# UPSEE - 2003

# Full Paper

## Section-1

## Physics

1. An electron and a proton have equal kinetic energies. They enter in a magnetic field perpendicular to B, then :

    1) both will follow a circular path with same radius

    2) both will follow a helical path

    3) both will follow a parabolic path

    4) all the statements are false

**Directions for question 2 to 3 :**
**A planet is revolving around the sun. Answer the next two questions keeping in mind Kepler's laws :**

2. The orbital velocity of the planet will be minimum at :
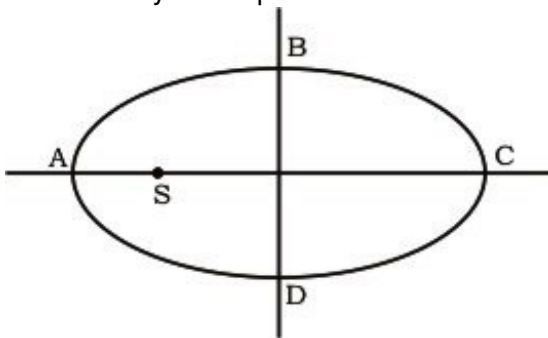


    1) A                     2) B                     3) C                     4) D

3. The correct option is :

    1) the time taken in travelling DAB is less than that for BCD

    2) the time taken in travelling DAB is greater than that for BCD

    3) the time taken in travelling CDA is less than that for ABC

    4) the time taken in travelling CDA is greater than that for ABC

4. The density of uranium is of the order of :

    1) $10^{20}$ kg/m$^3$

    2) $10^{17}$ kg/m$^3$

    3) $10^{14}$ kg/m$^3$

    4) $10^{11}$ kg/m$^3$

**Directions for question 5 to 6 : P-V curve is shown for a Carnot engine. Answer the**

**next two questions from the graph.**
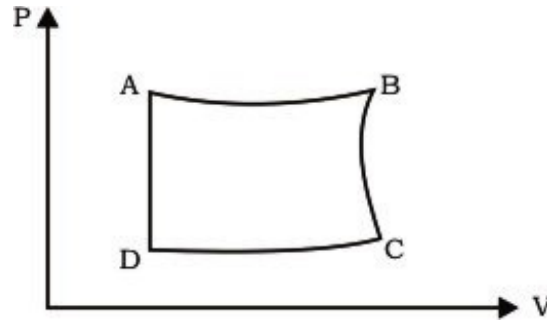


5. If the temperatures at B and C are $T_1$ and $T_2$ respectively, then it can be concluded :

    1) $T_1 = T_2$

    2) $T_1 > T_2$

    3) $T_1 < T_2$

    4) nothing can be said about $T_1/T_2$

6. The parts of the graph showing the adiabatic process are :

    1) AB and BC

    2) AB and CD

    3) AD and BC

    4) BC and CD

7. The ratio of the wavelengths for $2 \rightarrow 1$ transition in $Li^{2+}$, $He^+$ and H is :

    1) 1 : 2 : 3

    2) (1/9) : (1/4) : (1/1)

    3) 1 : 4 : 1

    4) 3 : 2 : 1

8. In a photoelectric effect experiment, the slope of the graph between the stopping potential and the incident frequency will be :

    1) 1

    2) 0.5

    3) $10^{-15}$

    4) $10^{-34}$

9. A and B are two radioactive substances whose half-lives are 1 and 2 yr respectively. Initially 10 g of A and 1 g of B is taken. The time (approximately) after which we will have same quantity remaining is :

    1) 6.65 yr

    2) 5 yr

    3) 3.2 yr

    4) 7 yr

10. The distance of a planet from the sun is 5 times the distance between the earth and the sun. The time period of the planet is :

1) $6^{3/2}$ T yr

2) $5^{3/2}$ T yr

3) $5^{3/1}$ T yr

4) $5^{1/2}$ T yr

11. The correct option for getting X = 1 from the given circuit is :
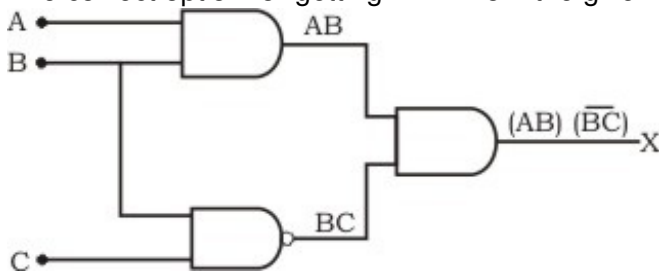


1) A = B = C = 1

2) A = B = 1 and C = 0

3) A = C = 1 and B = 0

4) A = 0 and B = C = 1

12. The ratio of speed of sound in nitrogen and helium gas at 300 K is :

1) $\sqrt{(2/7)}$

2) $\sqrt{(1)}/7$

3) $\sqrt{(3)}/5$

4) $\sqrt{(6)}/5$

13. The current gain $\beta$ for a transistor is 49 and the emitter current is 1 mA. The base current in $\mu$A is :

1) 20                2) 40                3) 10                4) 5

14. The dimensions of electric potential are :

1) $[ML^2T^{-2}Q^{-1}]$

2) $[MLT^{-2}Q^{-1}]$

3) $[ML^2T^{-1}Q]$

4) $[ML^2T^{-2}Q]$

15. A photon and an electron have equal energy E. $\lambda_{photon} / \lambda_{electron}$ is proportional to :

1) $\sqrt{E}$

2) $1/\sqrt{E}$

3) $1/E$

4) does not depend upon E

16. A gas mixture consists of 2 moles of oxygen and 4 moles of argon at temperature T. Neglecting all vibrational moles, the total internal energy of the system is :

