WB JEE

Engineering Entrance Exam

Practice Set 5

Physics

Category I (Q. Nos. 1 to 30)

Carry 1 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/4 mark will be deducted.

1. Consider a ray of light incident from air into a slap of glass (refractive index) of width d, at an angle θ. The phase difference between the ray reflected by the top surface of the glass and the bottom surface is

(a) $\frac{2\pi nd}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{-1/2}+\pi$

(b) $\frac{2\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}$

(c) $\frac{2\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+\pi/2$

(d) $\frac{2\pi d}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+2\pi$

2. A source contains two phosphorous radio nuclides $^{32}_{15}P$ ($T_{1/2}$ = 14.3 days) and $^{33}_{15}P$ ($T_{1/2}$ = 25.3 days).

Initially, 10% of the decay come from $^{33}_{15}P$. How long one must wait until 90% do so?

(a) 250 days (b) 295 days
(c) 305 days (d) 208 days

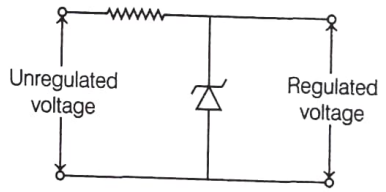
3. The wavelength of characteristic X-rays $^{\lambda}k_{\alpha}$ line emitted by hydrogen like atom is 0.32 Å. The wavelength of $^{\lambda}k_{\beta}$ line emitted by the same element is

(a) 0.21 Å (b) 0.27 Å
(c) 0.33 Å (d) 0.40 Å

4. An element with atomic number Z = 11 emits k_{α} X-ray of wavelength λ. The atomic number of element which emits k_{α} X-ray of wavelength 4λ, then

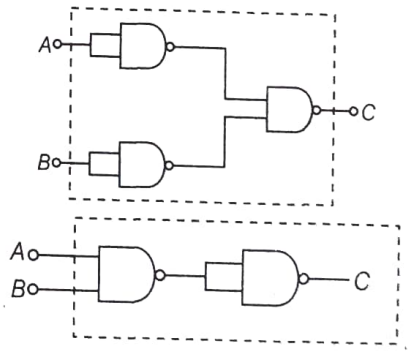
(a) 6 (b) 4 (c) 11 (d) 44

5. A Zener diode of power rating 1 W is to be used as a voltage regulator. If Zener has a breakdown of 5 V and it has to regulate voltage which fluctuated between 3 V and 7 V, what should be the value of R_S for safe operation?



(a) 5 Ω (b) 6 Ω (c) 8 Ω (d) 10 Ω

6. The combination of NAND gates shown here under figure, are equivalent to

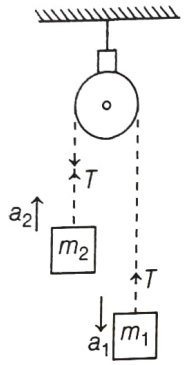


(a) an OR gate and an AND gate respectively
(b) an AND gate and a NOT gate respectively
(c) an AND gate and an OR gate respectively
(d) an OR gate and a NOT gate respectively

7. The correct dimensional formula for power is given by
(a) ML^2T^{-2} (b) MLT^{-1} (c) ML^2T^{-3} (d) MLT^{-2}

8. The relative density of material of a body is the ratio of its weight in air and the loss of its weight in water. By using a spring balance, the weight of the body in air is measured to be 5.00 ± 0.05 N. The weight of the body in water is measured to be 4.00 ± 0.05 N. Then, the maximum possible percentage error in relative density is
(a) 11% (b) 10% (c) 9% (d) 7%

9. The two bodies of mass m_1 and $m_2 (m_1 > m_2)$ respectively are tied to the ends of a massless string, which passes over a light and frictionless pulley. The masses are initially at rest and then released. Then, acceleration of the centre of mass of the system is



(a) $\left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2 g$ (b) $\left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2$
(c) g (d) zero

10. If r_1 and r_2 are the position vectors of two positive charges q_1 and q_2 with respect to same origin, then force on q_2 by q_1 is directed in the direction given by unit vector
(a) $\hat{r}_{21} = \frac{r_2 - r_1}{|r_2 - r_1|}$ (b) $\hat{r}_{21} = \frac{r_1 - r_2}{|r_2 - r_1|}$
(c) $\hat{r}_{21} = r_2 = r_1$ (d) $\hat{r}_{21} = r_1 - r_2$

11. A boat crosses a river of width 1 km by shortest path in 15 min. If the speed of boat in still water is 5 kmh^{-1}, then what is the speed of the river?
(a) 4 kmh^{-1} (b) 12 kmh^{-1}
(c) 5 kmh^{-1} (d) 3 kmh^{-1}

12. A man can jump upto a height of $h_0 = 1$ m on the surface of the Earth. What should be the radius of a spherical planet, so that the man makes a jump on its surface and escape out of its gravity? Assume that the man jumps with same speed as on Earth and the density of planet is same as that of Earth. (Take, escape speed on the surface of the Earth to be 11.2 km/s and radius of Earth to be 6400 km.)
(a) 2 km (b) 2.2 km
(c) 2.5 km (d) 3 km

13. The energy stored per unit volume in copper wire, which produces longitudinal strain of 0.1% is (Young's modulus = 1.1×10^{11} Nm^{-2})
(a) 11×10^4 Jm^{-3} (b) 11×10^3 Jm^{-3}
(c) 5.5×10^4 Jm^{-3} (d) 5.5×10^3 Jm^{-3}

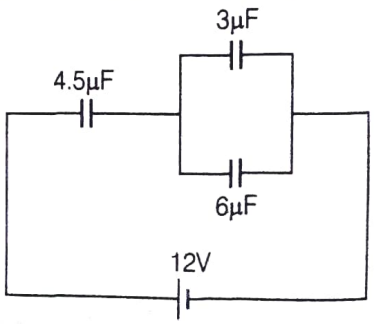
14. A 50 kg girl wearing high heel shoes balance on a single heel. The heel is circular with the diameter 1.0 cm. What is the pressure exerted on the horizontal floor?
(a) 6.24×10^6 Pa (b) 9×10^3 Pa
(c) 3×10^6 Pa (d) 2×10^4 Pa

15. An ideal gas heat engine operates in Carnot cycle between 227°C and 127°C. It absorbs 6×10^4 cal of heat of higher temperature. Amount of heat converted to work is
(a) 1.2×10^4 cal (b) 6×10^4 cal
(c) 4.8×10^4 cal (d) 2.4×10^4 cal

16. In an adiabatic process, when pressure is increased by $\frac{2}{3}$%. If $\frac{C_p}{C_V} = \frac{3}{2}$, then the volume decreases by about
(a) $\frac{9}{4}$% (b) $\frac{2}{3}$% (c) $\frac{4}{9}$% (d) 4%

17. An ideal refrigerator has a freezer at a temperature of –13°C. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) will be
(a) 320°C (b) 39°C (c) 325°K (d) 325°C

18. In the circuits shown in the figure, the potential difference across the 4.5 μF capacitor is



(a) 8V (b) 4V (c) 6V (d) $\frac{8}{3}$ V

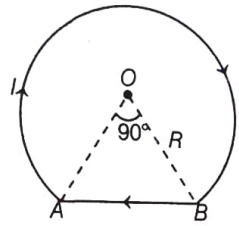
19. In a region, the potential is represented by $V(x, y, z) = 6x - 8xy - 8y + 6yz$, where V is in volts and x, y, z are in metres. The electric force experienced by a charge of 2 C situated at point $(1, 1, 1)$ is

(a) $4\sqrt{35}$ N (b) 30 N
(c) 24 N (d) $6\sqrt{5}$ N

20. The electrostatic force of repulsion between two positively charged ions carrying equal charges is 3.7×10^{-9} N. When they are separated by a distance of 5 Å. How many electrons are missing from each ion?

