Solved Paper 2016

PHYSICS

A man who weighs 670 N runs the first 7.0 m in 1.6 s, starting from rest and accelerating uniformly. What is the average power does the man generate during the 1.6 s time interval?

(a) 3.2 kW (b) 1.6 kW
(c) 0.9 kW (d) None of these

The kinetic energy of a particle of mass m kg is half of that of another particle of mass $m/2$ kg. If the speed of heavier particle is increased by 3 m s^{-1}, its kinetic energy becomes equal to the original kinetic energy of the lighter particle. The original speeds of the heavier and lighter particles are

(a) 3 m s^{-1}, 6 m s^{-1} (b) 2 m s^{-1}, 4 m s^{-1}
(c) 2 m s^{-1}, 6 m s^{-1} (d) 4 m s^{-1}, 8 m s^{-1}

Starting from origin, a body moves along x-axis. Its velocity at any time is given by $v = 4t^3 - 2t$ m s^{-1}.

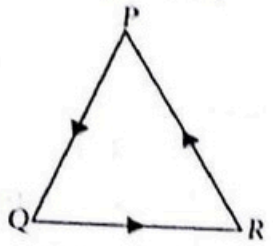
Acceleration of the particle when it is 2 m away from the origin is

(a) 28 m s^{-2} (b) 12 m s^{-2}
(c) 22 m s^{-2} (d) 14 m s^{-2}

4. Two cars are in a race. The white car passed the finishing point with a velocity v m s^{-1} more and took time t s less than the red car. If both the cars start from rest and travel with constant accelerations a_w and a_r respectively, $\frac{v}{t}$ is given

(a) $a_w a_r$ (b) $\sqrt{\frac{a_w}{a_r}}$ (c) $\sqrt{a_w a_r}$ (d) $\sqrt{\frac{a_r}{a_w}}$

5. Three particles P, Q and R are at rest at the vertices of an equilateral triangle of side s. Each of the particles starts moving with constant speed v m s^{-1}. P is moving along PQ, Q along QR and R along RP. The particles will meet each other at time t given by



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

A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backward, followed again by 5 steps forward and 3 steps backward and so on. Each step is 1 m long and requires 1 s. Determine how long the drunkard takes to fall in a pit 13 m away from the starting point.

(a) 37 s (b) 13 s (c) 49 s (d) 18 s

The displacement x of a body varies with time as

$$x = -\frac{1}{3}t^2 + 16t + 3$$

where x is in metres and t is in seconds. The time taken by the body to come to rest is

(a) 12 s (b) 24 s (c) 30 s (d) 36 s

8. The expression of the trajectory of a projectile is given as

$y = px - qx^2$,

where y and x are respectively the vertical and horizontal displacements, and p and q are constants. The time of flight of the projectile is

(a) $\frac{p^2}{4q}$ (b) $\frac{p^2}{2q}$ (c) $\sqrt{\frac{2p}{qg}}$ (d) $p\sqrt{\frac{2}{qg}}$

9. A particle moving with an initial velocity u m s^{-1} is retarded by a force at the rate of $a = -k\sqrt{v}$, where k is a positive constant and

v is the instantaneous velocity. The particle comes to rest in a time given by

(a) $\frac{2\sqrt{u}}{k}$ (b) $k\sqrt{u}$ (c) $\frac{\sqrt{2u}}{k}$ (d) $\frac{\sqrt{u}}{2k}$

10. The velocity of a transverse wave in a string is directly proportional to $\sqrt{T}$ and inversely proportional to $\sqrt{\mu}$. In a measurement, the mass applied at the end of string is 3.0 gm, length of string is 1 m and mass of string is 5 gm. If possible error in measuring mass is 0.1 gm and that of length is 1 mm, the percentage error in measurement of velocity is

(a) 4.5% (b) 2.7% (c) 2.1% (d) 3.7%

11. A gas at pressure P_0 is contained in a vessel. If the masses of all the molecules are halved and their speeds doubled, the resulting pressure would be

(a) $4P_0$ (b) $2P_0$ (c) P_0 (d) $\frac{P_0}{2}$

12. A gas under constant pressure of 4.5×10^5 Pa when subjected to 800 kJ of heat, changes the volume from 0.5 m^3 to 2.0 m^3. The change in internal energy of the gas is

(a) 6.75×10^5 J (b) 5.25×10^5 J
(c) 3.25×10^5 J (d) 1.25×10^5 J

13. Work done in increasing the size of a soap bubble from a radius of 3 cm to 5 cm is nearly (surface tension of soap solution = 0.03 N m^{-1})

(a) 4π mJ (b) 0.4π mJ
(c) 0.2π mJ (d) 2π mJ

14. A cylinder of radius R made of a material of thermal conductivity, k_1 is surrounded by a cylindrical shell of inner radius R and outer radius $2R$ and made of a material of thermal conductivity, k_2. The two ends of the combined system are maintained at two different temperatures. There is no loss of heat across the cylindrical surface and the system is in steady state. The effective thermal conductivity of the system is

(a) $\frac{3k_1 + k_2}{4}$ (b) $\frac{k_1 + 3k_2}{4}$
(c) $k_1 + k_2$ (d) $\frac{k_1 k_2}{k_1 + k_2}$

15. The density of air in atmosphere decreases with height and can be expressed by the relation $\rho = \rho_0 e^{-\alpha h}$, where ρ_0 is the density at sea level, α is a constant and h is the height. The atmospheric pressure at the sea level is

(a) $\frac{\rho_0 g}{\alpha}$ (b) $\frac{\rho_0 \alpha h}{g}$ (c) $\frac{\alpha h}{\rho_0 g}$ (d) $\frac{h}{\rho_0 g}$

16. Two wires of equal cross section but one made of steel and the other of copper, are joined end to end. When the combination is kept under tension, the elongations in the two wires are found to be equal. (Y for steel = 2×10^{11} N/m^2 and Y for copper = 1.1×10^{11} N/m^2). The ratio of the lengths of the two wires is

(a) 20 :11 (b) 2 : 1 (c) 1 : 2 (d) 1 : 1

17. An asteroid of mass $2 \times 10^{-4} M_e$, where M_e is the mass of the earth, revolves in a circular orbit around the sun at a distance that is twice earth's distance from the sun. Find the ratio of the kinetic energy of the asteroid to that of earth.