    1) 4 RT

    2) 15 RT

    3) 9 RT

    4) 11 RT

17. A small sphere carrying a charge q is hanging in between two parallel plates by a string of length L. Time period of pendulum is $T_0$. When parallel plates are charged, the time period changes to T. The ratio $T/T_0$ is equal to :
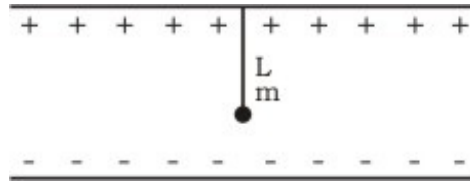


1) $\left(\dfrac{g+\dfrac{qE}{m}}{g}\right)^{1/2}$

2) $\left(\dfrac{g}{g+\dfrac{qE}{m}}\right)^{3/2}$

3) $\left(\dfrac{g}{g+\dfrac{qE}{m}}\right)^{1/2}$

    4) none of these

18. Two identical metal plates are given positive charges $Q_1$ and $Q_2$ ($< Q_1$) respectively. If they are now brought close together to form a parallel plate capacitor with capacitance C, the potential difference between them is :

    1) $(Q_1 + Q_2) / 2C$

    2) $(Q_1 + Q_2) / C$

    3) $(Q_1 - Q_2) / C$

    4) $(Q_1 - Q_2) / 2C$

19. A dancer is standing on a stool rotating about the vertical axis passing through its centre. She pulls her arms towards the body reducing her moment of inertia by factor of n. The new angular speed of turn table is proportional to :

    1) $n$

    2) $n^{-1}$

    3) $n^0$

    4) $n^2$

20. Which of the following is a correct statement ?

    1) β-rays are same as cathode rays

    2) Gamma rays are high energy electrons

    3) Alpha particles are singly ionised helium atoms

    4) Protons and neutrons have exactly the same mass

21. The half-life period of a radioactive element X is same as the mean-life time of another radioactive element Y. Initially both of them have the same number of atoms then :

    1) X and Y have the same decay rate initially

    2) X and Y have the same decay rate always

    3) Y will decay at a faster rate than X

    4) X will decay at a faster rate than Y

22. A coil of inductance 8.4 mH and resistance $6\,\Omega$ is connected to a 12 V battery. Approximately how much time it takes to attain a current of 1 A?

    1) 500 ms

    2) 20 ms

    3) 35 ms

    4) 1 ms

23. A circular loop of radius R, carrying current I lies in xy-plane with its centre at origin. The total magnetic flux through xy-plane is :

    1) directly proportional to R

    2) directly proportional to I

    3) inversely proportional to I

    4) zero

24. A disc like reel with massless thread unrolls itself while falling vertically downwards the acceleration of its fall is :

    1) g

    2) g/2

    3) zero

    4) (2/3) g

25. In hydrogen spectrum, the wavelength of $H\alpha$ line is 656 nm, whereas in the spectrum of a distant galaxy, $H\alpha$ wavelength is 706 nm. Estimated speed of the galaxy with respect to earth is :

    1) $2 \times 10^8$ m/s

    2) $2 \times 10^7$ m/s

    3) $2 \times 10^6$ m/s

    4) $2 \times 10^5$ m/s

26. The work done in which of the following processes is equal to the internal energy of the system ?

   1) Adiabatic process

   2) Isothermal process

   3) Isochoric process

   4) None of the above

27. The temperature of a metal block is increased from 27°C to 84°C. The rate of the radiated energy from the block will increase a approximately :

   1) 2 times

   2) 4 times

   3) 8 times

   4) 16 times

28. The equation of a wave is given as :
    $y = 0.07 \sin (12\pi x - 3000\pi t)$
    where x is in metre and t in second, then the correct statement is :

   1) $\lambda = 1/6$ m, v = 250 m/s

   2) a = 0.07 m, v = 300 m/s

   3) n = 1500, v = 200 m/s

   4) none of the above

29. The energy liberated on complete fission of 1 kg of $_{92}U^{235}$ is (Assume 200 MeV energy is liberated on fission of 1 nucleus) :

   1) $8.2 \times 10^{10}$ J

   2) $8.2 \times 10^{9}$ J

   3) $8.2 \times 10^{13}$ J

   4) $8.2 \times 10^{16}$ J

30. In the circuit, if the forward voltage drop for the diode is 0.5 V, the current will be :
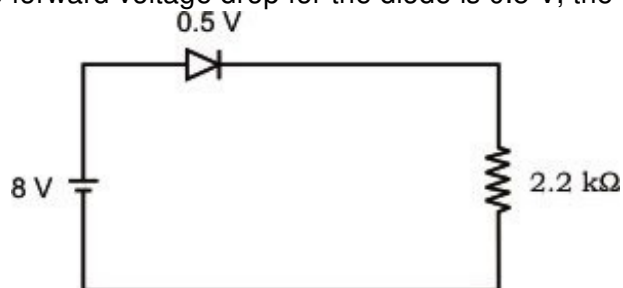


   1) 3.4 mA

   2) 2 mA

   3) 2.5 mA

   4) 3 mA

31. A 2 kg mass starts from rest on an inclined smooth surface with inclination 30° and length 2 m. How much will it travel before coming to rest on a frictional surface with frictional coefficient 0.25 ?