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

21. A current $I = 5.0$ A flows along a thin wire shaped as shown in figure. The radius of the curved part of the wire is equal to $R = 120$ mm. The angle $2\phi = 90°$, find the magnetic induction of the field at the point O.

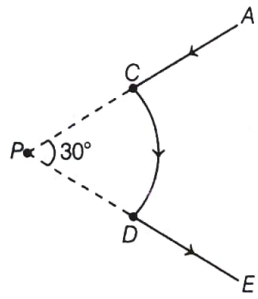


(a) 2×10^{-5} T (b) 2.8×10^{5} T
(c) 2.8×10^{-5} T (d) 2×10^{5} T

22. An electron after being accelerated through a potential difference of 10^4 V enters a uniform magnetic field of 0.04 T perpendicular to its direction of motion. Calculate the radius of curvature of its trajectory.

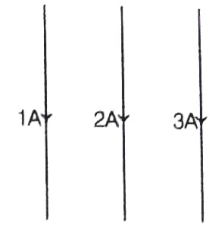
(a) 8.4 mm (b) 8.43 mm
(c) 8 mm (d) 8.2 mm

23. A current path shaped as shown in figure produces a magnetic field at P, the centre of the arc. If the arc subtends an angle of 30° and the radius of the arc is 0.6 m. What is the magnitude of the field at P, if the current is 3.0 A?



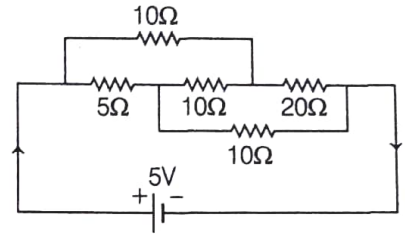
(a) 2.62×10^{-6} T (b) 2.62×10^{-7} T
(c) 3.62×10^{-9} T (d) 2.62×10^{-8} T

24. Three infinite straight wires A, B and C carry currents as shown in the figure. The net force on the wire B is directed



(a) towards A
(b) towards C
(c) normal to plane of paper
(d) zero

25. The current i drawn from the 5 V source will be



(a) 0.17 A (b) 0.33 A (c) 0.5 A (d) 0.67 A

26. An ideal battery of emf 2V and a series resistance R, are connected in the primary circuit of a potentiometer of length 1 m and resistance 5Ω. The value of R, to give a potential difference of 5 mV across 10 cm of potentiometer, where is

(a) 180 Ω (b) 190 Ω (c) 195 Ω (d) 200 Ω

27. A coil of inductance 300 mH and resistance 2Ω is connected to source of voltage 2V. The current reaches half of its steady state value in

(a) 0.05 s (b) 0.1 s (c) 0.15 s (d) 0.3 s

28. A concave lens forms the image of an object such that distance between the object and image is 10 cm; and the magnification produced is $\frac{1}{4}$. The focal length of the lens will be

(a) 8.6 cm (b) 6.2 cm (c) 10 cm (d) 4.4 cm

29. A parallel beam of monochromatic light of wavelength 450 nm passes through a slit of width 0.2 mm. Find the angular divergence in which most of light is diffracted.

(a) 4.5×10^{-3} rad (b) 5.5×10^{-3} rad
(c) 3.2×10^{-2} rad (d) 3.5×10^{-3} rad

30. White light is used to illuminate the two slits in a Young's double slit experiment. The separation between the slits is b and the screen

is at a distance $D >>> b$ from the slit. At a point on the screen directly in front of one of the slits. Find the missing wavelength.

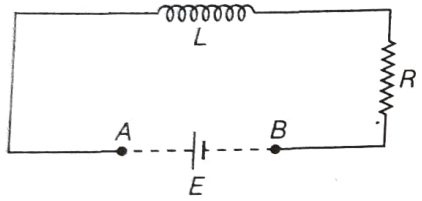
(a) $\frac{b^2}{D}, \frac{b^2}{3D}, \frac{b^2}{5D}$ ..... (b) $\frac{b^2}{2D}, \frac{b^2}{4D}, \frac{b^2}{5D}$ .....

(c) $\frac{b^2}{3D}, \frac{b^2}{5D}, \frac{b^2}{6D}$ ..... (d) None of the above

Category II (Q. Nos. 31 to 35)

Carry 2 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/2 mark will be deducted.

31. An inductor ($L = 100$ mH), a resistor ($R = 100\Omega$) and a battery ($E = 100$ V) are initially connected in series as shown in figure. After sometime, the battery is disconnected after short circuiting the points A and B. The current in the circuit 1 ms after the short circuit is



(a) eA (b) 0.1 A (c) 1 A (d) $\frac{1}{e}$ A

32. The diameter of a pipe at two points, where a venturimeter is connected is 8 cm and 5 cm; and the difference of levels in it is 4 cm. The volume of water flowing through the pipe per second is

(a) 1889 ccs^{-1} (b) 1520 ccs^{-1}

(c) 1321 ccs^{-1} (d) 1125 ccs^{-1}

33. A rectangular block is heated from 0°C to 100°C. The percentage increase in its length is 0.2%. What is the percentage increase in its volume?

(a) 0.6% (b) 0.10% (c) 0.2% (d) 0.4%

34. The incident intensity on a horizontal surface at a sea level from Sun is about 1 kW m^{-2}. Assuming that 50 per cent of this intensity is reflected and 50 per cent is absorbed, determine the radiation pressure on this horizontal surface.

(a) 5×10^{-11} Pa (b) 5×10^{-6} Pa

(c) 1×10^{-6} Pa (d) 1×10^{-11} Pa

35. A 20 W, 50 V filament is connected in series to an AC mains of 250 V-Hz. Calculate the value of the capacitor required to run the lamp.

(a) 6.6×10^{-5} F (b) 5.1×10^{-6} F

(c) 4.3×10^{-6} F (d) 302×10^{-5} F

Category III (Q. Nos. 36 to 40)

Carry 2 marks each and one or more option(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = 2 × number of correct answers marked ÷ actual number of correct answers. If any wrong option is marked or if any combination including a wrong option is marked, the answer will be considered wrong, but there is no negative marking for the same and zero marks will be awarded.

36. In which of the following situations are heavier of the two particles has smaller de-Broglie wavelength?

The two particles

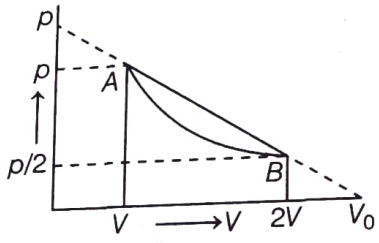
(a) move with same speed

(b) move with same KE

(c) move with same linear momentum

(d) have fallen through the same height

37. An ideal gas is taken from the state $A(p, V)$ to the state $B(p/2, 2V)$ along a straight line path as shown in figure. Select the correct statement from the following.



(a) Work done by the gas in going from A to B exceeds the work done in going from A to B under isothermal conditions

(b) In the T-V diagram, path AB would become a parabola

(c) In the p-T diagram, path AB would be part of hyperbola

(d) In going from A to B, the temperature T of gas first increases to a maximum value 1 and then decreases

38. Two particles are projected in air with speed v_0 at angles θ_1 and θ_2 (both acute) to the horizontal, respectively. If the height reached by the first particle is greater than that of the second, then tick the right choices.

