) $(x + \sqrt{7})^2 + (y - 1)^2 = 1$

(c) $x^2 + y^2 = 2\sqrt{7}x + 2y$

(d) None of these

109. The equation $\sin^4 x - (k + 2)\sin^2 x - (k + 3) = 0$ possesses a solution if

(a) $k > -3$ (b) $k < -2$

(c) -3£ £k -2

(d) k is any positive integer

110. If 16 identical pencils are distributed among 4 children such that each gets at least 3 pencils. The number of ways of distributing the pencils is

(a) 15 (b) 25 (c) 35 (d) 40

111. If a, b, c are positive numbers, then least value of (a + b + c) æç 1 + 1 + 1 ö÷ is è a

b

c ø

(a) 1 (b) 6 (c) 9 (d) None

¥ dx

112. Ò _____(x2 + a2)(x2 + b2) is

0

pab p

(a) a + b (b) p 2(a + b)

p +(ab)

(c) 2ab(a + b) (d) 2ab

113. If r and s are non-zero constant vectors and the scalar b is chosen such that $|r + bs|$ is minimum, then the value of $|bs|^2 + |r\, bs +$ $|^2$ is equal to

(a) $2|r|^2$ (b) $|r|^2/2$

(c) $3|r|^2$ (d) $|r|^2$

114. **Statement-1 :** If the general equation $x^2 + y^2 + 2xy + 2gx + 2fy + 4 = 0$ represents a pair of real lines then $|g| \geq 2$.

Statement-2 : The equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents pair of real lines if $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$. (a) Statement -1 is false, Statement-2 is true

(b) Statement -1 is true, Statement-2 is true; Statement -2 is a correct explanation for Statement-1

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

(d) Statement -1 is true, Statement-2 is false

115. If $|z_1 + z_2| = \ldots\ldots z = 1$, then the value of $|z_1 + z_2 + \ldots\ldots z_n|$ $\left|\frac{1}{z_2} + \frac{1}{} + \ldots\ldots + \frac{1}{z_n}\right|$ is,

(a) 0 (b) 1 (c) – 1 (d) None

116. In a statistical investigation of 1003 families of Calcutta, it was found that 63 families has neither a radio nor a T.V, 794 families has a radio and 187 has T.V. The number of families in that group having both a radio and a T.V is

(a) 36 (b) 41

(c) 32 (d) None of these

117. The domain of the function $f(x) = x - 1\, x_2$ is

é ù é 1 ù

(a) êë-1, 2úûÈêë 2 ,1úû

(b) [–1, 1]

æ-¥ -,1 ùúÈ ëê 12 , + ¥ö÷ø

(c) ç è 2 û

é 1 ù

(d) êë 2 ,1úû

118. If the coordinates at one end of a diameter of the circle $x^2 + y^2 - 8x - 4y + c = 0$ are (–3, 2), then the coordinates at the other end are

(a) (5, 3) (b) (6, 2)

(c) (1, –8) (d) (11, 2)

119. The value of sinêëénp + -(1)n p 4 ùúû, n Î I is

(a) 0 (b) 1 2

(c) - 1 2 (d) None of these

120. The number of possible outcomes in a throw of n ordinary dice in which at least one of the dice shows an odd number is

(a) $6^n - 1$ (b) $3^n - 1$

(c) $6^n - 3^n$ (d) None of these

22 24 26

121. The sum of the infinite series + — + + ...

2! 4! 6!

is equal to

$e^2 + 1$ $e^4 + 1$ (a) ____ 2e (b) ____ $2e_2$

$(e^2 - 1)^2$ $(e^2+1)^2$

(c) _____ 2e2 (d) _____ 2e2

122. The solution of the differential equation

$(x+1)\frac{dy}{dx} - y\,e\,x = {}^{3x}(+1)^2$ is

(a) $y = (x+1)e^{3x} + c$

(b) $3y = (x+ +1)\,e^{3x} + c$

$\frac{}{3y}$ $^{3x} + c$

(c) $= e\,x + 1$

(d) $ye^{-3x} = 3(x+ +1)\,c$

123. Consider the function $f(x) = |x - 1|/x^2$, then $f(x)$ is

(a) increasing in (0, 1) È (2, ¥)

(b) increasing in (– ¥, 0) È (1, 2) (c) decreasing in (0, 1) È (2, ¥)

(d) decreasing in (0, 1) È (2, ¥)

124. A straight rod of length 9 units slides with its ends A, B always on the X and Y-axis respectively. Then the locus of the centroid of DOAB is :

(a) $x^2 + y^2 = 3$ (b) $x^2 + y^2 = 9$

(c) $x^2 + y^2 = 1$ (d) $x^2 + y^2 = 81$

125. If $xy + y^{2} = \tan x + y$, then find $\frac{dy}{dx}$

(a) $\frac{\sec^2 x}{x + 2y}$

(b) $\frac{\sec x - y^2}{(x+ 2y-1)}$

(c) $(x+ 2y-1)\sec x^2$

(d) $\sec x\, y^2 \times$

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

(a) 0.99 (b) 0.871

(c) 0.891 (d) 0.762

127. Let $x\,y + = -3$ cos4q and $x - y = 4\sin 2q$ then the greatest of xy is

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

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

128. Total number of ways of selecting 2 white squares on a normal chess board if the squares are not from the same row or column is equal to

(a) 480 (b) 496 (c) 412 (d) 400

129. The length of the latus rectum of the parabola which has focus at (–1, 1) and the directrix is 4x + 3y – 24 = 0 is

(a) 4 (b) 6 (c) 8 (d) 10

p/2

130. Ò x sin (p[x] - x)dx is equal to : p/3

(a) $\frac{1}{2}+$ (b) $\frac{p^p}{66}+$ $1-\frac{\sqrt{3}}{2}$

(c) $-\frac{1}{2}\frac{p}{6}$ (d) $\frac{\sqrt{3}}{2}-\frac{1}{6}\frac{p}{}$

131. A student read common difference of an A. P. as – 2 instead of 2 and got the sum of first 5 terms as – 5. Actual sum of first five terms is

(a) 25 (b) – 25 (c) – 35 (d) 35

132. The number of real solutions of the equation

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

(a) 2 (b) 1 (c) 0 (d) 3

133. The least positive non-integral solution of the equation $\sin p(x^2+x)=\sin px^2$ is (a) rational

(b) irrational of the form $\sqrt{p}$

(c) irrational of the form $\frac{\sqrt{p}}{\sqrt{p}-1}$, where p is an odd integer

(d) $\frac{4}{\sqrt{p}+1}$ irrational of the form , where p is an 4 even integer

134. ABC is a triangular park with AB = AC = 100 m. A TV tower stands at the mid-point of BC. The angles of elevation of the top of the tower at A, B, C are 45°, 60°, 60° respectively. The height of the tower is

(a) 50 m (b) $50\sqrt{3}$ m

(c) $50\sqrt{2}$ m (d) $50(3-\sqrt{3})$ m

135. If x, y and z are real numbers, then $x^2+4y^2+9z^2-6yz-3zx-2xy$ is always

(a) positive (b) non-positive

(c) zero (d) non-negative

136. A person invites a party of 10 friends at dinner and place them so that 4 are on one round table and 6 on the other round table. The number of ways in which he can arrange the guests is

(a) $\frac{(10)!}{6!}$ (b) $\frac{(10)!}{24}$

(c) $\frac{(9)!}{24}$ (d) None of these

137. If a > 0, b > 0, c > 0 and a, b, c are distinct, then (a + b) (b + c) (c + a) is greater than

(a) 2(a + b + c) (b) 3(a + b + c)