   1) 4 m

   2) 6 m

   3) 8 m

   4) 2 m

32. A gas is filled in a closed container and its molecules are moving in horizontal direction with uniform acceleration. Neglecting acceleration due to gravity, the pressure inside the container is :

   1) uniform everywhere

   2) less in the front

   3) less at the back

   4) less at the top

33. A particle free to move along the x-axis has potential energy given as
   $U(x) = k [1 - \exp(-x^2)]$ for $-\infty \leq +\infty$,
   where k is a positive constant of appropriate dimensions. Then :

   1) at points away from origin, the particle is in equilibrium

   2) for any finite non-zero value of x, there is a force directed away from the origin

   3) Its total mechanical energy is k/2 and it is equal to its kinetic energy at origin

   4) at x = 0, the motion of the particle is simple harmonic

34. A charged particle is at rest in the region where magnetic field and electric field are parallel. The particle will move in a :

   1) straight line

   2) circle

   3) ellipse

   4) none of these

35. The velocity of the molecules of a gas at temperature 120 K is v. At what temperature will the velocity be 2 v ?

   1) 120K

   2) 240K

   3) 11K

   4) 24K

36. The gate shown in figure is :
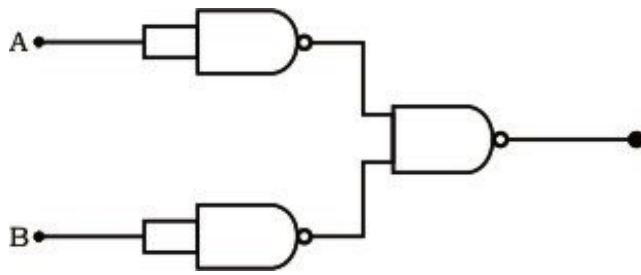
1) NOR gate

2) OR gate

3) AND gate

4) XOR gate

37. An electric dipole is situated in an electric field of uniform intensity E whose dipole moment is p and moment of inertia is I. If the dipole is displaced slightly from the equilibrium position, then the angular frequency of its oscillations is :

1) $(pE/I)^{1/2}$

2) $(pE/I)^{3/2}$

3) $(I/pE)^{1/2}$

4) $(P/IE)^{1/2}$

38. If in a stationary lift, a man is standing with a bucket full of water, having a hole at its bottom, the rate of flow of water through this hole is $R_0$. If the lift starts to move up and down with same acceleration and then that rates of flow of water are $R_u$ and $R_d$, then :

1) $R_0 > R_u > R_d$

2) $R_u > R_0 > R_d$

3) $R_d > R_0 > R_u$

4) $R_u > R_d > R_0$

39. A ray of light is incident on a plane mirror at an angle 57°. The resultant polarised light vibrates in a plane which makes an angle with the reflecting surface :
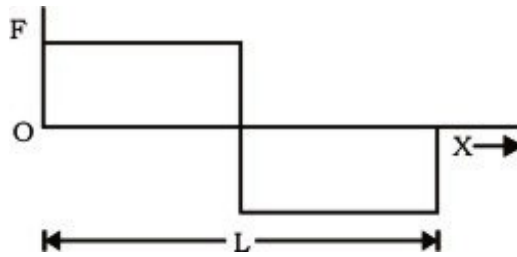
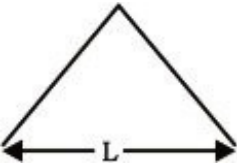1) 0°                 2) 90°                 3) 57°                 4) 33°
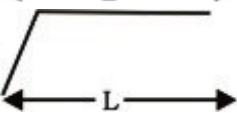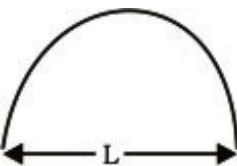
40. At critical point :

1) latent heat becomes infinite

2) liquid state is not possible

3) gaseous state is not possible

4) none of the above

41. A person used force (F), shown in figure move a load with constant velocity on give surface.
Identify the correct surface profile :

1)



2)



3)



4)



42. The work function of a substance is 4.0 eV. The maximum wavelength that can emit photoelectrons from the substance is approximately :

1) 540 nm

2) 400 nm

3) 310 nm

4) 220 nm

43. At what temperature the molecule of nitrogen will have same rms velocity as the molecule of oxygen at 127°C ?

1) 457°C

2) 273°C

3) 350°C

4) 77°C

44. Two identical circular loops of metal wire are lying on a table. Loop A carries a current which increases with time. In response, the loop B :

1) is attracted by the loop A

2) is repelled by the loop A

3) remains stationary

4) none of the above

45. A rod AB of mass M, length L is lying on a horizontal frictionless surface. A particle of mass

m traveling along the surface hits the end A of the rod with a velocity $v_0$ in a direction perpendicular to AB. The collision is completely elastic. After the collision, the particle comes to rest. The ratio (m/M) is :