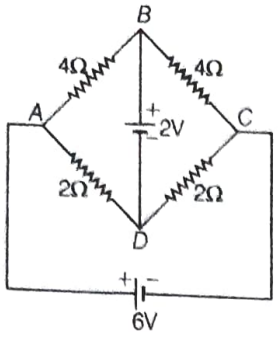
(a) Angle of projection : $\theta_1 > \theta_2$

(b) Time of flight : $T_1 > T_2$

(c) Horizontal range : $R_1 > R_2$

(d) Total energy : $U_1 > U_2$

39. Figure shows a network of resistances and batteries. Select the correct statements out of the following.



(a) The circuit satisfies the condition of a balanced Wheatstone bridge
(b) $V_B - V_D = 0$
(c) $V_B - V_D = 2V$
(d) No current flows in the branch BD

40. Consider a wire carrying a steady current I placed in a uniform magnetic field **B** perpendicular to its length. Consider the charges inside the wire. It is known that magnetic forces do no work. This implies that,
(a) motion of charges inside the conductor is unaffected by **B**, since they do not absorb energy
(b) some charges inside the wire move to the surface as a result of **B**
(c) if the wire moves under the influence of **B**, no work is done by the force
(d) if the wire moves under the influence of **B**, no work is done by the magnetic force on the ions, assumed fixed within the wire

Chemistry

Category I (Q. Nos. 41 to 70)

Carry 1 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/4 mark will be deducted.

41. A compound with haemoglobin like structure contain one atom of iron per molecule. If it contain 4.6% iron, its approximate molecular mass is
(a) 100 g mol^{-1} (b) 1200 g mol^{-1}
(c) 1600 g mol^{-1} (d) 1400 g mol^{-1}

42. Sulphur oxides which are responsible for major air pollution are caused by
(a) burning of coal and refining of petroleum
(b) using indoor combustion devices like cooking gas
(c) combustion of fuels containing carbon and hydrogen
(d) burning of fuels in automobiles

43. 1, 2-benzpyrene is
(a) a polynuclear hydrocarbon
(b) carcinogenic in nature
(c) an aromatic hydrocarbon
(d) Both (a) and (b)

44. The bond angles of NH_3, NH_4^+ and NH_2^- are in the order
(a) $NH_2^- > NH_3 > NH_4^+$ (b) $NH_4^+ > NH_3 > NH_2^-$
(c) $NH_3 > NH_2^- > NH_4^+$ (d) $NH > NH_4^+ > NH_2^-$

45. What is the value of ΔH for a reversible isothermal evaporation of 180 g of water at 100°C ? Latent heat of evaporation of water = 539.7 cal $K^{-1}g^{-1}$.
(a) 97.146 kcal (b) 5.397 kcal
(c) $\frac{10 \times 373 \times 539.7}{1000}$ kcal (d) $\frac{539.7 \times 373}{1000}$ kcal

46. The right order of the solubility of sulphates of alkaline earth metals in water is
(a) Be > Ca > Mg > Ba > Sr
(b) Mg > Be > Ba > Ca > Sr
(c) Be > Mg > Ca > Sr > Ba
(d) Mg > Ca > Ba > Be > Sr

47. The correct order of stability of conformations of $NH_2—CH_2—CH_2—OH$ is
(a) gauche > eclipsed > anti
(b) gauche > anti > eclipsed
(c) anti > eclipsed > gauche
(d) eclipsed > gauche > anti

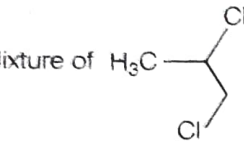
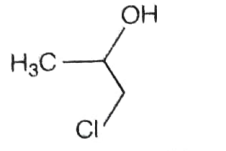
48. The rise in boiling point of a solution containing 1.8 g glucose in 100 g of solvent is 0.1°C. The molal elevation constant of the liquid is
(a) 1.0 (b) 2.0 (c) 3.0 (d) 2.5

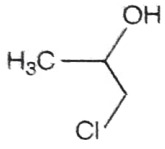
49. 1 mole heptane (v.p. = 92 mm of Hg) is mixed with 4 mol. Octane (v.p. = 31 mm of Hg), form an ideal solution. What will be the vapour pressure of the solution?
(a) 41.2 mm of Hg (b) 43.2 mm of Hg
(c) 40.2 mm of Hg (d) 23.2 mm of Hg

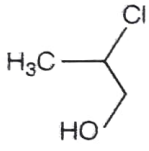
50. If the standard half cell reduction potentials are 0.522 V for Cu^+/Cu and 0.3402 V for Cu^{2+}/Cu. The standard half cell reduction potential for Cu^+/Cu^{2+} is
(a) 0.158 V (b) 0.20 V (c) 0.80 V (d) 0.40 V

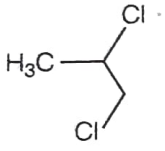
51. Identify Z in the following reaction series,

$$CH_3CH_2CH_2Br \xrightarrow{NaOH(aq)} X \xrightarrow[\Delta]{Al_2O_3} Y \xrightarrow{HOCl} Z$$

(a) Mixture of  and 

(b) 

(c) 

(d) 

52. In the reaction,

$$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$$

When 1 mol of ammonia and 1 mol of O_2 are made to react to completion then
(a) all the oxygen will consumed
(b) all the ammonia will be consumed
(c) 1.0 mol of NO will be produced
(d) 1.0 mol of H_2O is produced

53. Which of the following finds use as a superior thermometer liquid for high temperature measurement?
(a) Thallium (b) Gallium
(c) Mercury (d) Arsenic

54. The correct order of increasing oxidising power is
(a) $I_2 < Br_2 < Cl_2 < F_2$ (b) $Cl_2 < Br_2 < F_2 < I_2$
(c) $F_2 < Br_2 < Cl_2 < I_2$ (d) $F_2 < Cl_2 < Br < I_2$

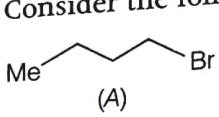
55. Choose the incorrect statement. Roasting is done to
(a) make the ore lumpy (b) make the ore porons
(c) remove volatile impurities (d) reduce the oxide to metal

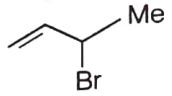
56. Calcium crystallises in a face centred cubic unit cell with $a = 0.556$ nm. Calculate the density if it contained 0.1% Schottky defects.
(a) 1.5463 g/cm^3 (b) 1.4962 g/cm^3
(c) 1.5448 g/cm^3 (d) 1.5943 g/cm^3

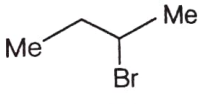
57. Limiting molar conductivity for some ions is given below (in S cm^2 mol^{-1}) $Na^+ = 50.1$, $Cl^- = 76.3$, $H^+ = 349.6$, $CH_3COO^- = 40.9$, $Ca^{2+} = 119.0$.
What will be the limiting molar conductivities (λ°_m) of $CaCl_2$, CH_3COONa and NaCl respectively?
(a) 271.6, 91.0 and 126.4 S cm^2 mol^{-1}
(b) 97.65, 111.0 and 242.8 S cm^2 mol^{-1}
(c) 119.0, 1024.5 and 9.2 S cm^2 mol^{-1}
(d) 111.0, 97.65 and 119.0 S cm^2 mol^{-1}

58. The decreasing order of boiling points of the following hydrides is
(a) $H_2O > PH_3 > AsH_3 > SbH_3 > NH_3$
(b) $H_2O > SbH_3 > NH_3 > AsH_3 > PH_3$
(c) $H_2O > NH_3 > SbH_3 > AsH_3 > PH_3$
(d) $H_2O > SbH_3 > AsH_3 > PH_3 > NH_3$