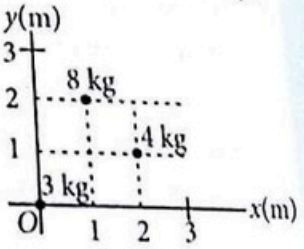
(a) 0.9×10^{-6} (b) 1.6×10^{-5}
(c) 3.6×10^{-5} (d) 1.0×10^{-4}

18. The density of a newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the earth is R, the radius of the planet would be

(a) $4R$ (b) $2R$ (c) $R/2$ (d) $R/4$

19. Find the x and y coordinates of the centre of mass of the three particle system (as shown).

(a) 1.0 m, 1.0 m
(b) 1.3 m, 0.9 m
(c) 1.1 m, 1.3 m
(d) 1.3 m, 1.1 m



20. The torque acting on a body about a given point is given by $\vec{\tau} = \vec{A} \times \vec{L}$, where $\vec{A}$ is a constant vector and $\vec{L}$ is the angular momentum of the body about that point. It follows that

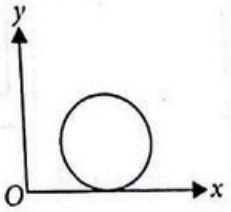
(a) the magnitude of $\vec{L}$ does not change with time.

(b) the component of $\vec{L}$ in the direction of $\vec{A}$ does not change with time.

(c) $\frac{d\vec{L}}{dt}$ is perpendicular to $\vec{L}$ at all instants of time.

(d) all the above choices are correct.

21. A disc of mass M and radius R is rolling with angular speed ω on a horizontal surface as shown in figure. The magnitude of angular momentum of the disc about the origin O is (here v is the linear velocity of the disc)



(a) $\frac{3}{2}MR^2\omega^2$ (b) $MR^2\omega$

(c) MRv (d) $\frac{3}{2}MRv$

22. If the moment of inertia of a disc about an axis tangential and parallel to its surface be I, then the moment of inertia about an axis tangential but perpendicular to the surface will be

(a) $\frac{6}{5}I$ (b) $\frac{3}{4}I$ (c) $\frac{3}{2}I$ (d) $\frac{5}{4}I$

23. A long straight wire of radius R carries a steady current I. The current is uniformly distributed across its cross-section. The ratio of magnetic field at $R/2$ and $2R$ is

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

24. An ion with a charge of $+3.2\times10^{-19}$ C is in a region where a uniform electric field of 5×10^4 V/m is perpendicular to a uniform magnetic field of 0.8 T. If its acceleration is zero, then its speed must be

(a) 0 (b) 1.6×10^4 m/s

(c) 4.0×10^4 m/s (d) 6.3×10^4 m/s

25. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of masses of X and Y is

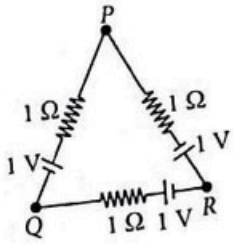
(a) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (b) $\left(\frac{R_2}{R_1}\right)$

(c) $\left(\frac{R_1}{R_2}\right)^2$ (d) $\left(\frac{R_1}{R_2}\right)$

26. A wire is being drawn to make it thinner such that the length of the wire l increases and radius r decreases. Its resistance R will finally be proportional to

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

27. Three batteries of emf 1 V and internal resistance 1 Ω each are connected as shown. Effective emf of the combination between the points P and Q is



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

28. Two bulbs consume the same power when operated at 200 V and 300 V respectively. When these bulbs are connected in series across a D.C. source of 500 V then the ratio of potential difference across them is

(a) $\frac{2}{3}$ (b) $\frac{4}{9}$ (c) $\frac{6}{27}$ (d) $\frac{8}{24}$

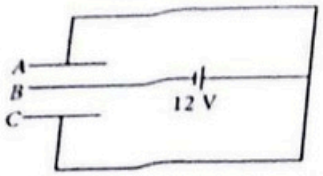
29. Three resistances P, Q and R, each of 2 Ω and an unknown resistance S form the four arms of a Wheatstone bridge circuit. When a resistance of 6 Ω is connected in parallel to S, the bridge gets balanced. The value of S is

(a) 3 Ω (b) 6 Ω (c) 1 Ω (d) 2 Ω

30. A point charge $+Q$ is placed at a distance $d/2$ directly above the centre of a square of side d. The magnitude of electric flux through the square is

(a) $\frac{Q}{6d}$ (b) $\frac{Q}{6\varepsilon_0}$ (c) $\frac{Qd}{6\varepsilon_0}$ (d) $\frac{Q\varepsilon_0}{6d}$

31. Three plates A, B and C each of area 50 cm^2 have separation 3 mm between A and B and 6 mm between B and C. The energy stored when the plates are fully charged by a 12 volt battery is