1) $\omega^2 L^2 / 9v_0^2$

2) $9v_0^2 / \omega^2 L^2$

3) $9v_0 / \omega L$

4) $\omega L / 9v_0$

46. The work done in which of the following processes is zero ?

    1) Isothermal process

    2) Adiabatic process

    3) Isochoric process

    4) None of the above

47. Two thin and parallel wires are placed at a distance b and i current is flowing through each of the wires. The magnitude of the force exerted on the unit length of wire due to another wire will be :

    1) $\mu_0 i^2 / b^2$

    2) $\mu_0 i^2 / 2\pi b$

    3) $\mu_0 i / 2\pi b$

    4) $\mu_0 i / 2\pi b^2$

48. The temperature of a gas is -68°C. At what temperature will the average kinetic energy of its molecules be twice that of at -68°C ?

    1) 137°C

    2) 127°C

    3) 100°C

    4) 105°C

49. A metallic loop is placed in a magnetic field. If a current is passed through it, then :

    1) the ring will feel a force of attraction

    2) the ring will feel a force of repulsion

    3) will move to and fro about its centre of gravity

    4) none of the above

50. For the circuit shown in figure, which of the following statements is true ?
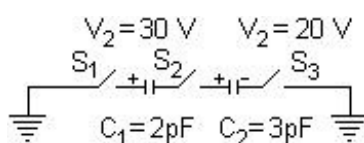


    1) With $S_1$ closed, $V_1$ = 15 V, $V_2$ = 20V

2) With $S_3$ closed, $V_1 = V_2 = 25V$

3) With $S_1$ and $S_2$ closed $V_1 = V_2 = 0$

4) With $S_1$ and $S_3$ closed, $V_1 = 30V$, $V_2 = 20V$

## Section-2
### Chemistry

51. The hybridization of carbon atom in benzene is :

    1) sp

    2) $sp^2$

    3) $sp^3$

    4) $dsp^2$

52. Compound which gives acetone on ozonolysis :

    1) $CH_3 - CH = CH - CH_3$

    2) $(CH_3)_2C = C(CH_3)_2$

    3) $C_6H_5CH = CH_2$

    4) $CH_3CH = CH_2$

53. *p*-chloro aniline and anilinium hydrogen chloride can be distinguished by :

    1) Sandmeyer reaction

    2) Carbyl amine reaction

    3) Hinsberg's reaction

    4) $AgNO_3$

54. In alumino thermic process, aluminium acts as :

    1) oxidant

    2) flux

    3) a reducing agent

    4) a solder

55. $Mn^{2+}$ can be converted into $Mn^{7+}$ by reacting with :

    1) $SO_2$

    2) $Cl_2$

    3) $PbO_2$

    4) $SnCl_2$

56. A compound is treated with iodine and an alkali. It gives a yellow ppt. The compound is ?

    1) propionaldehyde

    2) benzophenone

3) methyl acetate

4) acetophenone

57. Phenol is less acidic than :

    1) acetic acid

    2) p-methoxy phenol

    3) acetylene

    4) ethanol

58. Which reaction is not affected by change in pressure ?

    1) $H_2 + I_2 \rightleftharpoons 2HI$

    2) $2C + O_2 \rightleftharpoons 2CO$

    3) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

    4) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

59. Which of the following does not show Cannizaro reaction ?

    1) $CH_3CHO$

    2) $HCHO$

    3) $C_6H_5CHO$

    4) $(CH_3)_3C \cdot CHO$

60. Oxidation state exhibited by sulphur :

    1) +6

    2) +4

    3) 0

    4) all of these

61. Electronic configuration of chromium is given by :

    1) $[Ar]\ 3d^4,\ 4s^2$

    2) $[Ar]\ 3d^5,\ 4s^1$

    3) $[Ar]\ 3d^3,\ 4s^2$

    4) none of these

62. Benzene can react with :

    1) bromine water

    2) $HNO_3$

    3) $H_2O$

    4) $CH_3OH$

63. Hydrogen bonding is maximum in :

1) $C_2H_5OH$

2) $CH_3OCH_3$

3) $(CH_3)_2C = O$

4) $CH_3CHO$

64. Which of the following is non-metallic ?

1) B             2) Be            3) Mg            4) Al

65. The compound not soluble in acetic acid is :

1) $CaCO_3$

2) $CaO$

3) $CaC_2O_4$

4) $Ca(OH)_2$

66. Rate constant for a reaction is $10^{-3}$ $s^{-1}$. Time to leave 25% reaction is :

1) 693 s

2) 1386 s

3) 6930 s

4) 2029 s

67. A compound does not react with 2, 4 dinitrophenyl hydrazine, compound is :

1) acetone

2) acetaldehye

3) $CH_3OH$

4) $CH_3CH_2COCH_3$

68. A *meta* directing functional group is :
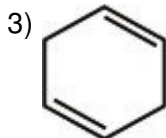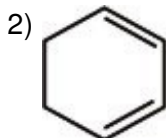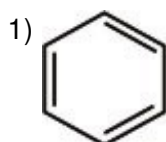
1) -COOH

