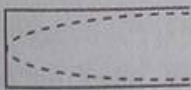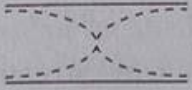# UPSEE - 2013

Physics

1. The resolving power of telescope depends on
   (a) focal length of eye lens
   (b) focal length of objective lens
   (c) length of the telescope
   (d) diameter of the objective lens

2. A ray is incident at an angle of incidence on one surface of a prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of the prism is μ, the angle of incidence i is nearly equal to
   (a) A/μ
   (b) $A/2\mu$
   (c) μ/A
   (d) μA

3. With the propagation of a longitudinal wave through a material medium the quantities transmitted in the propagation direction are
   (a) energy, momentum and mass
   (b) energy
   (c) energy and mass
   (d) energy and linear momentum

4. The vibrating of four air columns are represented in the figure. The ratio of frequencies $n_p : n_q : n_r : n_s$ is
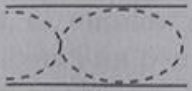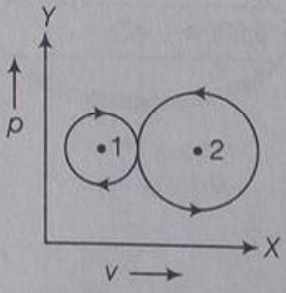

   (a) $12:6:3:5$
   (b) $1:2:4:3$
   (c) $4:2:3:1$
   (d) $6:2:3:4$

5. A source of sound emitting a tone of frequency 200 Hz moves towards an observer with a velocity v equal to the velocity of sound. If the observer also moves away from then source with the same velocity v, the apparent frequency heard by the observer is
   (a) 0 Hz
   (b) 100 Hz
   (c) 150 Hz
   (d) 200 Hz

6. If a gas has 'n' degrees of freedom, the ratio of the specific heats γ of the gas is
   (a) $\dfrac{1+n}{2}$
   (b) $1+\dfrac{n}{2}$
   (c) $1+\dfrac{1}{n}$
   (d) $1+\dfrac{2}{n}$

7. During an experiment, an ideal gas is found to obey an additional law $Vp^2 = $ constant. The gas is initially at temperature T and volume V. What will be the temperature of the gas when it expand to a volume $2V$?
   (a) $\sqrt{3}\,T$
   (b) $T\sqrt{1/2}$
   (c) $T\sqrt{2}$
   (d) $T\sqrt{3}$

8. In the indicator diagram shown in figure the net amount of work done is

   (a) negative
   (b) positive
   (c) zero
   (d) infinity

9. A sphere, a cube and a thin circular plate have the same mass and are made of the same material. All of them are heated to the same temperature. The rate of cooling is

   (a) the maximum for the sphere and minimum for the plate

   (b) the maximum for the sphere and minimum for the cube

   (c) both (a) and (b)

   (d) None of the above

10. When an ideal gas at pressure p, temperature T and volume V is isothermally compressed to V/n, its pressure becomes p_i. If the gas is compressed adiabatically to $\dfrac{V}{n}$, its pressure becomes p_a. The ratio p_i/p_a is $\left(\gamma = \dfrac{C_p}{C_V}\right)$

   (a) 1

   (b) n

   (c) n^γ

   (d) $n^{(1-\gamma)}$

11. A circular turn table of radius 0.5 m has a smooth groove as shown in figure. A ball of mass 90 g is placed inside the groove along with a spring of spring constant 10^2 N/cm. The ball is at a distance of 0.1 m from the centre when the turn table is at rest. On rotating the turn table with a constant angular frequency of 10^2 sec^{-1}, the ball moves away from the centre by a distance nearly equal to


0.1 m
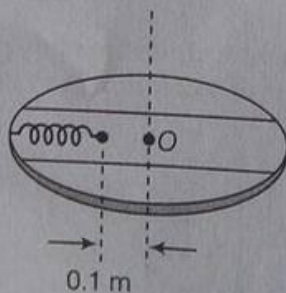
   (a) 10^{-1} m

   (b) 10^{-2} m

   (c) 10^{-3} m

   (d) 2×10^{-1} m

12. A particle is moving in a vertical circle. The tension in the string when passing through two positions at angles 30° and 60° from vertical (lowest position) are T_1 and T_2 respectively