(a) 2 μJ (b) 1.6 nJ (c) 5 μJ (d) 3.2 nJ

32. A photographic flash unit consists of a xenon filled tube. It gives a flash of average power 2000 W for 0.04 sec. The flash is due to discharge of a fully charged capacitor of 40 μF. The voltage to which it is charged before a flash is given by the unit is

(a) 1500 V (b) 2000 V
(c) 2500 V (d) 3000 V

33. A quantity of a substance in a closed system is made to undergo a reversible process from an initial volume of 3 m^3 and initial pressure 10^5 N/m^2 to a final volume of 5 m^3. If the pressure is proportional to the square of the volume (*i.e.* $P = AV^2$), the work done by the substance will be

(a) 3.6×10^2 J (b) 7.4×10^3 J
(c) 2.2×10^4 J (d) 3.6×10^5 J

34. An ideal gas at pressure P is adiabatically compressed so that its density becomes n times the initial value. If $\gamma = C_p/C_v$, the final pressure of the gas will be

(a) $n^{(1-\gamma)}P$ (b) $n^{(r-\gamma)}p$
(c) $n^{(-\gamma)}P$ (d) $n^{(\gamma)}P$

35. The red shift observed for stars due to the natural expanding of universe is given by the expression

(a) $(\lambda' - \lambda) = \left(\frac{c+v}{c}\right)\lambda$

(b) $(\lambda' - \lambda) = \left(\frac{c-v}{c}\right)\lambda$

(c) $(\lambda' - \lambda) = \left(\frac{v\lambda}{c}\right)$ (d) $(\lambda' - \lambda) = \left(\frac{c\lambda}{v}\right)$

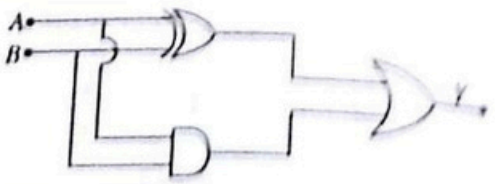
36. If the modulation index of an AM wave is changed from 0 to 1, the transmitted power is

(a) unchanged (b) doubled
(c) increased by 50% (d) zero

37. In an *N-P-N* transistor circuit, the collector current is 10 mA. If 90% of the electrons emitted reach the collector

(a) the emitter current will be nearly 9 mA
(b) the emitter current will be nearly 11.1 mA
(c) the base current will be nearly 0.9 mA
(d) the base current will be nearly 0.3 mA

38. The diagram given below is equivalent to a logic function of



(a) OR (b) AND
(c) NAND (d) XOR

39. The half life of radioactive nucleus is 100 years. The time interval between 20% and 80% decay of the parent nucleus is

(a) 100 years (b) 200 years
(c) 300 years (d) 400 years

40. Lines of Balmer series are emitted by the hydrogen atom when the electron jumps from the

(a) first ($n = 1$) orbit to any higher orbit
(b) second orbit ($n = 2$) to any higher orbit
(c) higher orbits to the first orbit
(d) higher orbits to the second orbit

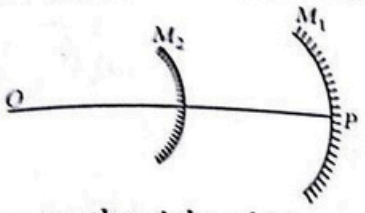
41. A proton (p) and an α-particle are accelerated through the same potential difference V volt. The de-Broglie wavelengths associated with the proton and the α-particle, λ_p and λ_α respectively are in the ratio

(a) 2 : 1 (b) $2\sqrt{2}$: 1
(c) 4 : 1 (d) $\sqrt{2}$: 1

42. The spherical aberration is minimized in a reflecting telescope using

(a) a concave mirror as objective
(b) a convex mirror as objective
(c) a parabolic mirror as objective
(d) an elliptical mirror as objective

44. Consider an optical system consisting of a concave mirror M_1 and convex mirror M_2 of radii of curvatures 60 cm and 20 cm respectively. Two mirror are separated by a distance of 40 cm. An object O is placed at a distance 80 cm from P. The final image is formed at a distance.



(a) 40 cm on the right of M_2
(b) 40 cm on the left of M_2
(c) 48 cm on the right of M_1
(d) 40 cm on the left of M_2

44. A vessel of depth d is half filled with a liquid of refractive index n_1 and the upper half is occupied by immiscible liquid of refractive index n_2. Viewing it from an eye in the upper liquid, the apparent depth of the lower liquid is

(a) $\frac{d}{2n_2}$ (b) $\frac{dn_1}{2n_2}$

(c) $\frac{dn_2}{2n_1}$ (d) $\frac{d}{2}\left(\frac{n_1+n_2}{n_1n_2}\right)$

45. Two lenses have 10 D power each and they are separated by a distance. Beyond which distance does the power of combination changes from positive to negative?
(a) 5 cm (b) 10 cm (c) 20 cm (d) 50 cm

46. Electromagnetic waves travel in a medium with a speed of 2×10^8 m/s. If the relative permeability of the medium is 1, the relative permittivity will be
(a) 1.5 (b) 2.25 (c) 3.37 (d) 1.0

47. In a series L-C-R circuit the voltages across resistance, capacitance and inductance are 20 V each. If the capacitance is short-circuited, the voltage across the inductance will be
(a) $\frac{20}{\sqrt{2}}$ V (b) 20 V (c) $20\sqrt{2}$ V (d) 40 V