(c) 6abc (d) 8abc

138. The equation of the tangent to the curve $y=be^{-x/a}$ at the point where it crosses the y-axis is $x\,y$

(a) $\frac{}{}-=1$ (b) $ax+by=1$ $a\,b$

(c) $ax-by=1$ (d) $\frac{x\,y}{a\,b}+=1$

139. The solutions of $(x+y+1)\,dy=dx$ are

(a) $x+y+2=Ce^y$

(b) $x+y+4=C\log y$

(c) $\log(x+y+2)=Cy$

(d) $\log(x+y+2)=C-y$

140. If $y=3x+6x^2+10x^3+$ ..... ¥, then

$\frac{1}{3}$ $y-1.4\,2\,2\,y2+1.4.73\,2\,3\,y3-$.....¥ is equal to

(a) x (b) $1-x$ (c) $1+x$ (d) x^x

141. Suppose p, q, r ¹ 0 and system of equation

$(p+a)x+by+cz=0$,

$ax+(q+b)y+cz=0$,

$ax+by+(r+c)z=0$ has a non-trivial solution,

then value of $\frac{a}{p}+\frac{b}{+q}+\frac{c}{r}$ is

(a) –1 (b) 0 (c) 1
(d) 2

142. If a, c, b are in G.P., then the area of the triangle formed by the lines ax + by + c = 0 with the coordinates axes is equal to
(a) 1 (b) 2
(c) $\frac{1}{2}$ (d) None of these

143. Suppose that $f(0) = -3$ and $f'(x) \le 5$ for all values of x.
Then, the largest value which $f(2)$ can attain is
(a) 7 (b) 10 (c) 2
(d) 9

144. The maximum value of $z = 6x + 8y$ subject to constraints $2x + y \le 30$, $x + 2y \le 24$ and $x \ge 0$, $y \ge 0$ is
(a) 90 (b) 120 (c) 96
(d) 240

145. If a, b, c are three natural numbers in AP and a + b + c = 21 then the possible number of values of the ordered triplet (a, b, c) is
(a) 15 (b) 14
(c) 13 (d) None of these

146. If $\frac{x}{ma} + \frac{y}{nb} = 1$ touches the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, then
(a) $m^2 = n^2$ or $n^2 = m^2$
(b) $m^2 = n^2 + 1$ or $n^2 = m^2 + 1$
(c) $n^2 \quad m^2$
(d) $m^2 = n^2 - 1$ or $n^2 = m^2 - 1$

147. Let f be the function defined by
$f(x) = \begin{cases} \frac{x^2 - 1}{x^2 - 2|x - 1| - 1}, & x \neq 1 \\ 1/2, & x = 1 \end{cases}$
(a) The function is continuous for all values of x
(b) The function is continuous only for x > 1
(c) The function is continuous at x = 1
(d) The function is not continuous at x = 1

148. The line y = mx bisects the area enclosed by lines x =0, y = 0 and x = 3/2 and the curve $y = 1 + 4x - x^2$. Then the value of m is
(a) $\frac{13}{6}$ (b) $\frac{13}{2}$ (c) $\frac{13}{5}$
(d) $\frac{13}{7}$

149. There are four numbers of which the first three are in G.P. and the last three are in A.P., whose common difference is 6. If the first and the last numbers are equal then two other numbers are
(a) –2, 4 (b) –4, 2 (c) 2, 6
(d) none

150. The distance from the point (3, 4, 5) to the point where the line $\frac{x-3}{1} = \frac{y-4}{2} = \frac{z-5}{2}$ meets the plane x + y+ z =17 is

(a) 1 (b) 2 (c) 3 √

(d) 2

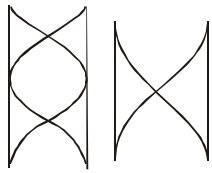
h'= æçççè 2ug'2 ö÷÷øø = 22ghg' = ggh' = rh -

SOLUTIONS

PART - I : PHYSICS

1. **(b)** Let the fundamental frequency of organ pipe be f

Case I : f = 200 ± 5 = 205 Hz or 195 Hz



Case II : frequency of 2nd harmonic of organ pipe = 2f (as is clear from the second figure) 2f = 420 ± 10 or f = 210 ± 5 or f = 205 or 215

Hence fundamental frequency of organ pipe = 205 Hz

2. **(b)** Apparent depth = $d/m_1 + d/m_2$

3. **(d)** Acceleration of block while sliding down upper half = gsinf; retardation of block while sliding down lower half = – (gsin f-mg cos f)

For the block to come to rest at the bottom, acceleration in I half = retardation in II half.

gsin f=-(gsin f-mg cos f) Þ m= 2tanf

Alternative method : According to work-energy theorem, W = DK = 0

(Since initial and final speeds are zero)

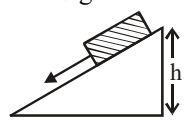
\ Work done by friction + Work done by gravity = 0

i.e., $-(\mu mg\cos\theta)f \frac{\ell}{2} + mg\sin\ell f = 0$

or $\frac{\mu}{2}\cos f = \sin f$ or $\mu = 2\tan f$

4. **(c)** The effective acceleration of the body

g'= ççæèè1- r'' ö÷÷øøg



Now, the depth to which the body sinks

´rr"

5. **(c)** Forward resistance

= DI = DV / 1.0 ´10-3 = 0.7 - 0.5 = 200W

6. **(d)**

DQ / Q ´100 = 2DI / I ´100 + DR / R ´100 + Dt / t ´100

= 2´2%+1%+1% = 6%.

oxg. = √(32) √

√(3R´400 / 2) H

3R ´ 289 æ 3RTÖ **7. (c)**

v Çèvrms = M ÷ø

v_H = so v = 2230.59 m/sec

8. **(c)** This happen when vertical velocity of both are same.

\ $v_2 = v \sin 30^\circ$ or $v_2 = \frac{1}{2} v_1$

9. **(b)** mmg = mv /r2 or v = √(g r) or v = √(0.25 ´ 9.8 ´ 20) = 7 m / s

10. **(c)** W = F s cos q = 10 × 2 cos 60º = 10 J.

mv2 / ms2 **11.** **(d)** $t = t_3$

since both P and m are constants

s2

$\therefore t_3 = \text{constant}$

12. **(b)** $\frac{1}{2}mv_e^2 = \frac{GMm}{R}$; $v_e = \sqrt{\frac{GM}{R}} = \sqrt{2gR}$

In tunnel body will perform SHM at centre $V_{max} = A\omega$ (see chapter on SHM)

$$= \frac{R2\pi}{2\pi\sqrt{R/g}} = \sqrt{gR} = \frac{v_e}{\sqrt{2}}$$

13. **(b)**

14. **(c)** Volume of ball $= \frac{40}{0.8} = 50\ cm^3$

Downthrust on water = 50 g.

Therefore reading is 650 g.

15. **(a)** $PV^{3/2} = K$ $\log P + \frac{3}{2}\log V = \log K$

$$\frac{\Delta P}{P} + \frac{3}{2}\frac{\Delta V}{V} = 0$$

$$\frac{\Delta V}{V} \times \frac{3}{2} \times \frac{P}{\Delta P} = -\frac{2}{3} \quad \text{or} \quad \frac{\Delta P}{P} \times \frac{V}{\Delta V} = -\frac{3}{2}$$

16. **(b)** Comparing the given equation with

$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$, we get

$\tan\theta = \sqrt{3}$

17. **(a)**

Let mass is displaced towards left by x then force on mass = – kx – 2kx = – 3kx

[negative sign is taken because force is opposite to the direction of motion]

$\therefore F = -3kx = -m\omega^2 x$ $\quad \sqrt{\frac{3k}{m}}$.

$\therefore \omega = \frac{1}{2\pi}\sqrt{\frac{3k}{m}}$ $\quad f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{3k}{m}}$.