   (a) $T_1 = T_2$

   (b) $T_2 > T_1$

   (c) $T_1 > T_2$

   (d) tension in the string always remain the same

13. In this figure, an ideal liquid flows through the tube having uniform area of cross-section and is held in vertical plane. Find the speed of liquid at A and B and also find the pressure difference between these points
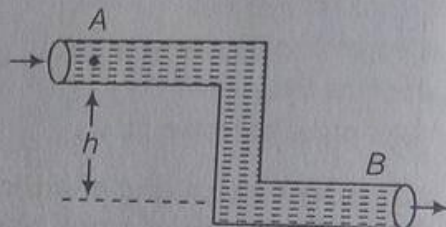
   (a) $2\rho gh$

   (b) ρgh

   (c) $\dfrac{3}{2}\rho gh$

   (d) zero

14. A sphere of radius R and density ρ_1 is dropped in a liquid of density σ. Its terminal velocity is v_1. If another sphere of radius R and density ρ_2 is dropped in the same liquid, its terminal velocity will be

   (a) $\left(\dfrac{\rho_2 - \sigma}{\rho_1 - \sigma}\right)v_1$

   (b) $\left(\dfrac{\rho_1 - \sigma}{\rho_2 - \sigma}\right)v_1$

   (c) $\left(\dfrac{\rho_1}{\rho_2}\right)v_1$

   (d) $\left(\dfrac{\rho_2}{\rho_1}\right)v_1$

15. A force F is required to break a wire of length l and radius r. What force is required to break a wire, of same material having twice the length and six times the radius?

   (a) F

   (b) $3F$

   (c) $9F$

   (d) $36F$

16. In a wire stretched by hanging a weight from its end, the elastic potential energy per unit volume in terms of the longitudinal strain σ and modulus of elasticity Y is

   (a) $Y\sigma^2/2$

   (b) $Y\sigma/2$

   (c) $2Y\sigma^2/2$

   (d) $Y^2\sigma/2$

17. A projectile is fixed from level ground at an angle θ above the horizontal. The elevation angle ϕ of the highest point as seen from the launch point is related to θ by the relation.

(a) $\tan\phi = \dfrac{1}{4}\tan\theta$ (b) $\tan\phi = \tan\theta$

(c) $\tan\phi = \dfrac{1}{2}\tan\theta$ (d) $\tan\phi = 2\tan\theta$

18. A thin semicircular conducting ring of radius R is falling with its plane vertical in a horizontal magnetic field B. At the position MNQ, the speed of the ring is v and the potential difference across the ring is
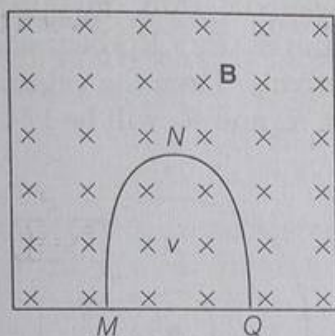
(a) zero

(b) $\dfrac{1}{2}Bv\pi R^2$ and M is at higher potential

(c) πRBv and Q is at higher potential

(d) $2RBv$ and Q is at higher potential

19. A body of mass 2 kg moving with a velocity $(\hat{i} + 2\hat{j} - 3\hat{k})$ m/s collides with another body of mass 3 kg moving with a velocity $(2\hat{i} + \hat{j} + \hat{k})$ m/s. If they stick together, the velocity in m/s of the composite body is

(a) $\dfrac{1}{5}(8\mathbf{i} + 7\mathbf{j} - 3\mathbf{k})$ (b) $\dfrac{1}{5}(-4\hat{i} + \hat{j} - 3\hat{k})$

(c) $\dfrac{1}{5}(5\hat{i} + \hat{j} - \hat{k})$ (d) $\dfrac{1}{5}(-4\hat{i} + 8\hat{j} - 3\hat{k})$

20. A circular disc rolls down an inclined plane. The ratio of the rotational kinetic energy to the total kinetic energy is

(a) $\dfrac{1}{2}$ (b) $\dfrac{1}{3}$

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

21. A stone of mass m is tied to a string and is moved in a vertical circle of radius 'r' making 'n' revolution per minute. The total tension in the string when the stone is at its lowest point is

(a) mg (b) $m(g + \pi nr^2)$

(c) $m(g + \pi nr)$ (d) $m\{g + (\pi^2 n^2 r)/900\}$

22. The angle between two vectors A and B is θ. Vector R is the resultant of the two vectors. If R makes an angle $\dfrac{\theta}{2}$ with A, then

(a) $A = 2B$ (b) $A = \dfrac{B}{2}$

(c) $A = B$ (d) $AB = 1$

23. A point moves with uniform acceleration and v_1, v_2 and v_3 denote the average velocities in the three successive intervals of time t_1, t_2 and t_3. Which of the following relation is correct?