59. Consider the following bromides :


(A)


(B)


(C)

The correct order of S_N1 reactivity is
(a) $C > B > A$ (b) $A > B > C$
(c) $B > C > A$ (d) $B > A > C$

60. What is the reagent X in the following reaction?

$$C_6H_5—N(CH_3)_2 + X \longrightarrow (CH_3)_2N—C_6H_4—CO—C_6H_4—N(CH_3)_2$$

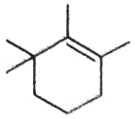
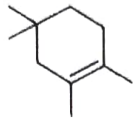
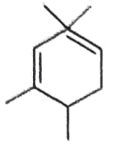
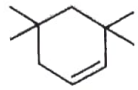
(a) CO (b) CO_2
(c) $COCl_2$ (d) $OC(OC_2H_5)_2$

61. $CH_2(Br)—CH=CH—CH_2(Br) \xrightarrow{Zn\ (dust)} A$

Above reaction is an example of 1, 4-elimination, predict the product.
(a) $CH_3—CH=C=CH_2$
(b) $CH_3—C\equiv C—CH_3$
(c) $CH_3—CH_2—C\equiv CH$
(d) $CH_2=CH—CH=CH_2$

62. Which one of the following is not an example of chain growth polymer?
(a) Neoprene (b) Buna-S
(c) PMMA (d) Glyptal

63. 2, 2, 6, 6-tetramethyl cyclohexanol is treated with an acid. An alkene is formed after rearrangement. The structure of the alkene is

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

64. 0.5 mole of each H_2, SO_2 and CH_4 are kept in a container. A hole was made in container. After 3 hours, the order of partial pressure in the container will be

(a) $p_{SO_2} > p_{CH_4} > p_{H_2}$ (b) $p_{H_2} > p_{SO_2} > p_{CH_4}$
(c) $p_{CH_4} > p_{SO_2} > p_{H_2}$ (d) $p_{H_2} > p_{CH_4} > p_{SO_2}$

65. Give the composition of tincture of iodine.

(a) 2-3% solution of iodine in alcohol water mixture
(b) A mixture of iodine in chloronylenol
(c) A mixture of 0.2% phenol and 2-3% iodine in water
(d) 2-3% solution of iodine in potassium iodide

66. Phosphorus pentachloride dissociates as follows in a closed reaction vessel,

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

If total pressure at equilibrium of the reaction mixture is p and degree of dissociation of PCl_5 is X, the partial pressure of PCl_3 will be

(a) $\left(\frac{X}{X+1}\right)p$ (b) $\left(\frac{X}{X-1}\right)p$
(c) $\left(\frac{2X}{1-X}\right)p$ (d) $\left(\frac{X}{1-X}\right)p$

67. The isoelectric point of a colloidally dispersed material is the pH value at which

(a) the dispersed phase does not migrate in an electric field
(b) the dispersed phase migrate in an electric field
(c) the dispersed phase has pH equal to 14
(d) the dispersed phase has pH equal to zero

68. If the radius of an atom of an element is 75 pm and the lattice type is body centred cubic, what is the edge length of the unit cell?

(a) 170 pm (b) 175 pm (c) 178 pm (d) 173.2 pm

69. Calculate the EMF of the following half cells :

$$Pt, H_2(2atm) \mid HCl(0.02\ M)\ E^{\ominus} = 0\ V$$

(a) – 0.10 5 V (b) – 0.109 V
(c) 0.109 V (d) 0.104 V

70. The rate constant of a reaction will be equal to the pre-exponential factor when

(a) the absolute temperature is infinity
(b) the absolute temperature is zero
(c) temperature in centigrade is zero
(d) None of the above

Category II (Q. Nos. 71 to 75)

Carry 2 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/2 mark will be deducted.

71. Which of the following is most effective in coagulating ferric hydroxide sol.

(a) KCl (b) $FeCl_3$
(c) Na_2SO_4 (d) $K_3[Fe(CN)_6]$

72. Select the incorrect statement.

(a) Water is considered pure if it has BOD less than 5 ppm
(b) In COD determination, the pollutants resistant to microbial oxidation are not oxidised by oxidising agent like $K_2Cr_2O_7$
(c) The lower concentration of DO dissolves oxygen, the more polluted is the water sample
(d) The tolerable limit of lead in drinking water is 50 ppm

73. Identify the correct statement regarding enzymes.

(a) Enzymes are specific biological catalysts that can normaly function at very high temperature ($T \sim 100$ K)
(b) Enzyme are normally heterogenous catalysts that are very specific in their action
(c) Enzymes are specific biological catalysts that cannot poisoned
(d) Enzyme are specific biological catalysts that possess well defined active sites

74. Chloramphenicol is a

(a) narrow spectrum bactericidal antibiotic
(b) narrow spectrum bacteriostatic antibiotic
(c) broad spectrum bactericidal antibiotic
(d) broad spectrum bacteriostatic antibiotic

75. In the reaction,

$$[Al(H_2O)_6]^{3+} + H_2O \rightleftharpoons [Al(H_2O)_5OH]^{2+} + H_3O^+$$

(a) $[Al(H_2O_6)]^{3+}$ is an acid
(b) $[Al(H_2O)_6]^{3+}$ is a base
(c) Both (a) and (b)
(d) None of the above

Category III (Q. Nos. 76 to 80)

Carry 2 marks each and one or more option(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = 2 × number of correct answers marked ÷ actual number of correct answers. If any wrong option is marked or if any combination including a wrong option is marked, the answer will considered wrong, but there is no negative marking for the same and zero marks will be awarded.

76. For particles having same K.E., the de-Broglie wavelength is
(a) unpredictable
(b) inversely proportional to its velocity
(c) independent of its mass and velocity
(d) directly proportional to its velocity

77. Which of the following compounds may give blood red colouration while performing Lassaigne's test for nitrogen
(a) $(NH_2)_2C=O$ (b) $(NH_2)_2C=S$
(c) $P-NH_2C_6H_4SO_3H$ (d) $C_6H_5SO_3H$

78. Pottassium cyanide is used for separating
(a) Ba^{2+} and Ca^{2+} (b) Co^{2+} and Ni^{2+}
(c) Cu^{2+} and Cd^{2+}
(d) Mn^{2+} and Zn^{2+}

79. Proteins can be classified into two types on the basis of their molecular shape, i.e., fibrous proteins and globular proteins. Examples of globular proteins are
(a) insulin (b) keratin
(c) myosin (d) albumin

80. Which of the following reactions should be balanced in basic medium?
(a) $NH_3 + MnO_4^{\ominus} \longrightarrow MnO_2 + NO_2$
(b) $Cr(OH)_2 + I_2 \longrightarrow Cr(OH)_2 + 2I^{\ominus}$
(c) $HNO_3 + Fe^{2+} \longrightarrow Fe^{3+} + NO_2$
(d) $H_2O_2 + Fe^{3+} \longrightarrow O_2 + Fe^{2+}$

Mathematics

Category I (Q. Nos. 1 to 50)

Only one answer is correct. Correct answer will fetch full marks 1. Incorrect answer or any combination of more than one answer will fetch −1/4 marks.