Thus it is propotional to $\sqrt{3k/m}$

18. **(a)** Current flowing through the conductor, I = n e v A. Hence

$$\frac{i_1}{i_2} = \frac{nev_{d1}\pi(1)^2}{nev_{d2}\pi(2)^2} \quad \text{or} \quad \frac{v_{d1}}{v_{d2}} = \frac{1}{4} = \frac{1}{16}.$$

19. **(a)** Velocity, $v = \frac{dx}{dt} = -A\omega\sin(\omega t + \pi/4)$

Velocity will be maximum, when $\omega t + \pi/4 = \pi/2$ or $\omega t = \pi/2 - \pi/4 = \pi/4$ or $t = \pi/4\omega$

20. **(a)** $\lambda_{max1} = R\left[\frac{(1)}{(1)^2} - \frac{(2)}{(1)^2}\right]$

$\therefore \lambda_{max} = \frac{4}{3R} \approx 1213Å$

and

$\lambda_{min1} = \left[\frac{1}{1} - \frac{1}{4}\right]\lambda_{min} = \frac{3}{4}R1 \approx$

$910Å. R\left[\frac{(1)}{(2)^2}\right]$

21. **(b)** Potential difference across the branch de is 6 V. Net capacitance of de branch is 2.1 μF

So, q = CV

$\therefore q = 2.1 \times 6\ \mu C \therefore q = 12.6\ \mu C$

Potential across 3 μF capacitance is

$V = \frac{12.6}{3} = 4.2$ volt

Potential across 2 and 5 combination in parallel is 6 – 4.2 = 1.8 V

So, q' = (1.8) (5) = 9 μC

22. **(c)** $g = a + a_1 + a_2 + a_3$

$= 13 \times 10^{-7} + 231 \times 10^{-7} + 231 \times 10^{-7}$

$= 475 \times 10^{-7}$

23. **(a)** Solid cylinder reaches the bottom first

because for solid cylinder $\frac{K^2}{R^2} = \frac{1}{2}$ and for

K2

hollow cylinder, $R_2 = 1$.

Acceleration down the inclined plane $\frac{1}{1+K^2/R^2}$. Solid cylinder has greater acceleration. It reaches the bottom first.

24. **(a)** By the concept of accoustic, the observer and source are moving towards each other, each with a velocity of 18 m s^{-1}.

$$\nu = \frac{330+18}{330-18}\times 1000 \approx 1115 \text{ Hz}$$

25. **(a)** $\lambda = m - (\quad 1)t$;

$$\lambda = (m-1)t = \frac{\quad}{\quad}(1.5$$

$$-1)\times 6 \quad 10^{-6} = 6000\text{Å} \quad n \quad 5$$

26. **(b)** Use theorem of parallel axes.

27. **(a)** $(F_{net\ q}) = 0$

$$\Rightarrow \quad k\frac{Qq}{\left(\frac{\ell}{2}\right)^2} + k\frac{4q^2}{\ell^2} = 0$$

where $k = \frac{1}{4\pi\varepsilon_0}$

$\Rightarrow \quad 4Qq + 4q^2 = 0 \quad \Rightarrow \quad Q = -q$

28. **(a)**

29. **(d)** $Bqv = mv^2/r$ or $q/m = v/rB$.

30. **(c)** The ball thrown upward will lose velocity in 1s. It return back to thrown point in another 1 s with the same velocity as second. Thus the difference will be 2 s.

31. **(a)** Angular retardation,

$$\alpha = \frac{\omega - \omega_1}{t} = \frac{2\pi(n_2 - n_1)}{t}$$

$$= \frac{2\pi - (0 \quad 900/60)}{60} = \frac{\pi}{2} \text{ rad/s}^2$$

32. **(a)** The amplitude is a maximum displacement from the mean position.

33. **(d)** Since the magnetic field is uniform the flux ϕ through the square loop at any time t is constant, because $\phi = B \times A = B \times L^2 = \text{constant}$

$$\therefore e = -\frac{d\phi}{dt} = \text{zero}$$

34. **(d)** Limiting friction

$= 0.5 \times 2 \times 10 = 10\text{N}$

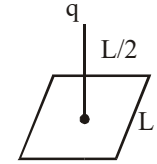
The applied force is less than force of friction, therefore the force of friction is equal to the applied force.

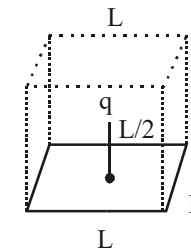
35. **(b)** As momentum is conserved, therefore $m_1 =$

$A_1 = v_2 = \frac{\quad}{\quad} 1 \quad m_2 \quad A_2 \quad v_1 \quad 2$

$$\therefore \quad \frac{1}{2}\left(\frac{\quad}{A_2}\right) = \frac{R}{\left(\frac{1}{2}\right)} = \left(\frac{1}{2}\right)^{1/3} = 1 : 2^{1/3}$$

36. **(c)**





The given square of side L may be considered as one of the faces of a cube with edge L. Then given charge q will be considered to be placed at the centre of the cube. Then according to Gauss's theorem, the magnitude of the electric flux through the faces (six) of the cube is given by $\phi = q/\varepsilon_0$

Hence, electric flux through one face of the cube for the given square will be $\phi' = \frac{1}{6}\phi = \frac{q}{6\varepsilon_0}$

37. **(c)** Incident momentum, $p = \frac{E}{c}$

For perfectly reflecting surface with normal incidence $2E$

$\Delta p = 2p = c$

$$F = \frac{\Delta p}{\Delta t} = \frac{2E}{ct}$$

$$P = \frac{F}{A} = \frac{2E}{ctA}$$

38. **(d)** ∵ Both wires are same materials so both will have same Young's modulus, and let it be Y.

$$Y = \frac{\text{stress}}{\text{strain}} = \frac{F/A}{\Delta L/L}, \quad F = \text{applied force}, \quad A = \text{area of cross-section of wire}$$

Now,

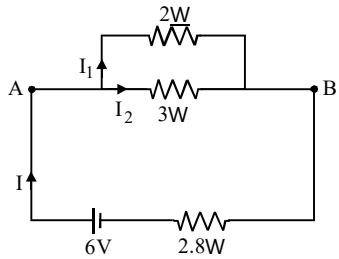
$$Y_1 = Y_2 \Rightarrow \frac{F}{A_1}\frac{L}{\Delta L_1} = \frac{F}{A_2}\frac{L}{\Delta L_2}$$

Since load and length are same for both

$$\Rightarrow r_1^2 \Delta L_1 = r_2^2 \Delta L_2, \quad \frac{\Delta L_1}{\Delta L_2} = \frac{r_2^2}{r_1^2} = \frac{4}{1}$$

$$\Delta L_1 : \Delta L_2 = 4:1$$

39. **(c)** At steady state the capacitor will be fully charged and thus there will be no current in the 1W resistance. So the effective circuit becomes



Net current from the 6V battery,

$$I = \frac{6}{1.2 + \frac{2.8 \times 3}{2.8 + 3}} = \frac{6}{1.2 + 1.5} = \frac{6}{2.7} = 2.22\text{A}$$