2) -OH

3) -$CH_3$

4) -Br

69. Which of the following is paramagnetic ?

1) $O_2^+$

2) $CN^-$

3) CO

4) $N_2$

70. 1, 2-dibromo cyclohexane on dehydrogenation gives :

1) 

2) 

3) 

4) none of these

71. Correct increasing order of first ionization potential is :

    1) Na < Mg > Al < Si

    2) Na < Mg < Al < Si

    3) Na > Mg > Al > Si

    4) Na < Mg < Al > Si

72. If enthalpies of methane and methane are respectively 320 and 560 cal, then the bond energy of C—C bond is :

    1) 60 cal

    2) 80 cal

    3) 40 cal

    4) 120 cal

73. A hydrocarbon contains 10.5 g carbon and 1 g hydrogen. Its 0.36 g has 1 L volume at 1 atm and 127°C, hydrocarbon is :

    1) $C_6H_7$

    2) $C_7H_8$

    3) $C_5H_6$

    4) none of these

74. How many bonding electron pairs are there in white phosphorus ?

    1) 6                2) 12               3) 4               4) 8

75. Addition of HBr to propylene in presence of benzoyl peroxide, follows :

    1) Markownikoff's rule

    2) Baeyer's rule

    3) Carbanion mechanism

    4) Anti-Markownikoff's rule

76. On adding a solute to a solvent having vapour pressure 0.80 atm, vapour pressure

reduces to 0.60 atm. Mole fraction of solute is :

1) 0.25          2) 0.75          3) 0.50          4) 0.33

77. Heavy water is :

    1) water containing Fe, Cr, Mn

    2) water at $0\,°C$

    3) $D_2O$

    4) water obtained after distillation

78. Volume of water needed to mix with 10 mL 10 N $HNO_3$ to get 0.1 N $HNO_3$ is :

    1) 1000 mL

    2) 990 mL

    3) 1010 mL

    4) 10 mL

79. Which will show maximum depression in freezing point when concentration is 0.1 M ?

    1) NaCl

    2) Urea

    3) Glucose

    4) $K_2SO_4$

80. Which gives lactic acid on hydrolysis after reacting with HCN ?

    1) HCHO

    2) $CH_3CHO$

    3) $C_6H_5CHO$

    4) $CH_3COCH_3$

81. $CHCl_3$ and KOH on heating with a compound form a bad smelling product, compound is :

    1) $C_2H_5CN$

    2) $C_2H_5NC$

    3) $C_2H_5OH$

    4) $C_2H_5NH_2$

82. On exciting $Cl_2$ molecules by UV light, we get :

    1) Cl

    2) $Cl^+$

    3) $Cl^-$

    4) all of these

83. Correct statement about 1, 3-dibutene :

1) conjugated double bonds are present

2) reacts with HBr

3) forms polymer

4) all of the above

84. Isomerism due to rotation round single bond of carbon-carbon is :

1) Enantiomerism

2) Position isomerism

3) Conformation

4) Diastereo isomerism

85. Which pair does not show hydrogen isotopes ?

1) *Ortho* and *para* hydrogen

2) Protium and deuterium

3) Deuterium and tritium

4) Tritium and protium

86. Which pair cannot exist together in solution ?

1) $NaHCO_3$ and NaOH

2) $NaHCO_3$ and NaCl

3) $NaHCO_3$ and $Na_2CO_3$

4) NaCl and $Na_2CO_3$

87. When an electron is removed from an atom, its energy :

1) increases

2) decreases

3) remains the same

4) none of the above

88. In a reaction, when the concentration of reactant is increased two times, the increase in rate of reaction was four times. Order of reaction is :

1) zero                    2) 1                    3) 2                    4) 3

89. Strongest base is :

1) $C_6H_5NH_2$

2) $p$-$NO_2$ - $C_6H_4NH_2$

3) $m$-$NO_2$ - $C_6H_4NH_2$

4) $C_6H_5CH_2NH_2$

90. The value of one amu is :

1) $1.66 \times 10^{-24}$ g

2) $6.023 \times 10^{23}$ g

3) $1.4 \times 10^{-21}$ g

4) $4.8 \times 10^{-24}$ g

91. Which of the following has minimum melting point ?

   1) CsF             2) HCl            3) HF            4) LiF
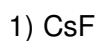
92. Which of the following is related with both wave nature and particle nature ?

   1) Interference

   2) $E = mc^2$

   3) Diffraction

   4) $E = hv$

93. Nirogen is obtained when $NaNO_2$ react with :

   1) $NH_4Cl$

   2) $NH_4NO_3$

   3) $(NH_4)_2CO_3$

   4) $NH_4OH$
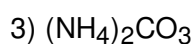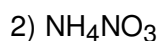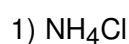
94. Hydrogen bond energy is equal to :

   1) 3-7 cal

   2) 30-70 cal

   3) 3-10 kcal

   4) 30-70 kcal

95. Strongest hydrogen bond is present in :

   1) F—H......O

   2) S—H......O

   3) O—H......S

   4) F—H.......F
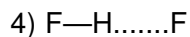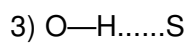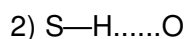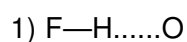
96. Which of the following has dipole moment ?