1. The value of $\lim_{n\to\infty}\left(\frac{a-1+\sqrt[n]{b}}{a}\right)$, $a, b > 0$ is
(a) $2\sqrt{a}$ (b) $\sqrt[a]{b}$ (c) $\sqrt[b]{a}$ (d) $4\sqrt{b}$

2. The point of intersection of $f_1(x) = \int_2^x (2t-5)\,dt$ and $f_2(x) = \int_0^x 2t\,dt$ is
(a) $\left(\frac{6}{5}, \frac{36}{25}\right)$ (b) $\left(\frac{2}{3}, \frac{4}{9}\right)$ (c) $\left(\frac{1}{3}, \frac{1}{9}\right)$ (d) $\left(\frac{1}{5}, \frac{1}{25}\right)$

3. If the normal at point $P(\theta)$ to the ellipse $5x^2 + 14y^2 = 70$ intersects it again at the point $Q(2\theta)$, then $\cos\theta$ is equal to
(a) $\frac{2}{3}$ (b) $-\frac{2}{3}$ (c) $\frac{1}{3}$ (d) $-\frac{1}{3}$

4. In ΔABC, equation of the right bisectors of the sides AB and AC are $x + y = 0$ and $x - y = 0$, respectively. If $A \equiv (5, 7)$, then equation of side BC is
(a) $7y = 5x$ (b) $x = 5y$
(c) $7x = 5y$ (d) $y = 5x$

5. There are 7 seats in a row. three persons take seats at random. The probability that the middle seat is always occupied and no two persons are consecutive is
(a) $\frac{6}{35}$ (b) $\frac{9}{22}$ (c) $\frac{4}{35}$ (d) $\frac{8}{21}$

6. The value of $\int_{-\pi}^{\pi} \frac{\cos^2 x}{1+a^x}\,dx$, $a > 0$ is
(a) $\frac{2}{\pi}$ (b) $\frac{\pi}{a}$ (c) $\frac{\pi}{2}$ (d) $\frac{a}{\pi}$

7. If S.D of variable x is $\forall x$, then the SD of $\frac{ax+b}{p}$, $\forall\, a, b, p \in R$ is
(a) $\left|\frac{p}{a}\right| \sigma x$ (b) $\left|\frac{a}{p}\right| \sigma x$ (c) $\frac{p}{a}\sigma x$ (d) $\frac{a}{p}\sigma x$

8. The complex numbers z_1, z_2 and z_3 satisfying $\frac{z_1 - z_3}{z_2 - z_3} = \frac{1-\sqrt{3}i}{2}$ are the vertices of a triangle which is
(a) equilateral (b) right angled
(c) right angled isosceles (d) obtuse angled isosceles

9. If $\mathbf{a} \parallel \mathbf{b} \times \mathbf{c}$ then $(\mathbf{a} \times \mathbf{b}) \cdot (\mathbf{a} \times \mathbf{c})$ is equal to

(a) $\mathbf{b}^2 \cdot (\mathbf{a} \cdot \mathbf{b})$ (b) $\mathbf{a}^2 \cdot (\mathbf{b} \cdot \mathbf{c})$

(c) $\mathbf{c}^2 \cdot (\mathbf{a} \cdot \mathbf{b})$ (d) $(\mathbf{a} \cdot \mathbf{b})^2 \mathbf{c}$

10. Let $f(x + y) + f(x - y) = 2f(x) \cdot f(y), \forall\, x, y \in R$ $f(0) \neq 0$, then $f(x)$ is

(a) periodic (b) odd

(c) even (d) None of these

11. Solution of the differential equation $xdy = \left[y + \frac{xf(y/x)}{f'(y/x)} \right] dx$ is

(a) $|f(y/x)| = c|x|, c > 0$

(b) $|f(y/x)| = |x| + c,\ c < 0$

(c) $|f(x/y)| = |x| + c, c > 0$

(d) $|f(x/y)| = c|x|, c < 0$

12. Median of ${}^{2n}C_0, {}^{2n}C_1, {}^{2n}C_2, \ldots, {}^{2n}C_n$ (When n is odd) is

(a) $\frac{1}{2}\left({}^{2n}C_{\frac{n-1}{2}} + {}^{2n}C_{\frac{n+1}{2}} \right)$ (b) ${}^{2n}C_{n/2}$

(c) ${}^{2n}C_n$ (d) None of these

13. If the sum of the coefficients in the expansion of $(x - 2y + 3z)^n$ is 128, then the greatest coefficient in the expansion of $(1 + x)^n$ is

(a) 35 (b) 20 (c) 15 (d) 10

14. $\lim\limits_{x \to \infty} \dfrac{\cot^{-1}(\sqrt{x+1} - \sqrt{x})}{\sec^{-1}\left\{ \left(\dfrac{2x+1}{x-1} \right)^x \right\}}$ is equal to

(a) 1 (b) 0

(c) $\frac{\pi}{2}$ (d) does not exists

15. The plane passing through the points (5, 1, 2) perpendicular to the line $2(x - 2) = y - 4 = z - 5$ will meet the line on the point

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

(c) (1, 3, 2) (d) (3, 2, 1)

16. If $f(x)$, $g(x)$ and $h(x)$ are three polynomials of degree 2 and

$$\Delta(x) = \begin{vmatrix} f(x) & g(x) & h(x) \\ f'(x) & g'(x) & h'(x) \\ f''(x) & g''(x) & h''(x) \end{vmatrix}$$

then $\Delta(x)$ is a polynomial of degree

(a) 2 (b) 3

(c) atmost 2 (d) atmost 3

17. The length of the chord of the parabola $y^2 = x$ which is bisected at the point (2, 1) is

(a) $4\sqrt{3}$ (b) $3\sqrt{2}$ (c) $2\sqrt{3}$ (d) $2\sqrt{5}$

18. In a ΔABC, $\angle B = 90°$, $AC = h$ and the length of the perpendicular from B to AC is p such that $h = 4p$. If $AB < BC$, then $\angle C$ has the measure

(a) $\frac{\pi}{4}$ (b) $\frac{7\pi}{12}$ (c) $\frac{\pi}{12}$ (d) $\frac{\pi}{6}$

19. If $(x^2 + y^2)dy = xydx$ and $y(x_0) = e$, $y(1) = 1$, then x_0 is

(a) $e\sqrt{3}$ (b) $\sqrt{2e^2 - 1}/\sqrt{2}$

(c) $\sqrt{e^2 - 1}/\sqrt{2}$ (d) $\dfrac{\sqrt{e^2 + 1}}{\sqrt{2}}$

20. If A and B are different matrices satisfying $A^3 = B^3$ and $A^2B = B^2A$, then

(a) at least one $\det(A^2 + B^2)$ or $\det(A - B)$ must be zero.

(b) $\det(A^2 + B^2)$ as well as $\det(A - B)$ must be zero

(c) $\det(A^2 + B^2)$ must be zero.

(d) $\det(A^2 - B^2)$ must be zero.