Between A and B, voltage is same in both resistances, $2I_1 = 3I_2$ where $I_1 + I_2 = I = 2.22$

$$\Rightarrow 2I_1 = 3(2.22 - I_1) \Rightarrow I_1 = 1.332\text{A}$$

40. **(b)** At a height h above the surface of earth the gravitational potential energy of the particle of mass m is

$$U_h = -\frac{GM_e m}{R_e + h}$$

Where M_e & R_e are the mass & radius of earth respectively. In this question, since $h = R_e$

$$GM_e m = -mgR_e$$

So $U_{h\,R=e} = -\frac{mgR_e}{2} = -\frac{mgR_e}{2}$

PART - II : CHEMISTRY

41. **(a)** $\frac{12}{44}$ % of C = $\frac{0.147}{0.2} \times 100 = 20.045\%$

% of H = $\frac{2}{18} \times \frac{0.12}{0.2} \times 100 = 6.666\ \%$

% of O = 100 - (20.045 + 6.666) = 73.29 %

42. **(b)** Na_2S and NaCN, formed during fusion with metallic sodium, must be removed before adding $AgNO_3$, otherwise black ppt. due to Na_2S or white precipitate due to AgCN will be formed and thus white precipitate of AgCl will not be identified easily.

$$Na_2S + 2AgNO_3 \rightarrow 2NaNO_3 + \underset{\text{Black}}{Ag_2S}\downarrow$$

$$NaCN + AgNO_3 \rightarrow NaNO_3 + \underset{\text{White}}{AgCN}\downarrow$$

$$NaCl + AgNO_3 \rightarrow NaNO_3 + \underset{\text{white}}{AgCl}\downarrow$$

$$Na_2S + 2HNO_3 \xrightarrow{\text{boil}} 2NaNO_3 + H_2S\uparrow$$

$$NaCN + HNO_3 \xrightarrow{\text{boil}} NaNO_3 + HCN\uparrow$$

43. **(c)** Pyridinium chloro chromate selectively oxidises a primary alcohol to an aldehyde

e.g. $RCH_2OH \xrightarrow{CH_2Cl_2} RCHO$

44. **(d)** Maleic acid and fumaric acids are geometrical isomers.

H – C – COOH H – C – COOH
‖ ‖
H – C – COOH HOOC – C – H
Fumaric acid Maleic acid

45. **(a)** Gaseous ions, when dissolved in water, get hydrated and heat is evolved (heat of hydration).

$Cl^-(g) + aq \rightarrow Cl^-(aq)$ is such reaction .

46. **(c)** AB : Isobaric expansion BC : Isothermal expansion
CD : Isochoric
DA : Isothermal compression

47. **(c)**

48. **(b)** Red P does not react with NaOH to give PH_3.

49. **(b)** $C_2H_6 + 3.5O_2 \rightarrow 2CO_2 + 3H_2O$;
$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$
Let volume of ethane is x litre,
$22.4 \times 4 = 3.5x + 3(28 - x)$
$\therefore$ x = 11.2 litre at constant
T and P, V $\propto$ n;

$\therefore$ Mole fraction of C_2H_6 in mixture = $\frac{11.2}{28}$ = 0.4

— = RZ

50. **(b)** l1 ² éê— 1₂— - n1₂²úûùú— = —R 2´ ²êëé11₂ - 21₂ùúû

êën₁

$\therefore 3R; \lambda = \frac{1}{3R}$

51. **(a)** Acidic character of oxide $\propto$ Non-metallic nature of element.
Non-metallic character increases along the period. Hence order of acidic character is $Cl_2O_7 > SO_2 > P_4O_{10}$.

52. **(a)** $2PCl_5 \rightleftharpoons PCl_4^+ + PCl_6^-$

-sp d³ -sp³ -sp d³ ²

53. **(b)** More will be the electronegativity of X, lesser will be the bond length of X-O bond.

54. **(a)** Given conditions
$V_1 = 16.4$ L, $V_2 = 5$ L
$P_1 = 1.5$ atm, $P_2 = 4.1$ atm
$T_1 = 273 + 27 = 300$ K,
$T_2 = 273 + 227 = 500$ K

Applying gas equation, P VP V₂ ²₁ ₁ = n Tn T₂ ²₁ ₁

$n_1 = P\ V\ T_{1\ 1\ 1}$

$n_2\ P\ V\ T_{2\ 2\ 2}$

× × — \ 1.5 16.4
× × —

500 = 2
4.1 5 300 1

55. **(c)** $\Delta H = \Delta U + \Delta nRT$
$\Delta n = n_P - n_R$

Now, $\Delta = -\frac{5}{2} = -n\ 2 - \frac{1}{2}$

$\therefore \Delta H = \Delta U \quad \frac{1}{2}RT$

Thus, $\Delta = \Delta U + \frac{1}{2}RT$

$\therefore \Delta U > \Delta H$

56. **(a)** $K_P = K_C (RT)^{\Delta n_g}$
For the reaction

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

$$\Delta n_g = 1 - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$$

$\therefore K_P = \frac{K_C}{\sqrt{RT}}$; $K_C = \frac{K_P = 1}{\sqrt{RT}}$

57. **(c)** pH = 8, pOH = 6; $[OH^-] = 10^{-6}$ M;

Ionic product of $Fe(OH)_2 = 0.2 \times (1'^{10}{}_{-6}{}^{2})$

$= 2'10^{-13} > K_{sp}(= 8.1 ' 10^{-16})$

58. **(d)** Disproportionation involves simultaneous oxidation and reduction of the same atom in a molecule.

59. **(a)** Molecular weight of $H_2O_2 = 34$

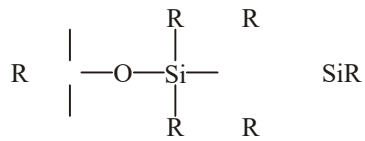
Equivalent weight of $H_2O_2 = 17$

\ 1 L of 1 N H_2O_2 has = 17 g of H_2O

\ 1 L of 1.5 N H_2O_2 has = $1.5 \times 17 = 25.5$ g of H_2O_2

60. **(c)** Be^{2+} being small in size is heavily hydrated and heat of hydration exceeds the lattice energy. Hence BeF_2 is soluble in water.

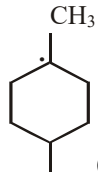
61. **(b)** The hydrolysis of Trialkylchlorosilane R_3 SiCl yields dimer :



62. **(b)** The resulting compound is $C_3H_7CH(OH)C_2H_5$ which is optically inactive and reaction leads the racemisation

63. **(a)** Bromine is more selective

\ abstract that hydrogen which forms stable free- radical



\ (3° free-radical) is most stable.

64. **(c)** V.P. of solution at t°C = 760 mm

[at b.p., V.P. of solution =atompheric pressure]

Thus $= P°_A.x_A + P°_B.x_B$ or $P = P°_A.x_A + P°_B.(1 - x_A)$ [$\because x_A + x_B = 1$] or $760 = 400X_A + 800(1 - X_A)$ [$\because$ P = 760 mm of Hg] or $-800 + 760 = -400\ x_A$ or $-40 = -400\ x_A$ or $x_A = \frac{}{44000} = 0.1$

Thus mole fraction in solution is 0.1

65. **(d)** Since 1 mole of compound X reacts with Na to evolve 1 mole of H_2 gas, therefore the compound should have 2 active hydrogen atoms per mole which is possible only in option *d*.

$CH\ OHCH\ CH\ CH\ OH_2 \quad {}_2 \quad {}_2$

${}_2 \quad + 2Na$ ¾¾®$NaOCH\ CH$

$CH\ CH\ ONa_2\ {}_2 \quad {}_2 \quad {}_2$

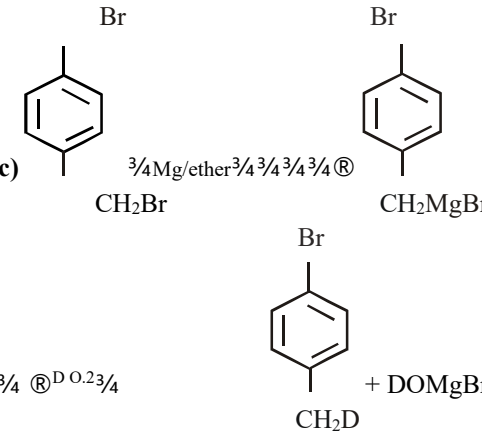
$+ 2H$

66. **(b)** $LiAlH_4$ will give the desired compound.

