# UPSEE - 2003

Physics

1. An electron and a proton have equal kinetic energies. They enter in a magnetic field perpendicular to B, then :
   (a) both will follow a circular path with same radius
   (b) both will follow a helical path
   (c) both will follow a parabolic path
   (d) all the statements are false

   Direction (Ques. 3-4) : *A planet is revolving around the sun. Answer the questions 2 and 3 keeping in mind Kepler's laws :*

2. The orbital velocity of the planet will be minimum at :
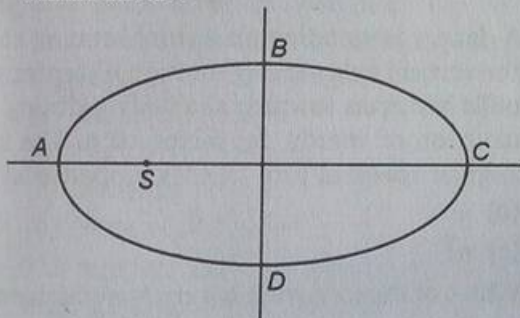
   (a) A
   (b) B
   (c) C
   (d) D

3. The correct option is :
   (a) the time taken in travelling DAB is less than that for BCD
   (b) the time taken in travelling DAB is greater than that for BCD
   (c) the time taken in travelling CDA is less than that for ABC
   (d) the time taken in travelling CDA is greater than that for ABC

4. The density of uranium is of the order of :
   (a) 10^{20} kg/m^3
   (b) 10^{17} kg/m^3
   (c) 10^{14} kg/m^3
   (d) 10^{11} kg/m^3

   Direction (Ques. 5-6) : *P-V curve is shown for a Carnot engine. Answer the questions 5 and 6 from the graph.*
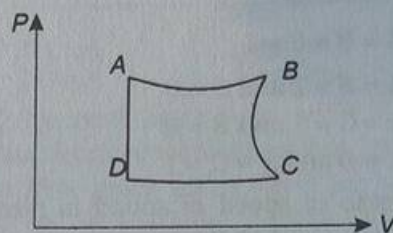
5. If the temperatures at B and C are T_1 and T_2 respectively, then it can be concluded :
   (a) $T_1 = T_2$
   (b) $T_1 > T_2$
   (c) $T_1 < T_2$
   (d) nothing can be said about T_1 / T_2

6. The parts of the graph showing the adiabatic process are :
   (a) AB and BC
   (b) AB and CD
   (c) AD and BC
   (d) BC and CD

7. The ratio of the wavelengths for $2 \rightarrow 1$ transition in Li^{2+}, He$^+$ and H is :
   (a) $1 : 2 : 3$
   (b) $\frac{1}{9} : \frac{1}{4} : \frac{1}{1}$
   (c) $1 : 4 : 1$
   (d) $3 : 2 : 1$

8. In a photoelectric effect experiment, the slope of the graph between the stopping potential and the incident frequency will be :
   (a) 1
   (b) 0.5
   (c) 10^{-15}
   (d) 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 :
   (a) 6.65 yr
   (b) 5 yr
   (c) 3.2 yr
   (d) 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 :
    (a) $6^{3/2} T$ yr
    (b) $5^{3/2} T$ yr
    (c) $5^{3/1} T$ yr
    (d) $5^{1/2} T$ yr

11. The correct option for getting $X = 1$ from the given circuit is :
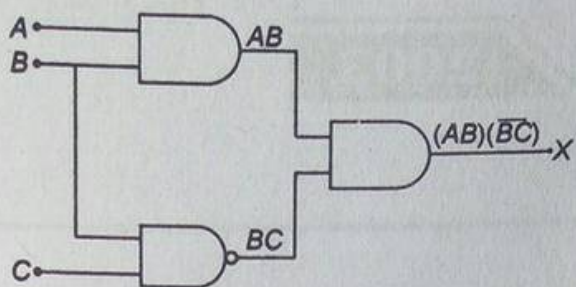
(a) $A = B = C = 1$

(b) $A = B = 1$ and $C = 0$

(c) $A = C = 1$ and $B = 0$

(d) $A = 0$ and $B = C = 1$

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

(a) $\sqrt{\dfrac{2}{7}}$

(b) $\dfrac{\sqrt{1}}{7}$

(c) $\dfrac{\sqrt{3}}{5}$

(d) $\dfrac{\sqrt{6}}{5}$

13. The current gain β for a transistor is 49 and the emitter current is 1 mA. The base current in μA is :

(a) 20

(b) 40

(c) 10

(d) 5

14. The dimensions of electric potential are :

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

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

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

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

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

(a) $\sqrt{E}$

(b) $1/\sqrt{E}$

(c) $1/E$

(d) 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 :