   1) $CO_2$

   2) *p*-dichlorobenzene

   3) $NH_3$

   4) $CH_4$
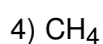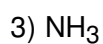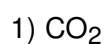
97. Which of the following $pK_a$ values, represent the strongest acid ?

   1) $10^{-4}$

   2) $10^{-8}$

3) $10^{-5}$

4) $10^{-2}$

98. Which group of the periodic table contains coinage metal ?

1) IIA

2) IB

3) IA

4) None of these

99. Which of the following has maximum bond energy ?

1) $Cl_2$

2) $F_2$

3) $Br_2$

4) $I_2$

100. For a process to be spontaneous, the most favourable condition is :

1) $\Delta H > 0, \Delta S > 0$

2) $\Delta H < 0, \Delta S > 0$

3) $\Delta H < 0, \Delta S < 0$

4) $\Delta H > 0, \Delta S < 0$

## Section-3
## Mathematics

101. $x^2 + \dfrac{1}{1+x^2}$ attains minimum value at :

1) $x = 0$

2) $x = 4$

3) $x = 1$

4) $x = 3$

102. If $\vec{a}, \vec{b}, \vec{c}$ are the non-coplanar vectors, then the value of $\dfrac{\vec{a}.(\vec{b} \times \vec{c})}{(\vec{c} \times \vec{a}).\vec{b}} + \dfrac{\vec{b}.(\vec{a} \times \vec{c})}{\vec{c}.(\vec{a} \times \vec{b})}$ is :

1) 1

2) 2

3) 0

4) none of these

103. If $x - 2y = 4$, the minimum value of $xy$ is :

1) -2                    2) 0                    3) -1                    4) -3

104. If z = x + iy and |(1 - iz)/(z - i)| = 1, the locus of z is :

    1) x-axis

    2) y-axis

    3) circle with unity radius

    4) none of the above

105. The vertex of an equilateral triangle is (2, -1) and the equation of its base is x + 2y = 1, the length of its sides is :

    1) $2/\sqrt{15}$

    2) $4/3\sqrt{3}$

    3) $1/\sqrt{5}$

    4) $4/\sqrt{15}$

106. The resultant of two forces P and Q is R. If the direction of P is reversed keeping the direction Q same, the resultant remains unaltered. The angle between P and Q is :

    1) 90°             2) 60°             3) 45°             4) 30°

107. The distance s (in cm) travelled by a particle in t seconds is given by, $s = t^3 + 2t^2 + t$. The speed of the particle after 1 s will be :

    1) 2 cm/s

    2) 8 cm/s

    3) 6 cm/s

    4) none of these

108. The roots of $|x - 2|^2 + |x - 2| - 6 = 0$ are :

    1) 4, 2

    2) 0, 4

    3) -1, 3

    4) 5, 1

109. The height of a tower is 7848 cm. A particle is thrown from the top of the tower with the horizontal velocity of 1784 cm/s. The time taken by the particle to reach the ground is (g = 981 cm/s$^2$) :

    1) $\sqrt{8}$ s

    2) 2 s

    3) 4 s

    4) 8 s

110. The directrix of the hyperbola $\dfrac{x^2}{9} - \dfrac{y^2}{4} = 1$ is :

    1) $y = (6/\sqrt{13})$

    2) $x = (6/\sqrt{13})$

3) y = (9/√13)

4) x = (9/√13)

111. The value of $\cos^{-1}\left(\cos\dfrac{5\pi}{3}\right) + \sin^{-1}\left(\cos\dfrac{5\pi}{3}\right)$ is :

1) 10π/3          2) 0          3) π/2          4) 5π/3

112. If $f(x) = \log\left(\dfrac{1+x}{1-x}\right)$, then $f\left(\dfrac{2x}{1+x^2}\right)$ will be equal to :

1) $2f(x^2)$

2) $f(x^2)$

3) $2f(2x)$

4) $2f(x)$

113. If $(1 + x - 2x^2)^6 = 1 + a_1 x + a_2 x^2 + ... + a_{12}\, x^{12}$ then the value of $a_2 + a_4 + ... + a_{12}$, is :

1) 31          2) 32          3) 64          4) 1024

114. $2x^3 - 6x + 5$ is an increasing function, if :

1) 0 < x < 1

2) -1 < x < 1

3) x < -1 or x > 1

4) -1 < x < -(1/2)

115. Two trains are 2 km apart. Their lengths are 200 m and 300 m. They are approaching towards each other with speed of 20 m/s and 30 m/s respectively. They will cross each other after :

1) 150 s

2) 100 s

3) 50 s

4) (25/3) s

116. $\dfrac{d^3 y}{dx^3} + 2\left[1 + \dfrac{d^2 y}{dx^2}\right] = 1$, has degree and order as :

1) 3, 1

2) 3, 2

3) 1, 3

4) 2, 3

117. The value of $I = \displaystyle\int_0^1 x\left|x - \dfrac{1}{2}\right| dx$ is :

1) 1/4

2) 1/2

3) 1/8

4) none of these

118. If $A = \begin{bmatrix} 4 & 2 \\ 3 & 4 \end{bmatrix}$, | adj A | is equal to :

1) 6

2) 16

3) 10

4) none of these

119. $\vec{a} \cdot (\vec{b} + \vec{c}) \times (\vec{a} + \vec{b} + \vec{c})$ is equal to :