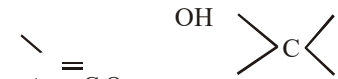
67. **(a)** Green house gases such as CO_2, ozone, methane, the chlorofluorocarbon compounds and water vapour form a thick cover around the earth which prevents the IR rays emitted by the earth to escape. It gradually leads to increase in temperature of atmosphere.

68. **(b)** The adsorption of methylene blue on activated charcoal is an example of physiosorption which is exothermic, multilayer and does not have energy barrier.

69. **(c)**



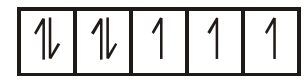
70. **(a)** Only –CHO group reacts with CN^- ion and the reaction is



¾¾¾¾¾¾¾®NaCN, ethanoldil.HCl

HHCN

71. **(a)** Electronic No. of unpaired



configuration electrons

Co^{2+} d^7 3

Cr^{2+} d^4 4 ↑ ↑ ↑ ↑ ( )

Mn^{2+} d^5 5 ↑ ↑ ↑ ↑ ↑

Fe^{2+} d^6 4 ↑↓ ↑ ↑ ↑ ↑

\ Since Co^{2+} has lowest no. of unpaired electrons hence lowest paramagnetic behaviour is shown by $[Co(H_2O)_6]^{2+}$

72. **(a)** Since the compound forms a yellow crystalline solid, i.e. osazone with phenylhydrazine, it may be an aldohexose or a ketohexose. Further, since on reduction, compound forms a mixture of sorbitol and mannitol, it must be a ketohexose, i.e. fructose. Recall that glucose on reduction gives only one alcohol glucitol (Sorbitol)

73. **(d)** When structures I and II are C–2 epimers, it implies that these are epimers and diastereomers too.

74. **(a)** Option (a) is incorrect as Yb^{3+} is colorless.

75. **(b)** (a) C H COOC$_6$ 5 2H$_5$ + (^{CH} $_{3\ 2}$) NH ® C H CON$_6$ 5 (CH_3 2) + C H OH$_2$ 5 (b) C H CONH$_6$ 5 2 + CH_3MgI ® C H CO$_6$ 5 NHMgI + CH4

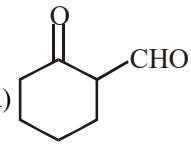
(c) C H COCl$_6$ 5 + (^{CH}) ^{NH} $_{3\ 2}$ ® C H CON$_6$ 5 (CH_3 2) + HCl

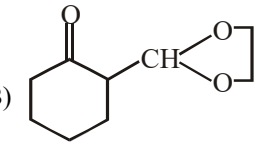
(d) C H CO$_6$ 5 .O.COC$_6$H$_5$ + (CH_3 2) NH ® C H CON$_6$ 5 (CH_3 2) + C H COOH$_6$ 5

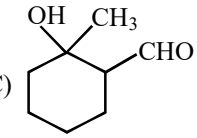
76. **(d)** n (CF_2 = CF)2 ¾¾¾¾¾¾¾¾® Benzoyl peroxide or (NH) S O4 2 2 8

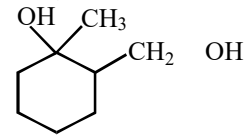
$(CF_2 - CF_2)$ PTFE (X) Here X is polytetrafluoroethylene. So, none of these i.e., option (d) is correct choice.

77. **(d)** Bacteriostatic drugs inhibit the growth of organisms while bactericidal drugs kill the microorganisms.

78. **(b)** (A) 

(B) 

(C) 

(D) 

79. **(c)** C(s) + $\frac{1}{2}$ O$_2$(g) ® CO(g); DS increases.

Hence, as the temperature increases, TDS increases and hence DG (DH – TDS) decreases. In other words, the slope of the curve for formation of CO decreases. However, for all other oxides, it increases.

80. **(c)** Given $t_{1/2}$ = 3 Total time T = 12

No. of half lives (n) = $\frac{12}{3}$ = 4

æ öç ÷ 1 n = NN \ æç 1

ö÷ 4 = 3 è ø2 o è 2 ø N

3 1

=

N 16

N = 48 g

PART - III (A): ENGLISH PROFICIENCY

81. **(b)** Warn a person of possible danger or a potential problem. Warn a person against a fault. Hence out of all four prepositions in options, 'of' is the correct choice.

82. **(b)** Attributes means regard something as being caused by.

83. **(a)** Write 'asked for'.

84. **(c)** Write 'that in' after 'like'.

85. **(b)** Use preposition 'to' after 'succumbed'. Verb 'Succumb' is characterized by preposition 'to'. Moreover, 'Succumb to something' is an idiomatic expression which means to yield to something, especially a temptation, fatal disease, a human weakness, etc.

86. **(a)** Harold succeeded in overcoming the need for security.

87. **(c)** Slimy tentacles and slug-like animals

88. **(c)** In a different land

89. **(d)** In it he saw slimy creatures feeding on people's bodies

90. **(b)** Subdued Lacking in vitality, intensity, or strength

91. **(b)** Fervent having or displaying a passionate intensity. Dispassionate not influenced by strong emotion, and so able to be rational and impartial.

92. **(a)** Scrupulous (of a person or process) diligent, thorough, and extremely attentive to details.

93. **(d)** Onslaught a fierce or destructive attack. Invasion an instance of invading a country or region with an armed force.

94. **(c)** Ignominy public shame or disgrace.

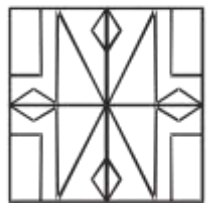
95. **(b)** Tryst An agreement (as between lovers) to meet

PART - III (B) : LOGICAL REASONING

96. **(b)** Closest Resemblance is mirror image of **98.** question figure.

97. **(b)**

98. **(c)**



99. **(c)**

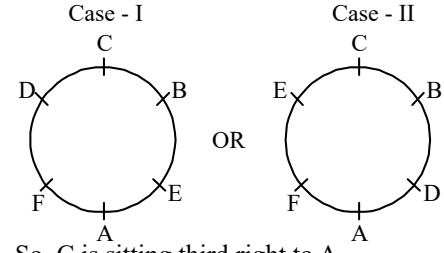
Front Face	–	'	$
Opposite Face	?	.	+

Only cube (4) can be formed.

100. **(b)** (100 + 12) – (28 + 25) = 59 Similarly, (102 + 52) – (36 + 28) = 90

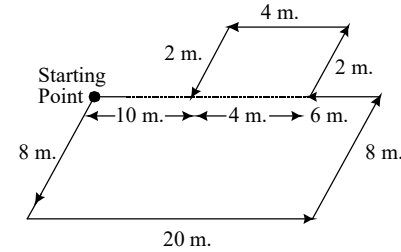
101. **(c)** In this time 12 : 30 we subtract that time from 17 : 90 – 12 : 30 = 5 : 60 = 6 : 00

102.(c)



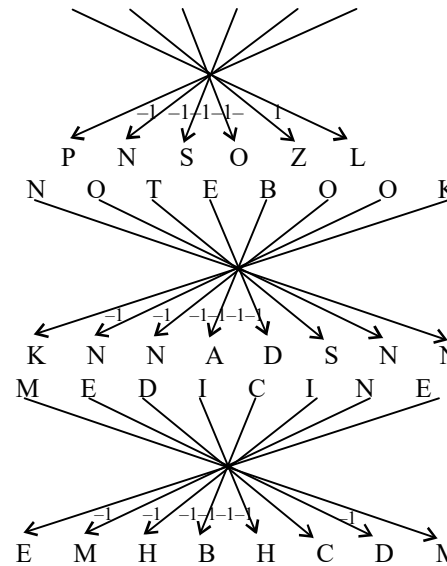
So, C is sitting third right to A

103.(b)