48. A flat rectangular coil is placed in a uniform magnetic field and rotated about an axis passing through its centre, parallel to its shorter edges and perpendicular to the field. The maximum flux linked and maximum induced emf are ϕ and E respectively. If the axis is shifted to coincide with one of the shorter edges, then
(a) Maximum flux and induced emf are $\phi/2$ and $E/2$
(b) Maximum flux and induced emf are $\phi/3$ and $E/3$
(c) Maximum flux and induced emf are $\phi/4$ and $E/4$
(d) Maximum flux and induced emf remain ϕ and E

49. A solenoid of inductance 50 mH and resistance 10 Ω is connected to a battery of 6 V. The time elapsed before the current acquires half of its steady state value is
(a) 2 ms (b) 3.5 ms (c) 5 ms (d) 5.5 ms

50. Two circular coils 1 and 2 are made from the same wire but the radius of the first coil is twice that of the second coil. What potential difference ratio should be applied across them so that the magnetic field at their centres is the same?
(a) 2 (b) 3 (c) 4 (d) 6

CHEMISTRY

51. For complexes $[NiCl_4]^{2-}$ and $Ni(CO)_4$ which one of the following statements is true ?
(a) $[NiCl_4]^{2-}$ is diamagnetic while $[Ni(CO)_4]$ is paramagnetic and both the complexes have square planar geometry.
(b) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic and both the complexes have tetrahedral geometry.
(c) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic and both the complexes have square planar geometry.
(d) $[NiCl_4]^{2-}$ is diamagnetic while $[Ni(CO)_4]$ is paramagnetic and both the complexes have tetrahedral geometry.

52. Which of the following complexes can also represent facial (*fac*) and meridional (*mer*) isomers ?
(a) $[Co(NH_3)_4NO_2Cl]$
(b) $[Co(NH_3)_2(NO_2)_2Cl_2]$
(c) $[Co(NH_3)_2(NO_2)_3Cl]$
(d) $[Co(NH_3)_3(NO_2)_3]$

53. Select the correct ground state electronic configuration.

	Cr	Eu	Ti^{2+}
(a)	$[Ar]3d^5\ 4s^1$	$[Xe]4f^7\ 5d^0\ 6s^2$	$[Ar]3d^2\ 4s^2$
(b)	$[Ar]3d^4\ 4s^2$	$[Xe]4f^7\ 5d^0\ 6s^2$	$[Ar]3d^2\ 4s^2$
(c)	$[Ar]3d^4\ 4s^2$	$[Xe]4f^6\ 5d^1\ 6s^2$	$[Ar]4s^2\ 3d^0$
(d)	$[Ar]3d^5\ 4s^1$	$[Xe]4f^6\ 5d^2\ 6s^1$	$[Ar]4s^1\ 3d^1$

54. Which of the followings is invert sugar?
(a) Sucrose (b) Cellulose
(c) Glucose (d) Fructose

55. The carbocation formed in S_N1 reaction of alkyl halide in the slow step is
(a) sp^3-hybridised (b) sp^2-hybridised
(c) sp-hybridised (d) sp^3d-hybridised.

56. DDT is
(a) 2,2-di(*p*-chlorophenyl)-1,1,1-trichloroethane
(b) 2,2-di(*m*-chlorophenyl)-1,1,1-trichloroethane
(c) 2,2-di(*o*-chlorophenyl)-1,1,1-trichloroethane
(d) 2,2-di(*p*-chlorophenyl)-1,1,1-trichloroethane.

57. Nucleotides are joined together by ? between 5′ and 3′ carbon atoms of pentose sugar.
(a) glycosidic linkage
(b) peptide linkage
(c) ether linkage
(d) phosphodiester linkage

58. Mention the catalyst and reaction conditions in the given reaction :

$$R-CH_2-COOH \xrightarrow{?} R-\underset{\displaystyle X}{\underset{|}{CH}}-COOH$$

(where X = Cl, Br)
(a) X_2/grey phosphorus, H_2O
(b) X_2/red phosphorus, H_2O
(c) X_2/white phosphorus, H_2O
(d) X_2/blue phosphorus, H_2O

59. Nylon-6 is obtained by the condensation of
(a) terephthalic acid and ethylene glycol
(b) adipic acid and styrene
(c) caprolactum with water at high temp
(d) phenol and formaldehyde.

60. Which of the following is aromatic compound ?
(a) 
(b) 
(c) 
(d) All of these

61. The following reaction

$$R-Cl + NaI \xrightarrow{\text{Acetone}} R-I + NaCl$$

is known as
(a) Frankland reaction
(b) Swarts reaction
(c) Etard reaction
(d) Finkelstein reaction.

62. Which one of the following compounds can exist in Zwitter ionic form?
(a) Amino acid (b) Fat
(c) Carbohydrate (d) Alcohol

63. *p*-Hydroxyazobenzene is
(a) an orange dye (b) a yellow dye
(c) a red dye (d) an orange-red dye.

64. In the reaction sequence

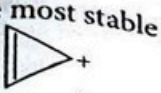
$$CH_3CH_2CH_2-Br \xrightarrow[\text{Dry ether}]{Mg} A \xrightarrow{CH_3CHO} B \xrightarrow{H_3O^+} C$$

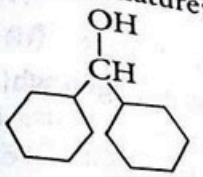
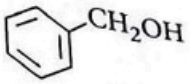
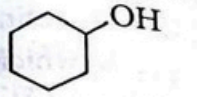
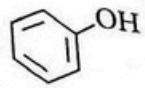
the product '*C*' is
(a) 1-propanol (b) 2-butanal
(c) 2-butanol (d) 2-pentanol.