21. If a line is tangent to one point and normal at another point on the curve $x = 4t^2 + 3$, $y = 8t^3 - 1$, then slope of each line is

(a) $\pm\sqrt{2}$ (b) $\pm\sqrt{3}$ (c) ± 1 (d) $\pm\sqrt{6}$

22. If the total number of m elements subsets of the set $A = \{a_1, a_2, a_3 \ldots a_n\}$ is λ times the number of elements subsets containing a_4, then n is

(a) $(m - 1)\lambda$ (b) $m\lambda$

(c) $(m + 1)\lambda$ (d) 0

23. If $\dfrac{\sin x}{x} = \sum\limits_{r=0}^{\infty} a_r x^r$, then

(a) $a_0 = 1, a_1 = 0$ (b) $a_0 = 1, a_1 = 0$

(c) $a_0 = 1, a_1 = 1$ (d) $a_0 = 0, a_1 = 0$

24. The number of negative integral solution of the equation $x_1 + x_2 + x_3 + x_4 + x_5 + 10 = 0$

(a) ${}^9C_5$ (b) ${}^{10}C_5$

(c) ${}^{12}C_6$ (d) ${}^6C_4$

25. Suppose, $f(x) = x\sin x - \frac{1}{2}\sin^2 x, x \in \left(0, \frac{\pi}{2}\right)$ then range of $f(x)$ is

(a) (0, 1) (b) $\left(0, \frac{\pi}{2}\right)$

(c) $\left(0, \frac{\pi - 1}{2}\right)$ (d) $\left(0, \frac{\pi + 1}{2}\right)$

26. In ΔPQR, $R = \frac{\pi}{2}$. If $\tan\frac{P}{2}$ and $\tan\frac{Q}{2}$ are the roots of the equation $ax^2 + bx + c = 0$, then

(a) $a = b + c$ (b) $b = c + a$
(c) $c = a + b$ (d) $b = c$

27. $\log_2(x^2 - 3x + 18) < 4$, then x belongs to

(a) (1, 2) (b) (2, 16)
(c) (1, 16) (d) None of these

28. The solution set of the inequality

$$\log_{0.8}\left[\log_6\left(\frac{x^2+4}{x+4}\right)\right] < 0 \text{ is}$$

(a) $(-4, -3) \cup (8, \infty)$ (b) $(4, -3) \cup (8, \infty)$
(c) $(-4, \infty)$ (d) None of these

29. Out of thirty points in a plane, eight of them are collinear. The number of straight lines that can be formed by joining these point is

(a) 348 (b) 408 (c) 540 (d) 296

30. If a line makes α, β, γ with the coordinate axes, then

(a) $\cos2\alpha + \cos2\beta + \cos2\gamma - 1 = 0$
(b) $\cos2\alpha + \cos2\beta + \cos2\gamma - 2 = 0$
(c) $\cos2\alpha + \cos2\beta + \cos2\gamma + 1 = 0$
(d) None of the above

31. If $\int \frac{x^{49}\tan^{-1}(x^{50})}{(1+x^{100})}dx = K[\tan^{-1}(x^{50})]^2 + C$, then k equals

(a) $\frac{1}{100}$ (b) $\frac{1}{20}$ (c) $\frac{1}{50}$ (d) $\frac{1}{200}$

32. If $f(x) = f(a - x)$ and $g(x) + g(a - x) = 2$, then the value of $\int_0^a f(x)\, g(x)\, dx$ is

(a) $\int_0^a f(x)\,dx$ (b) $\int_0^a g(x)\,dx$
(c) $\int_0^a [g(x) - f(x)]\,dx$ (d) $\int_0^a g(x) + f(x)]\,dx$

33. Value of θ lying between $\theta = 0$ and $\theta = \frac{\pi}{2}$ and satisfying

$$\begin{vmatrix} 1+\sin^2\theta & \cos^2\theta & 4\sin4\theta \\ \sin^2\theta & 1+\cos^2\theta & 4\sin4\theta \\ \sin^2\theta & \cos^2\theta & 1+4\sin4\theta \end{vmatrix}$$

(a) $\frac{\pi}{24}$ (b) $\frac{5\pi}{24}$ (c) $\frac{9\pi}{24}$ (d) $\frac{7\pi}{24}$

34. The sum of series $\sum_{n=1}^{\infty} \frac{2n}{(2n+1)!}$ is

(a) e^{-1} (b) e (c) $2e$ (d) e^3

35. The function f satisfies the functional equation $3f(x) + 2f\left(\frac{x+59}{x-1}\right) = 10x + 30$ for all real $x \neq 1$. The value of $f(7)$ is

(a) 4 (b) 11 (c) 44 (d) 0

36. $\sum_{k=1}^{2n+1} (-1)^{k-1} \cdot k^2$ equals

(a) $(n-1)(2n-1)$ (b) $(n+1)(2n+1)$
(c) $(n+1)(2n-1)$ (d) $(n-1)(2n+1)$

37. If the plane $x + y + z = 1$ is rotated through an angle 90° about its line of intersection with the plane $x - 2y + 3z = 0$, then the new position of the plane is

(a) $x - 5y + 4z = -1$ (b) $x - 8y + 7z = -2$
(c) $x - 5y - 4z = +1$ (d) $x - 8y + 7z = 2$

38. If $A = \begin{bmatrix} 0 & 3 & 3 \\ -3 & 0 & -4 \\ -3 & 4 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, then $B'(AB)$ is

(a) null matrix (b) symmetric matrix
(c) singular matrix (d) unit matrix

39. The expression $\left(1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \ldots\infty\right)^2$ will be represented in ascending power of x as

(a) $1 + \frac{2^2x^2}{2!} + \frac{2^4x^4}{4!} + \ldots\infty$

(b) $1 + \frac{(2x)^2}{2!} + \frac{2^2x^4}{4!} + \ldots\infty$

(c) $1 + \frac{(2x)^2}{2.2!} + \frac{2x^4}{4!} + \ldots\infty$

(d) $1 + \frac{(2x)^2}{2.2!} + \frac{(2x)^4}{2.4!} + \ldots\infty$

40. $\lim_{x\to2} \frac{\sqrt{1+\sqrt{2+x}} - \sqrt{3}}{x-2}$ equals

(a) $\frac{1}{8\sqrt{3}}$ (b) $\sqrt{3}$
(c) $2\sqrt{3}$ (d) $-\frac{1}{\sqrt{3}}$

41. $\int_0^{\pi} \frac{x\,dx}{a^2\cos^2x + b^2\sin^2x}$ is equal to

(a) $\frac{\pi}{ab}$ (b) $\frac{\pi^2}{2ab}$ (c) $\frac{\pi^2}{ab}$ (d) $\frac{\pi^2}{a^2+b^2}$

42. The locus of the point which divides the double ordinates of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ in the ratio 1 : 2 internally, is

(a) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (b) $\frac{x^2}{a^2} + \frac{9y^2}{b^2} = 1$
(c) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 9$ (d) $\frac{9x^2}{a^2} + \frac{y^2}{b^2} = 1$

43. The point on the axis of X, whose perpendicular distance from the straight line $\frac{x}{y} + \frac{y}{b} = 1$ is a, are

(a) $\frac{b}{a}(a \pm \sqrt{a^2 + b^2}, 0)$ (b) $\left(\frac{a}{b}(b \pm \sqrt{a^2 + b^2}), 0\right)$

(c) $\frac{b}{a}(a + b, 0)$ (d) $\frac{a}{b}(a \pm \sqrt{a^2 + b^2}, 0)$

44. The Length of major axis of ellipse

$(5x - 10)^2 + (5y + 15)^2 = \frac{(3x - 4y + 7)^2}{4}$ is

(a) $\frac{20}{3}$ (b) $\frac{10}{3}$ (c) $\frac{5}{3}$ (d) 2

45. If $f(x) = (x + 1)^2 - 1$, $(x \geq -1)$ Then, the set $S = \{x : f(x) = f^{-1}(x)\}$ is

(a) $\left[0, -1, \frac{-3 + i\sqrt{3}}{2}, \frac{-3 - i\sqrt{3}}{2}\right]$

(b) $\{0, 1, -1\}$

(c) $\{0, -1\}$

(d) Empty set

46. The equation of tangent to the curve $\left(\frac{x}{a}\right)^n + \left(\frac{y}{b}\right)^n = 2$ at (a, b) is

(a) $\frac{x}{a} + \frac{y}{b} = 2$ (b) $\frac{x}{a} + \frac{y}{b} = \frac{1}{2}$