Ganesh is **10m.** far from the starting point

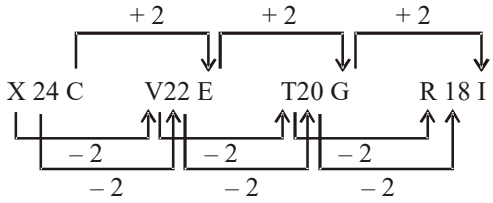
104. (a)



As, L A P T O P

So, required answer = ED

105. (c)



PART - IV : MATHEMATICS

106. (d) Given that, f (x) = [x] and g (x) = |x|

Now,

f çèæg æèç – – 85 öø÷÷øö = g æèç 85 øö÷ = é ùë ûê ú85 = 1

and gçæf èæç- _85 öø÷ö÷ø= gèçæëéê- _ 85ûùúö÷ø = g (– 2) = |– 2| = 2 è

\ f æçè g æçè _85 øö÷øö÷ - g æèçf èçæ- _85 øö÷ö÷ø = 1 – 2 = –1.

107. (c) Since the chord makes equal intercepts of length a on the coordinate axes. So, its equation can be written as $x \pm y = \pm a$. This line meets the given circle at two distinct points. So, length of the perpendicular from the centre (0, 0) of the given circle must be less than the radius.

i.e. $\left|\pm \frac{a}{\sqrt{2}}\right| < 8 \Rightarrow a^2 < 16 \Rightarrow |a| < 4$

108. (a) We have $x^2 + y^2 + 4y - 5 = 0$. Its centre is C $(0, -2)_1$,

$r_1 = \sqrt{+ =4}$

$\sqrt{53}$. Let C_2 (h, k) be the centre of the smaller circle and its radius r_2. Then $C_1C_2 = 4$.

Þ h² + +(k 2)² = + =3 r_2 4 ...(1)

Þ $r_2 = 1$

But k = r_2 = 1 [it touches x-axis]

\ From eq (1), $4 = \sqrt{h^2 + +(1\ \ 2)2}$

Þ 16 = h² + 9 Þ h² = 7 Þ h = ± 7 $\sqrt{}$

Since h > 0 \h = $\sqrt{7}$

Hence, required circle is

$(x - \sqrt{7})^2 + (y - 1)^2 = 1$

109. (c) We have, $\sin^4 x - (k + 2)\sin^2 x - (k + 3) = 0$

Þ $\sin^2 x = \frac{(k+2) \pm \sqrt{(k+2)^2 + 4(k+3)}}{2}$

$= \frac{(k+2) \pm (k+4)}{2}$

Þ $\sin^2 x = k + 3$ ($\because \sin^2 x = -1$ is not possible)

Since $0 \le \sin^2 x \le 1$,

\ 0 £ + £k 3 1or -3£ £k -2

110. (c) Required number of ways

= coeff. of x^{16} in $(x^3 + x^4 + x^5 + x^6 + x^7)^4$

111. (c) AM³HM

Þ $\frac{a + b + c}{3} \ge \frac{3}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c}}$

Þ $(a + b + c)\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right) \ge 9$

¥ $\int_0^1 \frac{dx}{\quad} \quad \frac{1}{\quad}$

112. (c) $\int_0^{\infty} \frac{dx}{(x^2 + a^2)(x^2 + b^2)} = \frac{\pi}{2(b - a)}$

$= \int_0^{\infty} \frac{(x^2 + b^2) - (x^2 + a^2)}{(x^2 + a^2)(x^2 + b^2)}\,dx$

¥

$= \frac{1}{b^2 - a^2}\int_0^{\infty}\left[\frac{1}{x^2 + a^2} - \frac{1}{x^2 + b^2}\right]dx$

$= \frac{1}{b^2 - a^2}\left[\tan^{-1}\frac{x}{a} - \tan^{-1}\frac{x}{b}\right]$

$= \frac{2}{2ab(pa + b)}(b - a)$

113. (d) For minimum value $|\vec{r} + b\vec{s}| = 0$.

Let $\vec{r}$ and $\vec{s}$ are anti-parallel so $\vec{bs} = -\vec{r}$

$\therefore |\vec{bs}|^2 + |\vec{r} + \vec{bs}|^2 = |\vec{r}|^2 + |\vec{r} - \vec{r}|^2 = |\vec{r}|^2$.

114. (d) The equation represents a pair of lines if

$$\begin{vmatrix} 1 & 1 & 4x \\ x & x & 2x \\ fg & 1 & x \end{vmatrix} - \begin{vmatrix} 1 & x & f^2 \\ 1 & x & g^2 \\ 4 & 1 & x^2 \end{vmatrix} = 0$$

$\Rightarrow (f - g)^2 = 0 \Rightarrow f = g$

The equation becomes $(x + y)^2 + 2g(x + y) + 4 = 0$ Which represents pair of parallel lines, which are real provided $(2g)^2 - 4 \cdot 4 \cdot 1 \cdot x \cdot x \geq 0 \Rightarrow |g| \geq 2$.

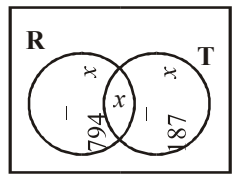
115. (a) $z_1 \bar{z}_1 = z_2 \bar{z}_2 = \ldots = z_n \bar{z}_n = 1$

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

$\therefore |z_1 + z_2 + \ldots + z_n| = \left|\frac{1}{z_1} + \frac{1}{z_2} + \ldots + \frac{1}{z_n}\right|$

$= |z_1 + z_2 + \ldots + z_n| - |\bar{z}_1 + \bar{z}_2 + \ldots + \bar{z}_n| = 0$

116.(b)



Let R be the set of families having a radio and *T* the set families having a T.V., then n (R È T) = The number of families having at least on of the radio and T.V. = 1003 – 63 = 940 n(R) = 794 and n(T) = 187 Let x families have both a radio and a T.V.

Then number of families who have only radio = $794 - x$

And the number of families who have only T.V. = $187 - x$

From Venn diagram, $794 - x + x - 187 - x = 940$

$\Rightarrow 981 - x = 940$ or $x = 981 - 940 = 41$ Hence, the required number of families having both a radio and a T.V. = 41

117. (d) For $f(x)$ to be defined, we must have $x - \sqrt{1 - x^2} \geq 0$ or $x \geq \sqrt{1 - x^2} > 0$

$\therefore x^2 \geq 1 - x^2$ or $x^2 \geq \frac{1}{2}$.

Also, $1 - x^2 \geq 0$ or $x^2 \leq 1$.