(a) $4\,RT$

(b) $15\,RT$

(c) $9\,RT$

(d) $11\,RT$

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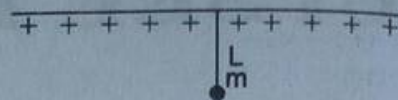
(a) $\left(\dfrac{g + \dfrac{qE}{m}}{g}\right)^{1/2}$

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

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

(d) 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 :

(a) $\dfrac{Q_1 + Q_2}{2C}$

(b) $\dfrac{Q_1 + Q_2}{C}$

(c) $\dfrac{Q_1 - Q_2}{C}$

(d) $\dfrac{Q_1 - Q_2}{2C}$

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 :

(a) n

(b) n^{-1}

(c) n^0

(d) n^2

20. Which of the following is a correct statement ?

(a) β-rays are same as cathode rays

(b) Gamma rays are high energy electrons

(c) Alpha particles are singly ionised helium atoms

(d) 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 :

(a) X and Y have the same decay rate initially

(b) X and Y have the same decay rate always

(c) Y will decay at a faster rate than X

(d) 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 ?

(a) 500 ms

(b) 20 ms

(c) 35 ms

(d) 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 :
    (a) directly proportional to R
    (b) directly proportional to I
    (c) inversely proportional to I
    (d) zero

24. A disc like reel with massless thread unrolls itself while falling vertically downwards the acceleration of its fall is :
    (a) g
    (b) $g/2$
    (c) zero
    (d) $\left(\dfrac{2}{3}\right)g$

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 :
    (a) 2×10^8 m/s
    (b) 2×10^7 m/s
    (c) 2×10^6 m/s
    (d) 2×10^5 m/s

26. The work done in which of the following processes is equal to the internal energy of the system ?
    (a) Adiabatic process
    (b) Isothermal process
    (c) Isochoric process
    (d) 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 :
    (a) 2 times
    (b) 4 times
    (c) 8 times
    (d) 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 :
    (a) $\lambda = 1/6$ m, $v = 250$ m/s
    (b) $a = 0.07$ m, $v = 300$ m/s
    (c) $n = 1500$, $v = 200$ m/s
    (d) none of the above

29. The energy liberated on complete fission of 1kg of $_{92}U^{235}$ is (Assume 200 MeV energy is liberated on fission of 1 nucleus) :
    (a) 8.2×10^{10} J
    (b) 8.2×10^9 J
    (c) 8.2×10^{13} J
    (d) 8.2×10^{16} J

30. In the circuit, if the forward voltage drop for the diode is 0.5 V, the current will be :
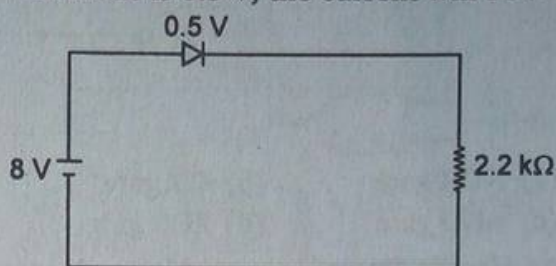
    (a) 3.4 mA
    (b) 2 mA
    (c) 2.5 mA
    (d) 3 mA

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 ?
    (a) 4 m
    (b) 6 m
    (c) 8 m
    (d) 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 :
    (a) uniform everywhere
    (b) less in the front
    (c) less at the back
    (d) less at the top

33. A particle free to move along the x-axis has potential energy given as
    $$U(x) = k\,[1 - \exp(-x^2)] \text{ for } -\infty \le +\infty,$$
   where k is a positive constant of appropriate dimensions. Then :
    (a) at points away from origin, the particle is in equilibrium
    (b) for any finite non-zero value of x, there is a force directed away from the origin
    (c) Its total mechanical energy is $k/2$ and it is equal to its kinetic energy at origin
    (d) 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 :
    (a) straight line
    (b) circle
    (c) ellipse
    (d) 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 $2v$?

36. The gate shown in figure is :
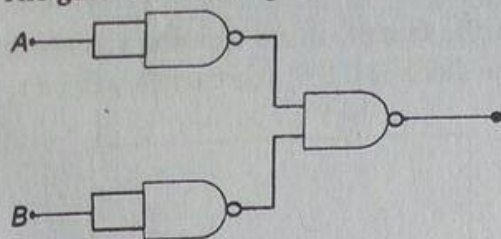
(a) NOR gate   (b) OR gate
(c) AND gate   (d) XOR gate

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 :

(a) $\left(\dfrac{pE}{I}\right)^{1/2}$ (b) $\left(\dfrac{pE}{I}\right)^{3/2}$

(c) $\left(\dfrac{I}{pE}\right)^{1/2}$ (d) $\left(\dfrac{P}{IE}\right)^{1/2}$

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 :