(c) $\frac{x}{b} - \frac{y}{a} = 2$ (d) $ax + by = 2$

47. If $A(z_1), B(z_2)$ and $C(z_3)$ are the vertices of ΔABC in which $\angle ABC = \frac{\pi}{4}$ and $\frac{AB}{BC} = \sqrt{2}$ then z_2 equals

(a) $z_3 + i(z_1 + z_3)$ (b) $z_3 - i(z_1 - z_3)$

(c) $z_3 + i(z_1 - z_3)$ (d) None of these

48. If $D_r = \begin{vmatrix} 2^{r-1} & 2.3^{r-1} & 4.5^{r-1} \\ \alpha & \beta & \gamma \\ 2^n - 1 & 3^n - 1 & 5^n - 1 \end{vmatrix}$, then $\sum_{r=1}^{n} D_r$ equals

(a) 0 (b) $\alpha\beta\gamma$

(c) $\alpha + \beta + \gamma$ (d) $\alpha.2^n + \beta.3^n + r.4^n$

49. The numbers of terms in the expansion of $(a + b + c)^n$ will be

(a) $n + 1$ (b) $n + 3$

(c) $\frac{(n + 1)(n + 2)}{2}$ (d) None of these

50. The locus of a point P which moves such that $2PA = 3PB$ where coordinates of points A and B are (0, 0) and (4, −3) is

(a) $5x^2 - 5y^2 - 72x + 54y + 225 = 0$

(b) $5x^2 + 5y^2 - 72x + 54y + 225 = 0$

(c) $5x^2 + 5y^2 + 72x - 54y + 225 = 0$

(d) $5x^2 + 5y^2 - 72x - 54y - 225 = 0$

Category II (Q. No. 51 to 65)

Carry 2 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/2 mark will be deducted.

51. The three vectors $\hat{i} + \hat{j}, \hat{j} + \hat{k}, \hat{k} + \hat{i}$ taken two at a time form three planes. The three unit vectors drawn perpendicular to three planes form a parallelopiped of volume.

(a) $\frac{4}{3\sqrt{3}}$ cubic unit (b) 4 cubic unit

(c) $\frac{1}{2}$ cubic unit (d) $\frac{3\sqrt{3}}{4}$ cubic unit

52. The normal at a variable point A on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ of eccentricity e meets the axes of the ellipse at S and T. Then locus of midpoint of ST is a conic with eccentricity e' such that

(a) $e' = e^2$ (b) $e' = e$

(c) $e' = \frac{1}{e}$ (d) None of these

53. Let x, y, z be such that $y(x + 3) \neq 0$. If $\begin{vmatrix} x & x+1 & x-1 \\ -y & y+1 & y-1 \\ z & z-1 & z+1 \end{vmatrix} + \begin{vmatrix} x+1 & y+1 & z-1 \\ x-1 & y-1 & z+1 \\ (-1)^{n+2}x & (-1)^{n+1}y & (-1)^n z \end{vmatrix} = 0$, then n equals

(a) zero (b) Any integer

(c) Any odd integer (d) Any even integer

54. If z_1 and z_2 are two complex numbers such that $|z_1| = |z_2| + |z_1 - z_2|$, then

(a) $\text{Re}\left(\frac{z_1}{z_2}\right) = 0$ (b) $\text{Re}\left(\frac{z_1}{z_2}\right) = \text{Im}\left(\frac{z_1}{z_2}\right)$.

(c) $\text{Im}\left(\frac{z_1}{z_2}\right) = 0$ (d) None of these

55. Suppose a, b and c are in AP and a^2, b^2 and c^2 are in GP. If $a < b < c$ and $a + b + c = \frac{3}{2}$, then a equals

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

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

56. The vertices of a variable triangle are (3, 4), $(5\cos\theta, 5\sin\theta)$ and $(5\sin\theta, -5\cos\theta)$, where $\theta \in R$. The Locus of its othocenter is

(a) $(x + y - 7)^2 + (x - y + 1)^2 = 100$

(b) $(x - y + 7)^2 + (x - y - 1)^2 = 100$

(c) $(x + y - 7)^2 + (x + y - 1)^2 = 25$

(d) $(x + y - 1)^2 + (x - y - 7)^2 = 25$

57. If $z_r = \cos\frac{r\alpha}{n^2} + i\sin\frac{r\alpha}{n^2}$, where $r = 1, 2, 3...n$, then $\lim_{n\to\infty} z_1 z_2 ... z_n$ equals

(a) $\sqrt[3]{e^{i\alpha}}$ (b) $\cos\left(\frac{\alpha}{z}\right) - i\sin\left(\frac{\alpha}{z}\right)$

(c) $\cos\alpha - i\sin\alpha$ (d) $e^{i\alpha/2}$

58. If $f(x) = \sin^2 x + \sin^2\left(x + \frac{\pi}{3}\right) + \cos x \cos\left(x + \frac{\pi}{3}\right)$ and $g(5/4) = 1$, then $gof(x)$ is equal to

(a) 1 (b) –1 (c) 2 (d) –2

59. The maximum value of the function.

$f(x) = \frac{(1+x)^{0.6}}{1+x^{0.6}}$ in the interval [0, 1] is

(a) $2^{0.6}$ (b) $2^{-0.4}$ (c) 2^0 (d) 0

60. A man is moving away from a tower 41.8m high at a rate of $2m/s$. If the eye level of the man is 1.8 m above the ground, then the rate at which the angle of elevation of the top of the tower changes, when he is 40 m from the foot of the tower is

(a) $\frac{-1}{40}$ rad/s (b) $\frac{-2}{625}$ rad/s

(c) $\frac{-4}{125}$ rad/s (d) None of these

61. Let $A(1, 1)$ and $B(3, 2)$ be two points. If C is a point on x-axis such that $AC + BC$ is minimum, then the coordinates of C are

(a) $\left(\frac{5}{3}, 0\right)$ (b) $\left(\frac{1}{3}, 0\right)$

(c) (3, 0) (d) None of these

62. If a, b, c are the p^{th}, q^{th}, r^{th} terms of an HP and $u = (q - r)\hat{i} + (r - p)\hat{j} + (p - q)\hat{k}$ and $v = \frac{\hat{i}}{a} + \frac{\hat{j}}{b} + \frac{\hat{k}}{c}$, then

(a) $uxv = \hat{i} + \hat{j} + \hat{k}$

(b) u, v are parallel vectors

(c) u, v are orthogonal vectors

(d) $u.v = 1$

63. If α and β are the roots of $ax^2 + bx + c = 0$, then the equation $ax^2 - bx(x-1) + c(x-1)^2 = 0$ has roots

(a) $\frac{\alpha}{1-\alpha}, \frac{\beta}{1-\beta}$ (b) $\frac{1-\alpha}{\alpha}, \frac{1-\beta}{\beta}$

(c) $\frac{\alpha}{\alpha+1}, \frac{\beta}{\beta+1}$ (d) $\frac{\alpha+1}{\alpha}, \frac{\beta+1}{\beta}$

64. The value of $\lim_{x\to\infty} \frac{2(x)^{1/2} + 3(x)^{1/3} + 4(x)^{1/4} + ...+ n(x)^{1/n}}{(2x-3)^{1/2} + (2x-3)^{1/3} + ...+ (2x-3)^{1/n}}$ is

(a) 2 (b) $\sqrt{2}$ (c) –1 (d) 0

65. $\tan\alpha$ and $\tan\beta$ are the roots of the equation $x^2 + ax + b = 0$, then the value of $\sin^2(\alpha+\beta) + a\sin(\alpha+\beta)\cos(\alpha+\beta) + b\cos^2(\alpha+\beta)$ is equal to

(a) ba (b) a (c) b^2a (d) b

Category III (Q. Nos. 66 to 75)

Carry 2 marks each and one or more option(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = 2× number of correct answers marked ÷ actual number of correct answer. If any wrong option is marked or if, any combination including a wrong option is marked, the answer will be considered wrong, but there is no negative marking for the same and zero marks will be awarded.