Now, $x^2 \geq \frac{1}{2} \Rightarrow \left(x - \frac{1}{\sqrt{2}}\right)\left(x + \frac{1}{\sqrt{2}}\right) \geq 0$

$\Rightarrow x \leq -\frac{1}{\sqrt{2}}$ or $x \geq \frac{1}{\sqrt{2}}$

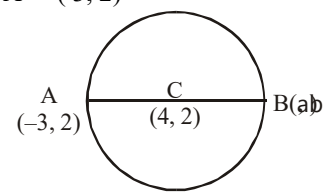
Also, $x^2 \leq 1 \Rightarrow (x - 1)(x + 1) \leq 0$

$\Rightarrow -1 \leq x \leq 1$

Thus, $x > 0, x^2 \geq \frac{1}{2}$ and $x^2 \leq 1 \Rightarrow x \in \left[\frac{1}{\sqrt{2}}, 1\right]$

118. (d) The centre of the given circle is C $\equiv$ (4, 2)

Let A $\equiv$ -(3, 2)



If (,a b) are the coordinates of the other end of the diameter, then, as the middle ploint of the diameter is the centre,

$\therefore \frac{a-3}{2} = 4$ and $\frac{b+2}{2} = 2 \Rightarrow a = 11, b = 2$

Thus, the coordinates of the other end of diameter are (11, 2)

119. (b) $\sin n\left[p + (-1)^n \frac{p}{4}\right] = (-1)^n \sin\left[(-1)^n \frac{p}{4}\right]$

$[\because \sin(n\pi+q = -) \quad (1)^n \sin q]$

$= -(1)(1)^n - {}^n \sin \frac{\pi}{4}$

$\therefore \sin[(-1)^n q = -] \quad (1)^n \sin q]$

$= -(1)^{2n} \sin \frac{\pi}{4} = \sin \frac{\pi}{4} = \frac{1}{\sqrt{2}}$

120. (c) Total number of ways = 6 × 6 × ..... to n times = 6^n.

Total number of ways to show only even number = 3 × 3 × ..... to n times = 3^n.

\ required number of ways = $6^n - 3^n$. **121.** **(c)** We know that

$$\frac{e^x + e^{-x}}{2} = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \ldots$$

keeping x = 2, we get

$$\frac{1}{2}\left[\frac{e^2 + e^{-2}}{2}\right] - (e^2 - 1) \text{ Expression}$$

$= 2 \left[\frac{2}{2} + \frac{2}{2!} + \frac{2}{4!} + \frac{2}{6!} + \ldots\right] - 1 = 2e^2$

122. (c) The given equation is

$$\frac{dy}{dx} - \frac{y}{x+1} = e^{x^3}(x+1)$$

$$\text{I.F.} = e^{\int -\frac{1}{x+1} dx} = e^{-\log(x+1)} = \frac{1}{x+1}$$

The solution is

$$\frac{1}{x+1} \cdot y = \int e^{x^3}(x+1) \cdot \frac{1}{x+1} dx + a$$

$$\Rightarrow y = (x+1) \int e^{x^3} dx + a(x+1)$$

$$\Rightarrow y = (x+1) \cdot \frac{1}{3} e^{x^3} + a(x+1)$$

$$\Rightarrow 3y = e^{x^3} + c, \; c = 3a$$

123. (d) $f(x) = \begin{cases} 1 - x^2, & x < 1, x \neq 0 \\ \frac{x^2 - 1}{|x^2 - 1|}, & x > 1 \end{cases}$

$$= \frac{x^2 - 1}{|x^2 - 1|} = \begin{cases} x^2 - 1, & x > 1 \\ -(x^2 - 1), & x < 1 \end{cases}$$

$$= \begin{cases} x^2 - 1, & x > 1 \\ 1 - x^2, & x < 1 \end{cases}$$

Clearly, $f(x)$ is continuous for all $x \in R$ except at $x = 0$.

$$f'(x) = \begin{cases} 2x, & x < 1, x \neq 0 \\ -2x, & x > 1 \end{cases}$$

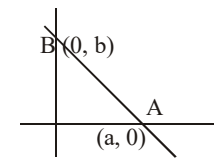
$$f(x) = \begin{cases} 2x, & x < 1 \\ -2x, & x > 1 \end{cases}$$

$f'(x) > 0 \Rightarrow x < 0$ or $1 < x < 2$

$f'(x) < 0 \Rightarrow 0 < x < 1$ or $x > 2$

Hence, $f(x)$ is increasing in $(-\infty, 0) \cup (1, 2)$ and decreasing in $(0, 1) \cup (2, \infty)$.

124. (b) Let end A is (a, 0) and end B is (0, b) then



$a^2 + b^2 = 81$ …(1)

If centroid is (x, y) then

$x = \frac{a}{3}$, $y = \frac{b}{3}$, putting in (1) we get the locus as

$x^2 + y^2 = 9$

125. (b) The given relation is $xy + y^2 = \tan x + y$.

Differentiating both sides with respect to x, we get $d(xy) + d(y^2) = d(\tan x) + dy$

$$\frac{dx}{dx} \cdot y + x \frac{dy}{dx} + 2y \frac{dy}{dx} = \sec^2 x \frac{dx}{dx} + \frac{dy}{dx}$$

or $\left(x+2y-1\right)\frac{dy}{dx}=\sec^2 x+y$

or $\frac{dy}{dx}=\frac{\sec^2 x+y}{\left(x+2y-1\right)}$

126. (c) Probability that the electronic component fails when first used is $P(F) = 0.10$. Therefore, $P(F') = 1 - P(F) = 0.90$

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

Then, $P(E) = P(F)P(E|F) + P(F')P(E|F')$

[total probability theorem] $= 0.10 \times 0 + 0.90 \times 0.99 = 0.891$.

127. (b) $x = \frac{3-\cos 4\theta+4\sin 2\theta}{2}$

$= \frac{3-(1-\sin^2 2\theta)+4\sin 2\theta}{2} = \frac{3+(1+\sin 2\theta)^2}{2}$

$= \frac{3-\cos 4\theta+4\sin 2\theta}{2}$

$= \frac{3-(1-\sin 2\theta)+4\sin 2\theta}{2} = \frac{3+(1+\sin 2\theta)^2}{2}$

$\therefore xy = \frac{1}{4}(1+\sin^2 2\theta)^2 = \frac{1}{4}\cos^4 2\theta+1$

128. (d) 2 white squares can be selected in ${}^{32}C_2$ ways

If they belong to some row or same column then

$2(8.{}^4C_2)$ ways.

129. (d) Length of latus rectum = 2 × distance of focus from directrix

$= 2\times\frac{|1+4+3\cdot 24|}{5} = 10$

130. (b) In the interval $\frac{\pi}{3}$ to $\frac{\pi}{2}$, $[x] = 1$

$$I=\int_{\pi/3}^{\pi/2} x\,\sin(\pi-x)\,dx=\int_{\pi/3}^{\pi/2} x\sin x\,dx$$

$$= -[x\cos x+\sin x]_{\pi/3}^{\pi/2} = -1+\frac{\sqrt{3}}{2}+\frac{\pi}{6}$$

131. (d) $\frac{5}{2}\{2a+4(2)\} = -5 \Rightarrow 2a = 6$

$\therefore$ Actual sum $= \frac{5}{2}\{6+4(2)\} = 35$

132. (c) Equation holds if and only if $x - 1 = 0$, $x - 2 = 0$ and $x - 3 = 0$ simultanesouly, which is not possible.

133. (a) We have, $\sin\pi(x^2+x) = \sin\pi x^2$

$\Rightarrow \pi(x^2+x) = n\pi+(-1)^n\pi x^2$

$\therefore$ Either $x^2+x = 2m\pi+x^2 \Rightarrow x = 2m\pi$

or $x^2+x = k-x^2$, where k is an odd integer

$\Rightarrow 2x^2+x-k = 0 \Rightarrow x = \frac{-1\pm\sqrt{1+8k}}{4}$

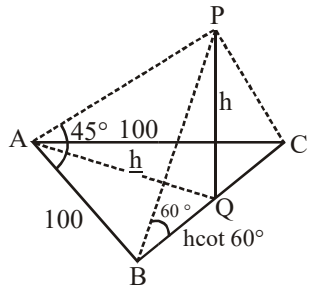
For least positive non-integral solution is $x = \frac{1}{2}$, when $k = 1$

134. (b) $\tan 45° = \frac{PQ}{AQ} = \frac{h}{AQ} \Rightarrow AQ = h$

Where PQ is tower and ABC is the park, with Q being mid point of the side BC and PQ = h

Also, $AQ^2 + BQ^2 = 100^2$

$\Rightarrow h^2 + h^2\cot^2 60° = 100^2$



$\therefore h^2\left[1+\frac{1}{3}\right]=100^2$

$\therefore h^2=\frac{3\times100^2}{4} \therefore h=50\sqrt{3}$

135. (d) $x^2+4y^2+9z^2-6yz-3zx-2xy$
$=x^2+(2y)^2+(3z)^2-(2y)(3z)-(3z)(x)-x(2y) \geq 0 \ \forall\ x,y,z$

$[\because a^2+b^2+c^2-ab-bc-ca \geq 0]$

136. (b) Selection of 6 guests = 10C6
Permutation of 6 on round table = 5!
Permutation of 4 on round table = 3!
Then, total number of arrangements = 10C6.5!.3!