(a) $R_0 > R_u > R_d$ (b) $R_u > R_0 > R_d$
(c) $R_d > R_0 > R_u$ (d) $R_v > R_d > R_0$

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 :
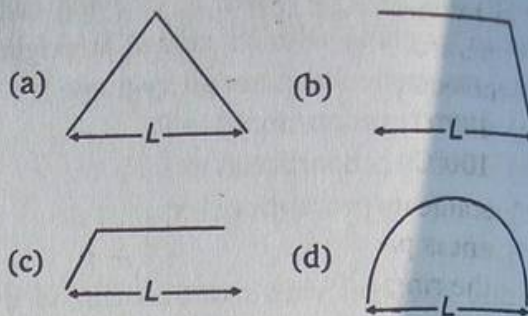
(a) 0°   (b) 90°
(c) 57°   (d) 33°

40. At critical point :

(a) latent heat becomes infinite
(b) liquid state is not possible
(c) gaseous state is not possible
(d) none of the above

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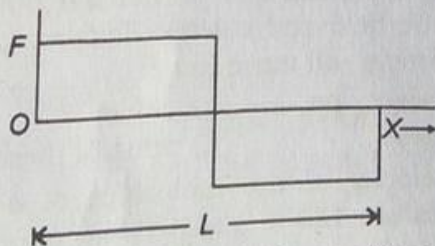
Identify the correct surface profile :

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

(a) 540 nm   (b) 400 nm
(c) 310 nm   (d) 220 nm

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

(a) 457°C   (b) 273°C
(c) 350°C   (d) 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 :

(a) is attracted by the loop A
(b) is repelled by the loop A
(c) remains stationary
(d) 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 travelling 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 $\dfrac{m}{M}$ is :

(a) $\dfrac{\omega^2 L^2}{9v_0^2}$ (b) $\dfrac{9v_0^2}{\omega^2 L^2}$

(c) $\dfrac{9v_0}{\omega L}$ (d) $\dfrac{\omega L}{9v_0}$

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

(a) Isothermal process
(b) Adiabatic process
(c) Isochoric process
(d) 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 :

(a) $\mu_0 i^2/b^2$ (b) $\mu_0 i^2/2\pi b$
(c) $\mu_0 i/2\pi b$ (d) $\mu_0 i/2\pi b^2$

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 ?
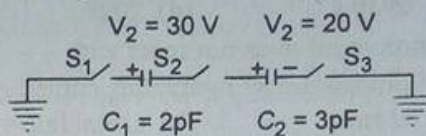   (a) 137°C
    (b) 127°C
    (c) 100°C
    (d) 105°C

49. A metallic loop is placed in a magnetic field. If a current is passed through it, then :
    (a) the ring will feel a force of attraction
    (b) the ring will feel a force of repulsion
    (c) will move to and fro about its centre of gravity

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

$$V_2 = 30\,V \qquad V_2 = 20\,V$$

$S_1 \quad S_2 \quad S_3$

$$C_1 = 2pF \qquad C_2 = 3pF$$

    (a) With S_1 closed, $V_1 = 15\,V, V_2 = 20\,V$
    (b) With S_3 closed, $V_1 = V_2 = 25\,V$
    (c) With S_1 and S_2 closed $V_1 = V_2 = 0$
    (d) With S_1 and S_3 closed, $V_1 = 30\,V, V_2 = 20\,V$

(d) none of the above

Chemistry

1. The hybridization of carbon atom in benzene is :
   (a) sp
   (b) sp^2
   (c) sp^3
   (d) dsp^2

2. Compound which gives acetone on ozonolysis :
   (a) $CH_3—CH = CH—CH_3$
   (b) $(CH_3)_2C = C(CH_3)_2$
   (c) $C_6H_5CH = CH_2$
   (d) $CH_3CH = CH_2$

3. p-chloro aniline and anilinium hydrogen chloride can be distinguished by :
   (a) Sandmeyer reaction
   (b) Carbyl amine reaction
   (c) Hinsberg's reaction
   (d) $AgNO_3$

4. In alumino thermic process, aluminium acts as :
   (a) oxidant
   (b) flux
   (c) a reducing agent
   (d) a solder

5. Mn^{2+} can be converted into Mn^{7+} by reacting with :
   (a) SO_2
   (b) Cl_2
   (c) PbO_2
   (d) $SnCl_2$

6. A compound is treated with iodine and an alkali. It gives a yellow ppt. The compound is ?
   (a) propionaldehyde
   (b) benzophenone
   (c) methyl acetate
   (d) acetophenone