(a) $(v_1 - v_2):(v_2 - v_3) = (t_1 - t_2):(t_2 + t_3)$

(b) $(v_1 - v_2):(v_2 - v_3) = (t_1 + t_2):(t_2 + t_3)$

(c) $(v_1 - v_2):(v_2 - v_3) = (t_1 - t_2):(t_1 - t_3)$

(d) $(v_1 - v_2):(v_2 - v_3) = (t_1 - t_2):(t_2 - t_3)$

24. A particle is dropped from a height H. The de-Broglie wavelength of the particle as a function of height is proportional to

(a) H (b) $H^{1/2}$ (c) H^0 (d) $H^{-1/2}$

25. Which one of the following represents correctly the truth table of the configuration shown in figure?
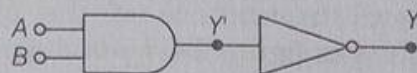
(a)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(b)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	1

(c)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(d)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

26. The radius of Ge nuclide is measured to be twice the radius of $_4\text{Be}^9$. The number of nucleon in Ge are

(a) 72
(b) 73
(c) 74
(d) 75

27. Which of the following has zero average value in a plane electromagnetic wave?

(a) Kinetic energy
(b) Magnetic field
(c) Electric field
(d) Both (b) and (c)

28. Two identical cells of emf E and internal resistance r are connected in parallel with an external resistance R. To get maximum power developed across R, the value of R is
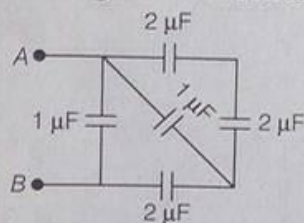
(a) $R = r/2$
(b) $R = r$
(c) $r = r/3$
(d) $R = 2r$

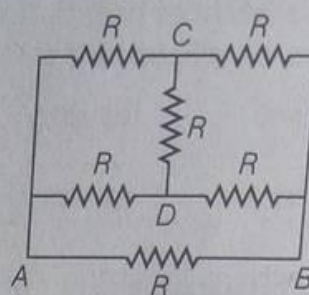**29.** In the circuit of given figure, the final voltage drop across the capacitor C is
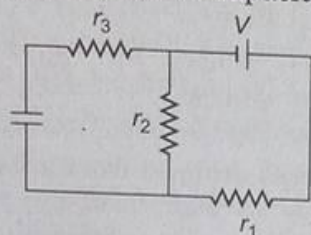
(a) $\dfrac{Vr_1}{r_1 + r_2}$
(b) $\dfrac{Vr_2}{r_1 + r_2}$
(c) $\dfrac{V(r_1 + r_2)}{r_2}$
(d) $\dfrac{V(r_1 + r_2)}{r_1 + r_2 + r_3}$

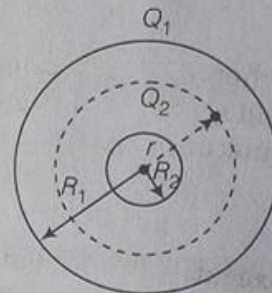**30.** The total capacitance of the system of capacitors in figure. between A and B is

(a) $1\,\mu F$
(b) $2\,\mu F$
(c) $3\,\mu F$
(d) $4\,\mu F$

31. In the circuit shown in figure, the effective resistance between A and B is

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

32. Two concentric, thin, metallic spheres of radii R_1 and $R_2\,(R_1 > R_2)$ bear charges Q_1 and Q_2 respectively. Then the potential at radius r between R_1 and R_2 will be $1/4\pi\,\varepsilon_0$ times

(a) $\dfrac{Q_1 + Q_2}{r}$
(b) $\dfrac{Q_1}{R_1} + \dfrac{Q_2}{r}$
(c) $\dfrac{Q_1}{R_1} + \dfrac{Q_2}{R_2}$
(d) $\dfrac{Q_1}{R_2} + \dfrac{Q_2}{R_1}$

33. A given charge situated at certain distance from an electric dipole in the end on position, experiences a force F. If the distance of charge is doubled, the force acting on the charge will be

(a) $2F$
(b) $F/2$
(c) $F/4$
(d) $F/8$

34. At what angle (θ) with the horizontal should a body be projected so that its horizontal range equals the maximum height it attains?