$=\frac{(10)!\times5!.3!}{6!.4!}=\frac{(10)!}{24}$

137. (d) AM > GM

$\therefore \frac{a+b}{2}>\sqrt{ab}, \frac{b+c}{2}>\sqrt{bc}, \frac{c+a}{2}>\sqrt{ca}$

So, $(a+b)(b+c)(c+a) > 8abc$

138. (d) $y = be^{-x/a}$ meets the y-axis at $(0, b)$. Again,

$\frac{dy}{dx}=-\frac{1}{a}be^{-x/a}$

$=-\frac{b}{a}e^{-x/a}$

At $(0, b)$, $\frac{dy}{dx}=-\frac{b}{a}e^{0}=-\frac{b}{a}$

Therefore, required tangent is

$y-b=-\frac{b}{a}(x-0)$ or $\frac{x}{a}+\frac{y}{b}=1$

139. (a) Putting $x + y + 1 = u$, we have $du = dx + dy$ and the given equation reduces to $u(du - dx) = dx$

$\therefore udu=dx \quad \therefore \frac{u}{u+1}=dx \quad \therefore u-\log(u+1)=x$

$\therefore \log(x+y+2)=y+\text{constant}$

$\therefore x+y+2=Ce^{y}$

140. (a) We have $y = 3x + 6x^2 + 10x^3 + \ldots\ldots \therefore \frac{dx}{dy}=\frac{1}{\frac{dy}{dx}}$

$=\frac{1}{3x+6x^2+10x^3+\ldots\ldots}$

$\therefore \frac{dx}{dy}=\frac{1}{3x(1+2x+\frac{10}{3}x^2+\ldots\ldots)} \quad \therefore \frac{dx}{dy}=\frac{1}{3x}(1+y)^{-1/3}$

$\therefore \frac{dx}{dy}=\frac{1}{3x}-\frac{1}{3x}(1+y)^{-1/3}$

$=\frac{1}{3}y-\frac{1.4}{3^2.2}y^2+\frac{1.4.7}{3^2.3}y^3-\ldots\ldots$

141. (a) Since the system is homogeneous and has a non-trivial solution

$$0=\begin{vmatrix} p+a & b & cp-q & 0 \\ a & q+b & c=0 & q-r \\ a & b & r+ca & b \\ r & & & \end{vmatrix}$$

$+c$ using $R_1 \to R_1 - R_2$ and $R_2 \to R_2 - R_3$.

Expanding along C_1 we get

$\therefore p[q(r+c)+br]+aqr=0 \therefore$

$pqr+pqc+prb+qra=0 \therefore$

$\frac{a}{p}+\frac{b}{q}+\frac{c}{r}=-1.$

142. (c) Area of the triangle

$=\frac{1}{2}(\text{x intercept})\times(\text{y intercept})$

$= \frac{1}{2}\left(\frac{c}{a}+\frac{a}{c}\right) = \frac{1}{2}c^{1} = 1$ unit

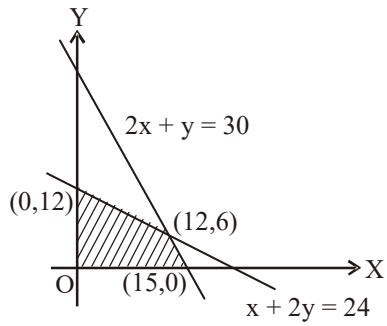
$[\because a, c, b$ are in G.P. $\Rightarrow c^2 = ab]$

143. **(a)** Using LMVT in [0, 2]

$$\frac{f(2)-f(0)}{2-0} = f'(c), \text{ where } c \in (0,2)$$

$$\frac{f(2)+3}{2} \le 5 \Rightarrow f(2) \le 7.$$

144. **(b)** Here, $2x + y \le 30$, $x + 2y \le 24$, $x, y \ge 0$ The shaded region represents the feasible region, hence $z = 6x + 8y$. Obviously it is maximum at (12, 6). Hence $z = 12 \times 6 + 8 \times 6 = 120$



145. **(c)** Let $a = b - d$ and $c = b + d$, then $a + b + c = 21$

$\Rightarrow b = 7$

So, the equation is $a + c = 14$

$\therefore$ No. of solution = coeff. of x^{14} in $(x + x^2 + ...)$

$= {}^{13}C_{12} = 13$

146. **(a)** The line is $y = -\frac{b}{n}x - nb$. It will touch the ellipse if

$$(-nb)^2 = a^2\left(-\frac{b}{n}\right)^2$$

$$+ b^2 = m^2a^2 + b^2$$

$[c^2 = a^2m^2 + b^2]$

147. **(d)** For $x < 1$, $f(x) = \frac{x^2+2^{-x}-1}{2} - 3$

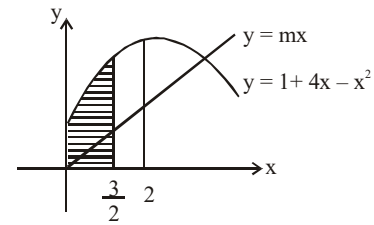
$= x^x + \frac{1}{2} - 3 \therefore \lim_{x\to 1^-} f(x) = -\frac{1}{2}$

For $x > 1$, $f(x) = \frac{x^2-1}{x^2-2x+1} = \frac{x+1}{x-1}$

$\therefore \lim_{x\to 1^+} f(x) = \infty$

$\therefore$ The function is not continuous at $x = 1$.

148. **(a)** $y = 1 + 4x - x^2 = -5 - (x - 2)^2$



We have $\int_0^{3/2} (1 + 4x - x^2)dx = 2\int_0^{3/2} mx\,dx$

$= \frac{3}{2} + 2\left(\frac{9}{4} - \frac{1}{2}\left(\frac{27}{8}\right)\right) = m \times \frac{9}{4}$

On solving we get $m = \frac{13}{6}$

149. **(b)** Let the last three numbers in A.P. be a, a + 6, a + 12, then the first term is also a + 12. But a + 12, a, a + 6 are in G.P.

$\therefore a^2 = (a + 12)(a + 6) \Rightarrow a^2 = a^2 + 18a + 72$

$\therefore a = -4.$

$\therefore$ The numbers are 8, –4, 2, 8.

150. **(c)** Any point on the line is $(r + 3, 2r + 4, 2r + 5)$.

It lies on the plane $x + y + z = 17$,

$\Rightarrow m_2 = n_2$ or $n_2 = \frac{m_2}{n^2 - 1}$ $m^2 - 1$

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[1] $= n_2 + 1 \Rightarrow n = \frac{m_2}{m_2}$

\ $(r + 3) + (2r + 4) + (2r + 5) = 17$ i.e $r = 1$

Thus the point of intersection of the plane and the line is (4, 6, 7)

Required distance = distance between (3, 4, 5) and (4, 6, 7)

$$= \sqrt{\{(4-3)^2 + -(6\quad 4)^2 + -(7\,5)\}^2} = 3$$