7. Phenol is less acidic than :
   (a) acetic acid
   (b) p-methoxy phenol
   (c) acetylene
   (d) ethanol

8. Which reaction is not affected by change in pressure ?
   (a) $H_2 + I_2 \rightleftharpoons 2HI$
   (b) $2C + O_2 \rightleftharpoons 2CO$
   (c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$
   (d) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

9. Which of the following does not show Cannizaro reaction ?
   (a) CH_3CHO
   (b) $HCHO$
   (c) C_6H_5CHO
   (d) $(CH_3)_3C \cdot CHO$

10. Oxidation state exhibited by sulphur :
    (a) $+6$
    (b) $+4$
    (c) 0
    (d) all of these

11. Electronic configuration of chromium is given by :
    (a) $[Ar]\,3d^4, 4s^2$
    (b) $[Ar]\,3d^5, 4s^1$
    (c) $[Ar]\,3d^3, 4s^2$
    (d) none of these

12. Benzene can react with :
    (a) bromine water
    (b) HNO_3
    (c) H_2O
    (d) CH_3OH

13. Hydrogen bonding is maximum in :
    (a) C_2H_5OH
    (b) CH_3OCH_3
    (c) $(CH_3)_2C = O$
    (d) CH_3CHO

14. Which of the following is non-metallic ?
    (a) B
    (b) Be
    (c) Mg
    (d) Al

15. The compound not soluble in acetic acid is :
    (a) $CaCO_3$
    (b) CaO
    (c) CaC_2O_4
    (d) $Ca(OH)_2$

16. Rate constant for a reaction is 10^{-3} s^{-1}. Time to leave 25% reaction is :
    (a) 693 s
    (b) 1386 s
    (c) 6930 s
    (d) 2029 s

17. A compound does not react with 2, 4 dinitrophenyl hydrazine, compound is :
    (a) acetone
    (b) acetaldehye
    (c) CH_3OH
    (d) $CH_3CH_2COCH_3$

18. A *meta* directing functional group is :
    (a) —COOH
    (b) —OH
    (c) —CH_3
    (d) —Br

19. Which of the following is paramagnetic ?
    (a) $O_2{}^+$
    (b) CN^-
    (c) CO
    (d) N_2

20. 1, 2-dibromo cyclohexane on dehydrogenation gives :

    (a)
    (b)

    (c)
    (d) none of these

21. Correct increasing order of first ionization potential is :
    (a) Na < Mg > Al < Si
    (b) Na < Mg < Al < Si
    (c) Na > Mg > Al > Si
    (d) Na < Mg < Al > Si

22. If enthalpies of methane and ethane are respectively 320 and 560 cal, then the bond energy of C—C bond is :
    (a) 60 cal
    (b) 80 cal
    (c) 40 cal
    (d) 120 cal

23. A hydrocarbon contains 10.5 g carbon and 1g hydrogen. Its 0.36 g has 1 L volume at 1 atm and 127°C, hydrocarbon is :
    (a) C_6H_7
    (b) C_7H_8
    (c) C_5H_6
    (d) none of these

24. How many bonding electron pairs are there in white phosphorus ?
    (a) 6
    (b) 12
    (c) 4
    (d) 8

25. Addition of HBr to propylene in presence of benzoyl peroxide, follows :
    (a) Markownikoff's rule
    (b) Baeyer's rule
    (c) carbanion mechanism
    (d) anti-Markownikoff's rule

26. 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 :
    (a) 0.25
    (b) 0.75
    (c) 0.50
    (d) 0.33

27. Heavy water is :
    (a) water containing Fe, Cr, Mn
    (b) water at 0°C
    (c) D_2O
    (d) water obtained after distillation

28. Volume of water needed to mix with 10 mL 10 N HNO_3 to get 0.1 N HNO_3 is :
    (a) 1000 mL
    (b) 990 mL
    (c) 1010 mL
    (d) 10 mL

29. Which will show maximum depression in freezing point when concentration is 0.1 M ?
    (a) NaCl
    (b) Urea
    (c) Glucose
    (d) K_2SO_4

30. Which gives lactic acid on hydrolysis after reacting with HCN ?
    (a) HCHO
    (b) CH_3CHO
    (c) C_6H_5CHO
    (d) CH_3COCH_3

31. $CHCl_3$ and KOH on heating with a compound form a bad smelling product, compound is :
    (a) C_2H_5CN
    (b) C_2H_5NC
    (c) C_2H_5OH
    (d) $C_2H_5NH_2$

32. On exciting Cl_2 molecules by UV light, we get :
    (a) Cl
    (b) Cl^+
    (c) Cl^-
    (d) all of these

33. Correct statement about 1, 3-dibutene :
    (a) conjugated double bonds are present
    (b) reacts with HBr
    (c) forms polymer
    (d) all of the above