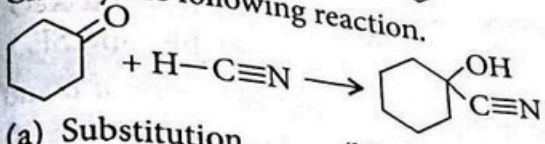
65. The acid strength of the following compounds

$CH\equiv CCOOH$	$CH_2=CHCOOH$	CH_3CH_2COOH
I	II	III

is in the order :
(a) II > I > III (b) III > II > I
(c) I > III > II (d) I > II > III

66. The most stable carbocation is
(a) 
(b) $CH_2=CH-\overset{+}{C}H_2$
(c) $CH_3\overset{+}{C}HCH_3$
(d) $CH_3\overset{+}{C}H=CH_2$

67. Which of the following compounds has the most acidic nature?
(a) 
(b) 
(c) 
(d) 

68. Classify the following reaction.

(a) Substitution
(b) Addtion
(c) Elimination
(d) Rearrangement

69. Pick out the electrophiles from the following : BF_3, NH_3, Me_3C^+, HCl
(a) BF_3 and NH_3
(b) Me_3C^+ and HCl
(c) BF_3 and Me_3C^+
(d) NH_3 and HCl

70. The antibiotic that contains arsenic is
(a) prontosil
(b) ofloxacin
(c) bithionol
(d) salvarsan.

71. For the cell $Ag_{(s)}|Ag^+_{(aq)}||Cu^{2+}_{(aq)}|Cu_{(s)}$, the reduction potentials of the left and right hand electrodes are 0.337 and 0.799 volts, the cell e.m.f. is
(a) –1.136 volt
(b) 1.136 volt
(c) –0.462 volt
(d) 0.462 volt

72. 50% of a first order reaction is complete in 23 minutes. Caculate the time required to complete 90% of the reaction.
(a) 70.4 minutes
(b) 76.4 minutes
(c) 38.7 minutes
(d) 35.2 minutes

73. The first order gaseous decomposition of N_2O_4 into NO_2 has a k value of $4.5 \times 10^3\ s^{-1}$ at 1°C and an energy of activation of 58 kJ $mole^{-1}$. At what temperature would k be $1.00 \times 10^4\ s^{-1}$?
(a) 274 K
(b) 283 K
(c) 273 K
(d) 293 K

74. 30.4 kJ is required to melt one mole of NaCl. The entropy change during melting is 28.4 J mol^{-1} K^{-1}. What is the melting point of sodium chloride?
(a) 1070.4 K
(b) 535.2 K
(c) 273.1 K
(d) 1007.4 K

75. What weight of HCl is present in 155 mL of a 0.54 M solution?
(a) 3.06 g (b) 6.12 g (c) 1.53 g (d) 0.30 g

76. When PCl_5 is heated it gasifies and dissociates into PCl_3 and Cl_2. The density of the gas mixture at 200°C is 70.2. What is the degree of dissociation of PCl_5 at 200°C ?
(a) 0.485 (b) 0.242 (c) 0.845 (d) 0.542

77. What is the value of K_{sp} for Bismuth sulphide (Bi_2S_3), which has a solubility of 1.0×10^{-15} mol/L at 25°C?
(a) 1.08×10^{-73}
(b) 1.08×10^{-74}
(c) 1.08×10^{-72}
(d) 1.08×10^{-75}

78. At 20°C the solubility of N_2 gas in water is 0.015 g/L when the partial pressure of N_2 is 580 torr. What is the solubility of N_2 in H_2O at 20°C when its partial pressure is 800 torr?
(a) 0.207 g/L
(b) 0.0207 g/L
(c) 0.414 g/L
(d) 0.0414 g/L

79. Which of the following is incorrect?
(a) Chemisorption is caused by bond formation.
(b) Chemisorption is reversible process.
(c) Chemisorption is specific in nature.
(d) Chemisorption increases with increase in temperature.

80. In a suspension the diameter of the dispersed particles is of the order
(a) 10 Å
(b) 100 Å
(c) 1000 Å
(d) 2000 Å

81. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is
(a) $H_2S < SiH_4 < NH_3 < BF_3$
(b) $NH_3 < H_2S < SiH_4 < BF_3$
(c) $H_2S < NH_3 < SiH_4 < BF_3$
(d) $H_2S < NH_3 < BF_3 < SiH_4$

82. Which of the following statements is false for alkali metals?
(a) Lithium is the strongest reducing agent.
(b) Na is amphoteric in nature.
(c) Li^+ is exceptionally small.
(d) All alkali metals give blue solution in liq. ammonia.

83. Among LiCl, RbCl, $BeCl_2$, $MgCl_2$ the compounds with greatest and least ionic character respectively are
(a) LiCl and RbCl (b) RbCl and $BeCl_2$
(c) RbCl and $MgCl_2$ (d) $MgCl_2$ and $BeCl_2$

84. Chemical formula for 'inorganic benzene' is
(a) $B_3N_3H_3Cl_3$ (b) $(BN)_x$
(c) $B_3N_3H_6$ (d) $B_3P_3H_6$

85. Which of the following statements is wrong about the oxides of nitrogen?
(a) N_2O_5 is an anhydride of HNO_3.
(b) NO is an acidic oxide.
(c) N_2O_3 is an anhydride of HNO_2.
(d) NO is not anhydride of an acid.