1) $[\vec{a}\ \vec{b}\ \vec{c}]$

2) $3[\vec{a}\ \vec{b}\ \vec{c}]$

3) 0

4) $2[\vec{a}\ \vec{b}\ \vec{c}]$

120. A block weighing w, is supported on an inclined surface with the help of a horizontal force P. The same block can be supported with the help of another force Q acting parallel to the inclined surface, then the value of $(1/p^2) + (1/w^2)$ is :

1) w sin α

2) 1

3) 1/Q

4) $1/Q^2$

121. $\int_0^2 |x - 1|\ dx$ is equal to :

1) 0                2) 1/2                3) 1                4) 2

122. From a pack of cards two are accidently dropped. Probability that they are of opposite shade is :

1) 13/51

2) 1/(52 × 51)

3) 26/51

4) none of these

123. If a particle is displaced from the point A(5, -5, -7) to the point B(6, 2, -2) under the influence of the forces $\vec{P}_1 = 10\hat{i} - \hat{j} + 11\hat{k}$, $\vec{P}_2 = 4\hat{i} + 5\hat{j} + 6\hat{k}$, $\vec{P}_3 = -2\hat{i} + \hat{j} - 9\hat{k}$, then the work done is :

1) 87

2) 85

3) 81

4) none of these

124. If sin x + cos x = (1/5), then tan 2x is :

1) 25/17

2) 24/7

3) 7/25

4) 25/7

125. In a Δ ABC, ∠B = (π/3) and ∠C = (π/4). If D divides BC internally in ratio 1 : 3, then the value of

((sin ∠BAD)/(sin ∠CAD)) is :

1) 1/√3

2) 1/√6

3) √(2/3)

4) 1/3

126. If $|\vec{a} \times \vec{b}| = |\vec{a} \cdot \vec{b}|$, then the angle between $\vec{a}$ and $\vec{b}$ is :

1) π                    2) 2π/3                    3) π/4                    4) π/2

127. Let    A,    B    and    C    are    the    angles    of    a    triangle    and

$\tan\left(\dfrac{A}{2}\right) = \dfrac{1}{3}, \tan\left(\dfrac{B}{2}\right) = \dfrac{2}{3}$. Then, $\tan\left(\dfrac{C}{2}\right)$ is equal to :

1) 1/3                    2) 2/3                    3) 2/9                    4) 7/9

128. The value of $\lim\limits_{x \to 1}(1 - x)\tan\left(\dfrac{\pi}{2}x\right)$ :

1) 3π/4

2) 2π/3

3) 2/π

4) π/4

129. If $f(x) = (1/x)^x$, then the maximum value of $f(x)$ is :

1) e

2) $(e)^{1/e}$

3) $(1/e)^e$

4) none of these

130. The volume of the solid formed by rotating the area enclosed between the curve y = x² and the line y = 1 about y = 1 is (in cubic unit) :

1) 9π/5

1) 9π/5

2) 4π/3

3) 8π/3

4) 7π/5

131. $\int_{8}^{15} \dfrac{dx}{(x-3)\sqrt{x+1}}$ is equal to :

1) (1/2) log (5/3)

2) (1/3) log (5/3)

3) (1/5) log (3/5)

4) (1/2) log (3/5)

132. Area of the square formed by |x| + |y| = 1 (in square unit) is :

    1) 0          2) 1          3) 2          4) 4

133. If x = 3 + i, then $x^3 - 3x^2 - 8x + 15$ is equal to :

    1) 45          2) -15          3) 10          4) 6

134. The function $f(x) = \log(x + \sqrt{(x^2 + 1)})$ is :

1) even function

2) odd function

3) neither even nor odd

4) periodic function

135. The perpendicular PL, PM are drawn from any point P on the rectangular hyperbola xy = 25 to the asymptotes. The locus of the mid point of OP is curve with eccentricity :

1) an ellipse with e = √2

2) hyperbola with e = √2

3) parabola with e = (1/√2)

4) none of the above

136. If $|\vec{a}| = |\vec{b}| = |\vec{c}| = 1$ and $\vec{a} + \vec{b} + \vec{c} = 0$, then the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ is :

    1) 0          2) -1          3) -(3/2)          4) 3

137. If $x = \log_b a$, $y = \log_c b$, $z = \log_a c$, then xyz is :

1) 0

2) 1

3) 3

4) none of these

138. The value of the determinant

$$\begin{vmatrix} 1 & \cos(\alpha - \beta) & \cos\alpha \\ \cos(\alpha - \beta) & 1 & \cos\beta \\ \cos\alpha & \cos\beta & 1 \end{vmatrix} \text{ is :}$$