34. Isomerism due to rotation round single bond of carbon-carbon is :
    (a) Enantiomerism
    (b) Position isomerism
    (c) Conformation
    (d) Diastereo isomerism

35. Which pair does not show hydrogen isotopes ?
    (a) *Ortho* and *para* hydrogen
    (b) Protium and deuterium
    (c) Deuterium and tritium
    (d) Tritium and protium

36. Which pair cannot exist together in solution ?
    (a) $NaHCO_3$ and NaOH
    (b) $NaHCO_3$ and NaCl
    (c) $NaHCO_3$ and Na_2CO_3
    (d) NaCl and Na_2CO_3

(d) NaCl and Na_2CO_3

37. When an electron is removed from an atom, its energy :
    (a) increases
    (b) decreases
    (c) remains the same
    (d) none of the above

38. 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 :
    (a) zero
    (b) 1
    (c) 2
    (d) 3

39. Strongest base is :
    (a) $C_6H_5NH_2$
    (b) $p\text{-}NO_2\text{—}C_6H_4NH_2$
    (c) $m\text{-}NO_2\text{—}C_6H_4NH_2$
    (d) $C_6H_5CH_2NH_2$

40. The value of one amu is :
    (a) $1.66 \times 10^{-24} g$
    (b) $6.023 \times 10^{23} g$
    (c) $1.4 \times 10^{-21} g$
    (d) $4.8 \times 10^{-24} g$

41. Which of the following has minimum melting point ?
    (a) CsF
    (b) HCl
    (c) HF
    (d) LiF

42. Which of the following is related with both wave nature and particle nature ?
    (a) Interference
    (b) $E = mc^2$
    (c) Diffraction
    (d) $E = hv$

43. Nirogen is obtained when $NaNO_2$ react with :
    (a) NH_4Cl
    (b) NH_4NO_3
    (c) $(NH_4)_2CO_3$
    (d) NH_4OH

44. Hydrogen bond energy is equal to :
    (a) 3-7 cal
    (b) 30-70 cal
    (c) 3-10 kcal
    (d) 30-70 kcal

45. Strongest hydrogen bond is present in :
    (a) F—H......O
    (b) S—H......O
    (c) O—H......S
    (d) F—H......F

46. Which of the following has dipole moment ?
    (a) CO_2
    (b) p-dichlorobenzene
    (c) NH_3
    (d) CH_4

47. Which of the following pK_a values, represent the strongest acid ?
    (a) 10^{-4}
    (b) 10^{-8}
    (c) 10^{-5}
    (d) 10^{-2}

48. Which group of the periodic table contains coinage metal ?
    (a) IIA
    (b) IB
    (c) IA
    (d) None of these

49. Which of the following has maximum bond energy ?
    (a) Cl_2
    (b) F_2
    (c) Br_2
    (d) I_2

50. For a process to be spontaneous, the most favourable condition is :
    (a) $\Delta H > 0, \Delta S > 0$
    (b) $\Delta H < 0, \Delta S > 0$
    (c) $\Delta H < 0, \Delta S < 0$
    (d) $\Delta H > 0, \Delta S < 0$

Mathematics

1. $x^2 + \dfrac{1}{1 + x^2}$ attains minimum value at :
    (a) $x = 0$
    (b) $x = 4$
    (c) $x = 1$
    (d) $x = 3$

2. If $\vec{a}, \vec{b}, \vec{c}$ are the non-coplanar vectors, then the value of $\dfrac{\vec{a} \cdot (\vec{b} \times \vec{c})}{(\vec{c} \times \vec{a}) \cdot \vec{b}} + \dfrac{\vec{b} \cdot (\vec{a} \times \vec{c})}{\vec{c} \cdot (\vec{a} \times \vec{b})}$ is :
    (a) 1
    (b) 2
    (c) 0
    (d) none of these

3. If $x - 2y = 4$, the minimum value of xy is :
    (a) –2
    (b) 0
    (c) 0
    (d) –3

4. If $z = x + iy$ and $\left|\dfrac{1 - iz}{z - i}\right| = 1$, the locus of z is :
    (a) x-axis
    (b) y-axis
    (c) circle with unity radius
    (d) none of the above

5. 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 :
    (a) $\dfrac{2}{\sqrt{15}}$
    (b) $\dfrac{4}{3\sqrt{3}}$
    (c) $\dfrac{1}{\sqrt{5}}$
    (d) $\dfrac{4}{\sqrt{15}}$

6. 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 :

(a) 90°   (b) 60°

(c) 45°   (d) 30°

7. 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 :