86. The molecule which is linear is
(a) N_2O (b) NO_2
(c) SO_2 (d) H_2O

87. Which of the following complexes does not show geometrical isomerism ?
(a) $[Pt(NH_3)_2Cl_2]$ (b) $[Co(NH_3)_4Cl_2]$
(c) $[CoCl_2(en)_2]$ (d) $[Ni(CO)_4]$

88. Which of the following complexes would give white precipitate with excess of $AgNO_3$ sol.
(a) $[Co(NH_3)_2Cl_2]NO_3$
(b) $[Co(NH_3)_5SO_4]Cl$
(c) $[Co(NH_3)_4Cl_2]$
(d) $[Co(NH_3)_5NO_3]NO_3$

89. The spin only magnetic moment (μ_s) of a complex $[MnBr_4]^{2-}$ is 5.9 BM. The geometry of the complex will be
(a) tetrahedral (b) square planar
(c) square pyramidal (d) tetragonal.

90. The purple colour of $KMnO_4$ can be attributed to
(a) d-d transitions
(b) charge transfer transition
(c) n-π^* transitions
(d) none of these.

91. The number of P—O—P bonds in cyclic metaphosphoric acid is
(a) zero (b) two (c) three (d) four.

92. Among the trihalides of nitrogen which one is the least basic ?
(a) NF_3 (b) NCl_3
(d) NBr_3 (d) NI_3

93. Among the following the pair in which the two species are not isostructural is
(a) SiF_4 and SF_4 (b) IO_3^- and XeO_3
(c) BH_4^- and NH_4^+ (d) PF_6^- and SF_6

94. The hybridization and geometry of B and N is $[H_3B \leftarrow NH_3]$ are, respectively
(a) sp^3, tetrahedral and sp^3, pyramidal
(b) sp^3, pyramidal and sp^3, tetrahedral
(c) sp^3, pyramidal and sp^3, pyramidal
(d) sp^3, tetrahedral and sp^3, tetrahedral

95. Permanganate ions are
(a) tetrahedral and paramagnetic
(b) tetrahedral and diamagnetic
(c) octahedral and paramagnetic
(d) octahedral and diamagnetic.

96. The root mean square velocity of hydrogen at STP is 1.83×10^5 cm sec^{-1} and its mean free path is 1.78×10^{-5} cm. What will be the collision number at STP?
(a) 9.476×10^9 sec^{-1} (b) 9.746×10^{-9} sec^{-1}
(c) 9.746×10^9 sec^{-1} (d) 9.647×10^9 sec^{-1}

97. There are certain properties related to adsorption :
I. revesible
II. formation of unimolecular layer
III. low heat of adsorption
IV. occurs at low temperature and decreases with increasing temperature

Which of the above properties are for physical adsorption?
(a) I, II, III (b) I, III, IV
(c) II, III, IV (d) I, III

Which of the following *fcc* structures contains cations in the alternate tetrahedral voids ?
(a) Na_2O (b) ZnS (c) CaF_2 (d) CaO

One litre of water (molecular weight 18.06) weighs 0.9970 kg. The degree of ionisation of water is _____, if $K_w = 1.10 \times 10^{-14}$ at 25°C.
(a) 1.05×10^{-7} (b) 1.9×10^{-9}
(c) 1.01×10^{-11} (d) 4.52×10^{-7}

100. The specific conductance of 0.01 M solution of acetic acid was found to be 0.0163 S m^{-1} at 25°C. Molar conductance of acetic acid at infinite dilution is 390.7×10^{-4} S m^2 mol^{-1} at 25°C. What will be the degree of dissociation of CH_3COOH?
(a) 0.4072 (b) 0.7402 (c) 0.2720 (d) 0.0472

MATHEMATICS

101. A certain item is manufactured by machine M_1 and M_2. It is known that machine M_1 turns out twice as many items as machine M_2. It is also known that 4% of the items produced by machine M_1 and 3% of the items produced by machine M_2 are defective. All the items produced are put into one stock pile and then one item is selected at random. The probability that the selected item is defective is equal to
(a) 10/300 (b) 11/300
(c) 10/200 (d) 11/200

102. Out of $(2n + 1)$ consecutively numbered tickets, three tickets are drawn at random. The probability that the numbers on them are in arithmetic progression is
(a) $\frac{n}{4n^2-1}$ (b) $\frac{n^2}{4n^2-1}$
(c) $\frac{3n}{4n^2-1}$ (d) $\frac{3n^2}{4n^2-1}$

103. The determinant $\begin{vmatrix} xp+y & x & y \\ yp+z & y & z \\ 0 & xp+y & yp+z \end{vmatrix} = 0$ if
(a) x, y, z are in A.P. (b) x, y, z are in G.P.
(c) x, y, z are in H.P. (d) xy, yz, zx are in A.P.

104. The only integral root of the equation $\begin{vmatrix} 2-y & 2 & 3 \\ 2 & 5-y & 6 \\ 3 & 4 & 10-y \end{vmatrix} = 0$ is
(a) $y = 3$ (b) $y = 2$
(c) $y = 1$ (d) none of these

105. If A and B are two square matrices such that $AB = A$ and $BA = B$, then
(a) A and B are idempotent
(b) only A is idempotent
(c) only B is idempotent
(d) none of these

106. If $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is to be square root of the two rowed unit matrix, then α, β and γ should satisfy the relation
(a) $1 + \alpha^2 + \beta\gamma = 0$ (b) $1 - \alpha^2 - \beta\gamma = 0$
(c) $1 - \alpha^2 + \beta\gamma = 0$ (d) $1 + \alpha^2 - \beta\gamma = 0$

107. Consider the following propositions:
p : I take medicine.
q : I can sleep.
Then the compound statement $\sim p \rightarrow \sim q$ means
(a) If I do not take medicine, then I can not sleep.
(b) I take medicine if I can sleep.
(c) If I do not take medicine, then I can sleep.
(d) I take medicine iff can sleep.