66. $A(z_1)$, $B(z_2)$, $C(z_3)$ and $D(z_4)$ are four complex numbers representing the vertices of a rhombus on the complex plane, then

(a) $\text{amp}\frac{z_1 - z_4}{z_2 - z_4} = \text{amp}\frac{z_2 - z_4}{z_3 - z_4}$

(b) $\frac{z_1 - z_3}{z_2 - z_4}$ is purely imaginary

(c) $\frac{z_1 - z_4}{z_2 - z_3}$ is purely real

(d) Not necessary that $|z_1 - z_3| \neq |z_2 - z_4|$

67. Let $f(x) = \begin{vmatrix} n & n+1 & n+2 \\ {}^nP_n & {}^{n+1}P_{n+1} & {}^{n+2}P_{n+2} \\ {}^nC_n & {}^{n+1}C_{n+1} & {}^{n+2}C_{n+2} \end{vmatrix}$

Then $f(x)$ is divisible by

(a) $n^2 + n + 1$ (b) $(n + 1)!$

(c) $n!$ (d) None of these

68. If foci of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ coincide with the foci of $\frac{x^2}{25} + \frac{y^2}{9} = 1$ and eccentricity of the hyperbola is 2, then

(a) $a^2 + b^2 = 16$

(b) there is no director circle of the hyperbola

(c) centre of the director circle is (0, 0)

(d) Length of latusrectum of the hyperbola = 12

69. The parabolas $y^2 = 4x$ and $x^2 = 4y$ divide the square region bounded by the lines $x = 4$, $y = 4$ and the coordinate axes. If A_1, A_2 and A_3 are respectively, the areas of these parts numbered from top to bottom, then

(a) $\frac{A_2}{A_3} = 1$ (b) $\frac{A_1}{A_2} = \frac{1}{2}$

(c) $\frac{A_3}{A_2} = \frac{1}{2}$ (d) $\frac{A_1}{A_2} = 1$

70. The roots of the equation $x^5 - 40x^4 + Px^3 + Qx^2 + Rx - S = 0$ are in GP If the sum of their reciprocals is 10, then the value of S can be equal to

(a) –32 (b) $\frac{1}{32}$

(c) $\frac{-1}{32}$ (d) 32

71. $f(x) = |x^2 - 3|x| + 2|$, then which of the following is/are true ?

(a) $f'(x) = 2x - 3$ for $x \in (0, 1) \cup (2, \infty)$

(b) $f'(x) = 2x + 3$ for $x \in (-\infty, -2) \cup (-1, 0)$

(c) $f'(x) = -2x - 3$ for $x \in (-2, -1)$

(d) None of the above

72. The Eq. of two equal sides PQ, PR of an isoceles triangle PQR are $x + y = 5$ and $7x - y = 3$. If area of ΔPQR is 5, then the equation of BC is

(a) $3x + y - 12 = 0$

(b) $3x + y + 2 = 0$

(c) $x - 3y + 1 = 0$

(d) $x - 3y - 21 = 0$

73. Let $f(x) + f(y) = f(x\sqrt{1 - y^2} + y\sqrt{1 - x^2})$. Then,

(a) $f(2x\sqrt{1 - x^2}) = 2f(x)$

(b) $f(4x^3 - 3x) + 3f(x) = 0$

(c) $f(4x^3 - 3x) = 3f(x)$

(d) $f(2x\sqrt{1 - x^2}) + 2f(x) = 0$

74. If the tangent at any point $A\ (4m^2, 8m^3)$ of $x^3 - y^2 = 0$ is also a normal to the curve $x^3 - y^2 = 0$, then m equals

(a) $\frac{-3}{\sqrt{2}}$

(b) $\frac{3}{\sqrt{2}}$

(c) $\frac{-\sqrt{2}}{3}$

(d) $\frac{\sqrt{2}}{3}$

75. If $a_1, a_2, \ldots a_n$ are in AP with common difference d, then

$$\cot^{-1}\left|\frac{1 + a_1a_2}{d}\right| + \cot^{-1}\left|\frac{1 + a_2a_3}{d}\right| + \cot^{-1}\left|\frac{1 + a_3a_4}{d}\right| + \ldots + \cot^{-1}\left[\frac{1 + a_na_{n-1}}{d}\right]$$

is equal to

(a) $\tan^{-1} a_n - \tan^{-1} a_1$

(b) $\cot^{-1} a_1 + \cot^{-1} a_n$

(c) $\cot^{-1} a_1 - \cot^{-1} a_n$

(d) None of these

Answers

Physics

1. (a)	2. (d)	3. (b)	4. (a)	5. (d)	6. (a)	7. (c)	8. (a)	9. (a)	10. (a)
11. (d)	12. (c)	13. (c)	14. (a)	15. (a)	16. (c)	17. (b)	18. (a)	19. (a)	20. (b)
21. (c)	22. (b)	23. (b)	24. (a)	25. (c)	26. (c)	27. (b)	28. (d)	29. (a)	30. (a)
31. (d)	32. (a)	33. (a)	34. (b)	35. (b)	36. (a,b, d)	37. (a, b)	38. (a, b)	39. (a, c)	40. (b, d)

Chemistry

41. (b)	42. (a)	43. (d)	44. (b)	45. (a)	46. (c)	47. (b)	48. (a)	49. (b)	50. (a)
51. (b)	52. (a)	53. (b)	54. (a)	55. (d)	56. (c)	57. (a)	58. (b)	59. (c)	60. (c)
61. (d)	62. (d)	63. (a)	64. (a)	65. (a)	66. (a)	67. (a)	68. (d)	69. (b)	70. (a)
71. (d)	72. (b)	73. (d)	74. (d)	75. (a)	76. (d)	77. (b, c)	78. (b, c)	79. (a, d)	80. (a, b)

Mathematics

1. (b)	2. (a)	3. (b)	4. (a)	5. (c)	6. (c)	7. (b)	8. (a)	9. (b)	10. (c)
11. (a)	12. (a)	13. (a)	14. (a)	15. (a)	16. (c)	17. (d)	18. (c)	19. (a)	20. (a)
21. (a)	22. (b)	23. (a)	24. (a)	25. (c)	26. (c)	27. (a)	28. (a)	29. (b)	30. (c)
31. (a)	32. (a)	33. (d)	34. (a)	35. (a)	36. (b)	37. (b)	38. (a)	39. (d)	40. (a)
41. (c)	42. (b)	43. (b)	44. (b)	45. (c)	46. (a)	47. (c)	48. (a)	49. (c)	50. (b)
51. (a)	52. (b)	53. (c)	54. (c)	55. (c)	56. (a)	57. (d)	58. (a)	59. (c)	60. (a)
61. (a)	62. (c)	63. (c)	64. (b)	65. (d)	66. (a,b,c,d)	67. (a, c)	68. (a, b, d)	69. (a, d)	70. (a, d)
71. (a, b, c)	72. (a, b, c, d)	73. (a, b)	74. (c, d)	75. (a, c)					

* For detailed solutions visit http://tinyurl.com/y45jxqcn or scan