(a) 2 cm/s   (b) 8 cm/s

(c) 6 cm/s   (d) none of these

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

(a) 4, 2   (b) 0, 4

(c) −1, 3   (d) 5, 1

9. 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 $(g = 981 \text{ cm/s}^2)$:

(a) $\sqrt{8}$ s   (b) 2 s

(c) 4 s   (d) 8 s

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

(a) $y = \dfrac{6}{\sqrt{13}}$ (b) $x = \dfrac{6}{\sqrt{13}}$

(c) $y = \dfrac{9}{\sqrt{13}}$ (d) $x = \dfrac{9}{\sqrt{13}}$

11. The value of

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

(a) $\dfrac{10\pi}{3}$ (b) 0

(c) $\dfrac{\pi}{2}$ (d) $\dfrac{5\pi}{3}$

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

(a) $2f(x^2)$ (b) $f(x^2)$

(c) $2f(2x)$ (d) $2f(x)$

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

(a) 31   (b) 32

(c) 64   (d) 1024

14. $2x^3 - 6x + 5$ is an increasing function, if :

(a) $0 < x < 1$ (b) $-1 < x < 1$

(c) $x < -1$ or $x > 1$ (d) $-1 < x < -\dfrac{1}{2}$

15. 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 :

(a) 150 s   (b) 100 s

(c) 50 s   (d) $\dfrac{25}{3}$ s

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

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

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

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

(a) $\dfrac{1}{4}$ (b) $\dfrac{1}{2}$

(c) $\dfrac{1}{8}$ (d) none of these

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

(a) 6   (b) 16

(c) 10   (d) none of these

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

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

(c) 0   (d) $2[\vec{a}\ \vec{b}\ \vec{c}]$

20. 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 $\dfrac{1}{p^2} + \dfrac{1}{w^2}$ is :

(a) $w \sin \alpha$ (b) 1

(c) $\dfrac{1}{Q}$ (d) $\dfrac{1}{Q^2}$

21. $\displaystyle\int_0^2 |x - 1| \, dx$ is equal to :

(a) 0   (b) $\dfrac{1}{2}$

(c) 1   (d) 2

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

(a) $\dfrac{13}{51}$ (b) $\dfrac{1}{52 \times 51}$

(c) $\dfrac{26}{51}$ (d) none of these

Q same, the resultant remains unaltered. The angle between P and Q is :
(a) 90°
(b) 60°
(c) 45°
(d) 30°

7. 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 :
(a) 2 cm/s
(b) 8 cm/s
(c) 6 cm/s
(d) none of these

8. The roots of $|x-2|^2 + |x-2| - 6 = 0$ are :
(a) 4, 2
(b) 0, 4
(c) −1, 3
(d) 5, 1

9. 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 $(g = 981 \text{ cm/s}^2)$:
(a) $\sqrt{8}$ s
(b) 2 s
(c) 4 s
(d) 8 s

10. The directrix of the hyperbola $\dfrac{x^2}{9} - \dfrac{y^2}{4} = 1$ is :
(a) $y = \dfrac{6}{\sqrt{13}}$
(b) $x = \dfrac{6}{\sqrt{13}}$
(c) $y = \dfrac{9}{\sqrt{13}}$
(d) $x = \dfrac{9}{\sqrt{13}}$

11. The value of
$$\cos^{-1}\left(\cos\frac{5\pi}{3}\right) + \sin^{-1}\left(\cos\frac{5\pi}{3}\right) \text{ is :}$$
(a) $\dfrac{10\pi}{3}$
(b) 0
(c) $\dfrac{\pi}{2}$
(d) $\dfrac{5\pi}{3}$

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

13. If $(1 + x - 2x^2)^6 = 1 + a_1x + a_2x^2 + \ldots + a_{12}x^{12}$ then the value of $a_2 + a_4 + \ldots + a_{12}$, is :
(a) 31
(b) 32
(c) 64
(d) 1024

14. $2x^3 - 6x + 5$ is an increasing function, if :
(a) $0 < x < 1$
(b) $-1 < x < 1$
(c) $x < -1$ or $x > 1$
(d) $-1 < x < -\dfrac{1}{2}$

15. 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 :
(a) 150 s
(b) 100 s
(c) 50 s
(d) $\dfrac{25}{3}$ s

16. $\dfrac{d^3y}{dx^3} + 2\left[1 + \dfrac{d^2y}{dx^2}\right] = 1$, has degree and order as :
(a) 3, 1
(b) 3, 2
(c) 1, 3
(d) 2, 3

17. The value of $I = \int_0^1 x\left|x - \dfrac{1}{2}\right| dx$ is :
(a) $\dfrac{1}{4}$
(b) $\dfrac{1}{2}$
(c) $\dfrac{1}{8}$
(d) none of these