108. The function $f(x) = \cos^2 x$ is strictly decreasing on
(a) $\left[0, \frac{\pi}{2}\right]$ (b) $\left[0, \frac{\pi}{2}\right)$
(c) $\left(0, \frac{\pi}{2}\right)$ (d) $\left(0, \frac{\pi}{2}\right]$

109. The maximum value of $\frac{\log x}{x}$ is
(a) 1 (b) $2/e$ (c) e (d) $1/e$

110. The sum of two numbers is 10. Their product will be maximum when they are
(a) 3, 7 (b) 4, 6 (c) 5, 5 (d) 8, 2

111. The integral $\int \sqrt{16-9x^2}\,dx$ equals

(a) $\frac{x}{2}\sqrt{16-9x^2}+\frac{8}{3}\sin^{-1}\left(\frac{3x}{4}\right)+C$

(b) $\frac{3x}{2}\sqrt{16-9x^2}+16\sin^{-1}\left(\frac{3x}{4}\right)+C$

(c) $\frac{x}{2}\sin^{-1}\left(\frac{3x}{4}\right)+\frac{9x}{2}+C$

(d) none of these

112. The value of the integral $\int_{-2}^{0}\frac{dx}{\sqrt{12-x^2-4x}}$ is

(a) $\pi/2$ (b) $\pi/6$ (c) $\pi/3$ (d) $-\pi/6$

113. $\int\frac{x^3dx}{1+x^4}$ equals

(a) $\log(x^4+1)+C$

(b) $\frac{1}{4}\log(x^4+1)+C$

(c) $\frac{1}{2}\log(x^4+1)+C$

(d) none of the above

114. The value of the integral $\int_0^1\frac{e^{5\log_e x}-e^{4\log_e x}}{e^{\log_e x^3}-e^{\log_e x^2}}dx$ is

(a) 1/3 (b) 1 (c) −1/3 (d) −1

115. The area bounded by the circle $x^2+y^2=4$ and the line $x=y\sqrt{3}$ in the first quadrant (in sq. units) is

(a) π (b) $\pi/2$

(c) $\pi/3$ (d) none of these

116. If $49^n+16n+\lambda$ is divisible by 64 for all $n\in N$, then the least negative integral value of λ is

(a) −1 (b) −2 (c) −3 (d) −4

117. Given the LPP

Minimize $f=2x_1-x_2$

$x_1\geq 0, x_2\geq 0$

$x_1+x_2\geq 5$

$-x_1+x_2\leq 1$

$5x_1+4x_2\leq 40$

The solution is

(a) 1 (b) −1 (c) 2 (d) −2

118. An n-tuple $(x_1, x_2, \ldots, x_n)$ which satisfies all the constraints of a linear programming problem and for which the objective function is maximum (compared to all n-tuples which satisfy all the constraints) is called

(a) a solution

(b) a feasible solution

(c) an optimal solution

(d) an actual solution

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

(a) −1 (b) 1/2 (c) −1/2 (d) 0

120. If $y=\sec(\tan^{-1}x)$, then $\frac{dy}{dx}$ at $x=1$ is

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

121. If $y=\tan^{-1}(\sqrt{1+x^2}-x)$, then $\frac{dy}{dx}$ equals

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

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

122. If $f(x)=\frac{x}{2}-1$, then on the interval $[0, \pi]$

(a) $\tan[f(x)]$ and $\frac{1}{f(x)}$ are both continuous

(b) $\tan[f(x)]$ and $\frac{1}{f(x)}$ are both discontinuous

(c) $\tan[f(x)]$ is continuous but $\frac{1}{f(x)}$ is not continuous

(d) $\tan[f(x)]$ is not continuous but $\frac{1}{f(x)}$ is continuous

123. If $\lim_{x\to 0}\frac{\log(3+x)-\log(3-x)}{x}=K$, then K is equal to

(a) 2/5 (b) 2/3 (c) 1/2 (d) 5/2

124. If $x^2+y^2=t-\frac{1}{t}$ and $x^4+y^4=t^2+\frac{1}{t^2}$ then $x^3y\frac{dy}{dx}$ equals

(a) 0 (b) 1
(c) −1 (d) none of these

125. If $x^y=e^{x-y}$ then $\frac{dy}{dx}$ is equal to

(a) $\frac{1}{1+\log x}$ (b) $\frac{1}{(1+\log x)^2}$
(c) $\frac{\log x}{1+\log x}$ (d) $\frac{\log x}{(1+\log x)^2}$

126. The sum of n terms of the series $1^2+(1^2+2^2)+(1^2+2^2+3^2)+....$ is

(a) $\frac{n(n+1)(n+2)}{12}$
(b) $\frac{n(n+1)(n+2)^2}{12}$
(c) $\frac{n^2(n+1)(n+2)}{12}$
(d) $\frac{n(n+1)^2(n+2)}{12}$

127. The minimum value of 9^x+9^{1-x}, $x\in R$ is

(a) 2 (b) 3 (c) 6 (d) 9

128. Given that the points $P(3, 2, -4)$, $Q(5, 4, -6)$ and $R(9, 8, -10)$ are collinear, the ratio in which Q divides PR externally is