1) 0

2) 1

3) $\alpha^2 - \beta^2$

4) $\alpha^2 + \beta^2$

139. If $P(A) = P(B) = x$ and $P(A \cap B) = P(A' \cap B') = (1/3)$, then x is equal to :

1) 1/2          2) 1/4          3) 1/3          4) 1/6

140. If p and q are the roots of the equation $x^2 + px + q = 0$, then :

1) p = 1 or 0

2) p = -2 or 0

3) p = -2

4) p = 1

141. If a dice is thrown twice, the probability of occurrence of 4 at least once is :

1) 11/36

2) 35/36

3) 7/12

4) none of these

142. The value of $\displaystyle\int_0^8 |x - 5|\, dx$ is :

1) 9          2) 12          3) 17          4) 18

143. The value of $\displaystyle\int_0^\pi |\sin^3\theta|\, d\theta$ is :

1) 0          2) $\pi$          3) 4/3          4) 3/8

144. A ball weighing 2 kg and speed 6 m/s collides with another ball of 4 kg moving in opposite direction with speed of 3 m/s. They combine after the collision. The speed of this combined mass (in m/s) is :

1) 4          2) 2          3) 0          4) 3

145. If $\alpha$, $\beta$, $\gamma$ are the roots of the equation $x^3 + 4x + 1 = 0$, then $(\alpha + \beta)^{-1} + (\beta + \gamma)^{-1} + (\gamma + \alpha)^{-1}$ is equal to :

1) 2          2) 3          3) 4          4) 5

146. If $\cos\theta + \cos 2\theta + \cos 3\theta = 0$, the general value of $\theta$ is :

    1) $\theta = 2m\pi \pm (\pi/4)$

    2) $\theta = m\pi + (-1)^n (2\pi/3)$

    3) $\theta = m\pi + (-1)^n (\pi/3)$

    4) $\theta = 2m\pi \pm (\pi/3)$

147. Three like parallel forces P, Q and R are acting on the vertices of $\triangle ABC$ whose resultant passed through its centroid, then :

    1) $(P/b) = (Q/a) = (R/c)$

    2) $(P/\tan A) = (Q/\tan B) = (R/\tan C)$

    3) $P = Q = R$

    4) none of the above

148. A person observes the angle of elevation of a building as 30°. The person proceeds towards the building with a speed of $25(\sqrt{3} - 1)$ m/h. After two hours, he observes the angle of elevation as 45°. The height of the building (in m) is :

    1) $50(\sqrt{3} - 1)$

    2) $50(\sqrt{3} + 1)$

    3) 50

    4) 100

149. The value of $\lim\limits_{x\to\infty} \left(\dfrac{x+3}{x+1}\right)^{x+2}$ is :

    1) 0

    2) 1

    3) $e^2$

    4) $e^4$

150. If $A + B + C = \pi$, then $\cos 2A + \cos 2B + \cos 2C + 4 \sin A \sin B \sin C$ is equal to :

    1) 0                2) 1                3) 2                4) 3

**Answer Key**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1) 4 | 2) 3 | 3) 2 | 4) 1 | 5) 3 | 6) 3 | 7) 2 | 8) 3 | 9) 1 | 10) 2 |
| 11) 2 | 12) 3 | 13) 1 | 14) 1 | 15) 2 | 16) 4 | 17) 3 | 18) 4 | 19) 1 | 20) 1 |
| 21) 3 | 22) 4 | 23) 4 | 24) 4 | 25) 2 | 26) 1 | 27) 1 | 28) 1 | 29) 3 | 30) 1 |
| 31) 1 | 32) 1 | 33) 4 | 34) 1 | 35) 2 | 36) 2 | 37) 3 | 38) 2 | 39) 4 | 40) 2 |
| 41) 1 | 42) 3 | 43) 4 | 44) 1 | 45) 1 | 46) 3 | 47) 2 | 48) 1 | 49) 4 | 50) 2 |
| 51) 2 | 52) 2 | 53) 4 | 54) 3 | 55) 3 | 56) 4 | 57) 1 | 58) 1 | 59) 1 | 60) 4 |
| 61) 2 | 62) 2 | 63) 1 | 64) 1 | 65) 3 | 66) 2 | 67) 3 | 68) 1 | 69) 1 | 70) 2 |
| 71) 1 | 72) 2 | 73) 2 | 74) 1 | 75) 4 | 76) 1 | 77) 3 | 78) 2 | 79) 4 | 80) 2 |
| 81) 2 | 82) 1 | 83) 4 | 84) 3 | 85) 1 | 86) 3 | 87) 1 | 88) 3 | 89) 4 | 90) 1 |
| 91) 2 | 92) 4 | 93) 4 | 94) 3 | 95) 1 | 96) 3 | 97) 2 | 98) 2 | 99) 1 | 100) 2 |
| 101) 1 | 102) 3 | 103) 1 | 104) 1 | 105) 1 | 106) 1 | 107) 2 | 108) 2 | 109) 3 | 110) 4 |
| 111) 3 | 112) 4 | 113) 1 | 114) 3 | 115) 3 | 116) 3 | 117) 3 | 118) 3 | 119) 3 | 120) 4 |
| 121) 3 | 122) 3 | 123) 1 | 124) 2 | 125) 2 | 126) 3 | 127) 4 | 128) 3 | 129) 2 | 130) 2 |
| 131) 1 | 132) 3 | 133) 2 | 134) 2 | 135) 2 | 136) 3 | 137) 2 | 138) 1 | 139) 1 | 140) 1 |
| 141) 1 | 142) 3 | 143) 3 | 144) 1 | 145) 3 | 146) 1 | 147) 3 | 148) 3 | 149) 3 | 150) 2 |