18. If $A = \begin{bmatrix} 4 & 2 \\ 3 & 4 \end{bmatrix}$, $|\text{adj } A|$ is equal to :
(a) 6
(b) 16
(c) 10
(d) none of these

19. $\vec{a} \cdot (\vec{b} + \vec{c}) \times (\vec{a} + \vec{b} + \vec{c})$ is equal to :
(a) $[\vec{a}\,\vec{b}\,\vec{c}]$
(b) $3[\vec{a}\,\vec{b}\,\vec{c}]$
(c) 0
(d) $2[\vec{a}\,\vec{b}\,\vec{c}]$

20. 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 $\dfrac{1}{p^2} + \dfrac{1}{w^2}$ is :
(a) $w \sin \alpha$
(b) 1
(c) $\dfrac{1}{Q}$
(d) $\dfrac{1}{Q^2}$

21. $\int_0^2 |x-1|\, dx$ is equal to :
(a) 0
(b) $\dfrac{1}{2}$
(c) 1
(d) 2

22. From a pack of cards two are accidently dropped. Probability that they are of opposite shade is :
(a) $\dfrac{13}{51}$
(b) $\dfrac{1}{52 \times 51}$
(c) $\dfrac{26}{51}$
(d) none of these

23. If $A(5$
infl
$\vec{P_2}$
the
(a)
(c)

24. If si
(a)
(c)

25. In a
BC
$\sin$
$\sin$
(a)
(c)

26. If $|\vec{a}$
and
(a)
(c)

27. Let
$\tan$
equa
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(c)

28. The
(a)
(c)

29. If $f($
$f(x)$
(a) e
(c)

30. The v
area

23. 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 :

(a) 87
(b) 85
(c) 81
(d) none of these

24. If $\sin x + \cos x = \dfrac{1}{5}$, then $\tan 2x$ is :

(a) $\dfrac{25}{17}$
(b) $\dfrac{24}{7}$
(c) $\dfrac{7}{25}$
(d) $\dfrac{25}{7}$

25. In a $\triangle ABC$, $\angle B = \dfrac{\pi}{3}$ and $\angle C = \dfrac{\pi}{4}$. If D divides BC internally in ratio $1:3$, then the value of $\dfrac{\sin \angle BAD}{\sin \angle CAD}$ is :

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

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

(a) π
(b) $\dfrac{2\pi}{3}$
(c) $\dfrac{\pi}{4}$
(d) $\dfrac{\pi}{2}$

27. 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 :

(a) $\dfrac{1}{3}$
(b) $\dfrac{2}{3}$
(c) $\dfrac{2}{9}$
(d) $\dfrac{7}{9}$

28. The value of $\displaystyle\lim_{x \to 1} (1 - x) \tan\left(\dfrac{\pi}{2} x\right)$:

(a) $\dfrac{3\pi}{4}$
(b) $\dfrac{2\pi}{3}$
(c) $\dfrac{2}{\pi}$
(d) $\dfrac{\pi}{4}$

29. If $f(x) = \left(\dfrac{1}{x}\right)^x$, then the maximum value of $f(x)$ is :

(a) e
(b) $(e)^{1/e}$
(c) $\left(\dfrac{1}{e}\right)^e$
(d) none of these

30. The volume of the solid formed by rotating the area enclosed between the curve $y = x^2$ and the line $y = 1$ about $y = 1$ is (in cubic unit) :

(a) $\dfrac{9\pi}{5}$
(b) $\dfrac{4\pi}{3}$
(c) $\dfrac{8\pi}{3}$
(d) $\dfrac{7\pi}{5}$

31. $\displaystyle\int_8^{15} \dfrac{dx}{(x - 3)\sqrt{x + 1}}$ is equal to :

(a) $\dfrac{1}{2} \log \dfrac{5}{3}$
(b) $\dfrac{1}{3} \log \dfrac{5}{3}$
(c) $\dfrac{1}{5} \log \dfrac{3}{5}$
(d) $\dfrac{1}{2} \log \dfrac{3}{5}$

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

(a) 0
(b) 1
(c) 2
(d) 4

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

(a) 45
(b) -15
(c) 10
(d) 6

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

(a) even function
(b) odd function
(c) neither even nor odd
(d) periodic function

35. 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 :

(a) an ellipse with $e = \sqrt{2}$
(b) hyperbola with $e = \sqrt{2}$
(c) parabola with $e = \dfrac{1}{\sqrt{2}}$
(d) none of the above

36. 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 :