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

129. The angle between the lines with direction ratios 4, −3, 5 and 3, 4, 5 is

(a) $\pi/3$ (b) $\pi/4$ (c) $\pi/6$ (d) $\pi/2$

130. If origin is the centroid of a triangle PQR with vertices $P(2a, 2, 6)$, $Q(-4, 3b, -10)$ and $R(8, 14, 2c)$, the value of a, b and c are respectively

(a) −2, 2, 2
(b) −2, 2, −16/3
(c) −2, −16/3, 2
(d) −16/3, −2, 2

131. A line perpendicular to the line segment joining the points (1, 0) and (2, 3) divides it in the ratio $1:n$. The equation of the line is

(a) $3y+x=\frac{n+11}{n+1}$ (b) $3y-x=\frac{n+11}{n+1}$
(c) $3y+x=\frac{n-11}{n+1}$ (d) $3y-x=\frac{n+11}{n-1}$

132. The directrix of the parabola $4y^2+12x-12y+39=0$ is

(a) $x=\frac{3}{4}$ (b) $x=\frac{-7}{4}$
(c) $x=\frac{-5}{2}$ (d) $x=\frac{3}{2}$

133. The two lines $ty=x+t^2$ and $y+tx=2t+t^3$ intersect at the point lies on the curve whose equation is

(a) $y^2=4x$ (b) $y^2=-4x$
(c) $x^2=4y$ (d) $x^2=-4y$

134. The equation $x^2+y^2+4x+6y+13=0$ represents

(a) a pair of coincident lines
(b) a pair of concurrent straight lines
(c) a parabola
(d) a point circle

135. If p and q are the order and degree of the differential equation $y\frac{dy}{dx}+x^3\left(\frac{d^2y}{dx^2}\right)^3+xy=\cos x$, then

(a) $p<q$ (b) $p=q$
(c) $p>q$ (d) none of these

136. The differential equation of all parabolas whose axis of symmetry is parallel to x-axis is of order

(a) 2 (b) 3 (c) 1 (d) 4

137. The value of λ so that the vectors $\vec{a}=2\hat{i}-\hat{j}+\hat{k}$, $\vec{b}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{c}=3\hat{i}+\lambda\hat{j}+5\hat{k}$ are coplanar is

(a) −1 (b) −2 (c) −3 (d) −4

138. If A and B are independent events associated to some experiment E such that $P(A^C\cap B)=2/15$ and $P(A\cap B^C)=1/6$, then $P(B)$ is equal to

(a) $\frac{1}{6}, \frac{1}{5}$ (b) $\frac{1}{6}, \frac{4}{5}$

(c) $\frac{4}{5}, \frac{1}{5}$ (d) $\frac{4}{5}, \frac{5}{6}$

139. If A and B are independent events such that $P(B)=\frac{2}{7}$, $P(A \cup \bar{B})=0.8$, then $P(A)=$

(a) 0.4 (b) 0.3 (c) 0.2 (d) 0.1

140. Let R be a reflexive relation on a finite set A having n elements and let there be m ordered pairs in R then

(a) $m \geq n$ (b) $m \leq n$

(c) $m = n$ (d) none of these

141. A root of the equation,

$$17x^2+17x\tan\left(2\tan^{-1}\frac{1}{5}-\frac{\pi}{4}\right)-10=0 \text{ is}$$

(a) $\frac{10}{17}$ (b) -1 (c) $\frac{-7}{17}$ (d) 1

142. The solution set of the equation $\sin^{-1}x = 2\tan^{-1}x$ is

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

(c) $\{-1, 1, 0\}$ (d) $\{1, 1/2, 0\}$

143. The value of the expression

$$1-\frac{\sin^2 y}{1+\cos y}+\frac{1+\cos y}{\sin y}-\frac{\sin y}{1-\cos y} \text{ is equal to}$$

(a) $\sin y$ (b) $\cos y$

(c) 0 (d) 1

144. The value of $\frac{\sin^2 3\theta}{\sin^2\theta}-\frac{\cos^2 3\theta}{\cos^2\theta}$ is equal to

(a) $8\cos 2\theta$ (b) $3\sin 2\theta$

(c) $\frac{1}{8}\cos 2\theta$ (d) none of these

145. If $X=\{4^n-3n-1 \mid n \in N\}$ and $Y=\{9(n-1) \mid n \in N\}$ then

(a) $X \subset Y$ (b) $Y \subset X$

(c) $X = Y$ (d) none of these

146. An electrician can be paid under two schemes as follows:

I : ₹ 600 and ₹ 50 per hour

II : ₹ 170 per hour

If the job take n hours, for which values of n does the scheme I give the electrician better wages

(a) $n > 5$ (b) $n > 4$

(c) $n < 5$ (d) $n < 4$

147. The value of $\sum_{n=1}^{13}(i^n+i^{n+1})$ where $i=\sqrt{-1}$ equals

(a) 0 (b) i (c) $-i$ (d) $i-1$

148. The value of $\left(\frac{1+i}{1-i}\right)^{100}$ is equal to

(a) 1 (b) -1 (c) i (d) $-i$

149. The greatest value of the term independent of x, as α varies over R, in the expansion of $\left(x\cos\alpha+\frac{\sin\alpha}{x}\right)^{10}$ is

(a) ${}^{10}C_5$ (b) $\left(\frac{1}{2}\right)^5 {}^{10}C_5$

(c) $\left(\frac{1}{2}\right)^4 {}^{10}C_5$ (d) $\left(\frac{1}{2}\right)^3 {}^{10}C_5$

150. A polygon has 44 diagonals. The number of its sides are

(a) 9 (b) 8 (c) 11 (d) 7