(a) 0
(b) -1
(c) $-\dfrac{3}{2}$
(d) 3

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

(a) 0
(b) 1
(c) 3
(d) none of these

38. The value of the determinant
$$\begin{vmatrix} 1 & \cos(\alpha - \beta) & \cos\alpha \\ \cos(\alpha - \beta) & 1 & \cos\beta \\ \cos\alpha & \cos\beta & 1 \end{vmatrix}$$ is :

(a) 0
(b) 1
(c) $\alpha^2 - \beta^2$
(d) $\alpha^2 + \beta^2$

39. If $P(A) = P(B) = x$ and $P(A \cap B) = P(A' \cap B') = \dfrac{1}{3}$, then x is equal to :

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

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

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

(a) $p = 1$ or 0 (b) $p = -2$ or 0

(c) $p = -2$ (d) $p = 1$

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

(a) $\frac{11}{36}$ (b) $\frac{35}{36}$

(c) $\frac{7}{12}$ (d) none of these

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

(a) 9 (b) 12

(c) 17 (d) 18

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

(a) 0 (b) π

(c) $\frac{4}{3}$ (d) $\frac{3}{8}$

44. 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 :

(a) 4 (b) 2

(c) 0 (d) 3

45. If α, β, γ are the roots of the equation $x^3 + 4x + 1 = 0$, then

$(\alpha + \beta)^{-1} + (\beta + \gamma)^{-1} + (\gamma + \alpha)^{-1}$ is equal to :

(a) 2 (b) 3

(c) 4 (d) 5

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

(a) $\theta = 2m\pi \pm \frac{\pi}{4}$

(b) $\theta = m\pi + (-1)^n \frac{2\pi}{3}$

(c) $\theta = m\pi + (-1)^n \frac{\pi}{3}$

(d) $\theta = 2m\pi \pm \frac{\pi}{3}$

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

(a) $\frac{P}{b} = \frac{Q}{a} = \frac{R}{c}$

(b) $\frac{P}{\tan A} = \frac{Q}{\tan B} = \frac{R}{\tan C}$

(c) $P = Q = R$

(d) none of the above

48. 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 :

(a) $50(\sqrt{3} - 1)$ (b) $50(\sqrt{3} + 1)$

(c) 50 (d) 100

49. The value of $\lim_{x \to \infty} \left(\frac{x+3}{x+1}\right)^{x+2}$ is :

(a) 0 (b) 1

(c) e^2 (d) e^4

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

(a) 0 (b) 1

(c) 2 (d) 3

⟁NSWERS

➡ PHYSICS

1. (d)	2. (c)	3. (b)	4. (a)	5. (c)	6. (c)	7. (b)	8. (c)	9. (a)	10. (b)
11. (b)	12. (c)	13. (a)	14. (a)	15. (b)	16. (d)	17. (c)	18. (d)	19. (a)	20. (a)
21. (c)	22. (d)	23. (d)	24. (d)	25. (b)	26. (a)	27. (a)	28. (a)	29. (c)	30. (a)
31. (a)	32. (a)	33. (d)	34. (a)	35. (c)	36. (b)	37. (c)	38. (b)	39. (d)	40. (b)
41. (a)	42. (c)	43. (d)	44. (a)	45. (a)	46. (c)	47. (b)	48. (a)	49. (d)	50. (b)

➡ CHEMISTRY

1. (b)	2. (b)	3. (d)	4. (c)	5. (c)	6. (d)	7. (a)	8. (a)	9. (a)	10. (d)
11. (b)	12. (b)	13. (a)	14. (a)	15. (c)	16. (b)	17. (c)	18. (a)	19. (a)	20. (b)
21. (a)	22. (b)	23. (b)	24. (a)	25. (d)	26. (a)	27. (c)	28. (b)	29. (d)	30. (b)
31. (b)	32. (a)	33. (d)	34. (c)	35. (a)	36. (c)	37. (a)	38. (c)	39. (d)	40. (a)
41. (b)	42. (d)	43. (d)	44. (c)	45. (a)	46. (c)	47. (b)	48. (b)	49. (a)	50. (b)

➡ MATHEMATICS

1. (a)	2. (c)	3. (a)	4. (a)	5. (a)	6. (a)	7. (b)	8. (b)	9. (c)	10. (d)
11. (c)	12. (d)	13. (a)	14. (c)	15. (c)	16. (c)	17. (c)	18. (c)	19. (c)	20. (d)
21. (c)	22. (c)	23. (a)	24. (b)	25. (b)	26. (c)	27. (d)	28. (c)	29. (b)	30. (b)
31. (a)	32. (c)	33. (b)	34. (b)	35. (b)	36. (c)	37. (b)	38. (a)	39. (a)	40. (a)
41. (a)	42. (c)	43. (c)	44. (a)	45. (c)	46. (a)	47. (c)	48. (c)	49. (c)	50. (b)