(a) $\theta = \tan^{-1}(\sqrt{2})$
(b) $\theta = \tan^{-1}(2\sqrt{2})$
(c) $\theta = \tan^{-1}(2\sqrt{3})$
(d) $\theta = \tan^{-1}(4)$

35. Dimensions $[ML^{-1}T^{-1}]$ are related to
    (a) torque
    (b) work
    (c) energy
    (d) coefficient of viscosity

36. The dimension of $\dfrac{a}{b}$ in the equation
    $p = \dfrac{a - t^2}{bx}$, where p is pressure, x is distance
    and t is time is
    (a) $[LT^{-3}]$
    (b) $[ML^3T^{-1}]$
    (c) $[M^2LT^{-3}]$
    (d) $[MT^{-2}]$

37. If the distance between the earth and the sun is half its present value, the number of days in a year would have been
   (a) 730
    (b) 182.5
    (c) 129
    (d) 64.5

38. In a SHM, when the displacement is one half the amplitude, what fraction of the total energy is kinetic?
    (a) Zero
    (b) 1/4
    (c) 1/2
    (d) 3/4

39. A body is executing simple harmonic motion. At a displacement x, its potential energy is E_1 and at a displacement y its potential energy is E_2. The potential energy E at a displacement $(x + y)$ is
    (a) $E_1 + E_2$
    (b) $\sqrt{E_1^2 + E_2^2}$
    (c) $E_1 + E_2 + 2\sqrt{E_1 E_2}$
    (d) $\sqrt{E_1 E_2}$

40. Which one of the following graph between velocity *versus* time for a body falling in viscous fluid is correct
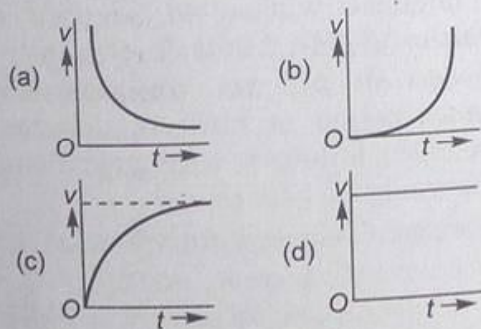
41. A body of mass M is kept on a rough horizontal surface (friction coefficient μ). A person is trying to pull the body by applying a horizontal force but the body is not moving. The force by the horizontal surface on the surface of the body is F, where
    (a) $F = Mg$
    (b) $F = \mu MgF$
    (c) $Mg \le f \le Mg\sqrt{1 + \mu^2}$
    (d) $Mg \ge f \ge Mg\sqrt{1 + \mu^2}$

42. The ratio of acceleration due to gravity at a height h above the surface of the earth and at a depth h below the surface of the earth $h <$ radius of earth
    (a) is constant
    (b) increases linearly with h
    (c) decreases linearly with h
    (d) decreases parabolically with h

43. What is self inductance of a coil when a charge of current from 0 to 2 A in 0.05 second induces an emf of 40 V in it?
    (a) 1 H
    (b) 2 H
    (c) 3 H
    (d) 4 H

44. Permanent magnet has properties retentivity and coercivity respectively
    (a) high – high
    (b) low-low
    (c) low – high
    (d) high-low

45. The flux linked with a circuit is given by $\phi = t^3 + 3t - 7$. The graph between time (x-axis) and induced emf (y-axis) will be
    (a) a straight line through the origin
    (b) straight line with positive intercept
    (c) straight line with negative intercept
    (d) parabola not through origin

46. An inductor of 1 H is connected across a 220 V, 50 Hz supply. The peak value of the current is approximately
   (a) 0.5 A
    (b) 0.7 A
    (c) 1 A
    (d) 1.4 A

47. Power supplied to a particle of mass 2 kg varies with time as $P = \dfrac{t^2}{2}$ watt, where t is in second. If the velocity of particle at $t = 0$ is $v = 0$, the velocity of particle at time $t = 2$ s will be
    (a) 1 m/s
    (b) 4 m/s
    (c) $2\sqrt{2}$ m/s
    (d) $2\sqrt{\dfrac{2}{3}}$ m/s

48. A stick of length L and mass M lies on a frictionless horizontal surface on which it is free to move in any way. A ball of mass m moving with speed v collides elastically with the stick as shown in figure.
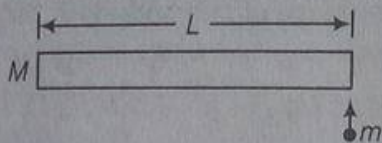
If after the collision the ball comes to rest, then what should be the mass of the ball?

(a) $m = 2M$ (b) $m = M$ (c) $m = M/2$ (d) $m = M/4$

49. The refracting angle of a prism is A and the refractive index is $\cot\left(\dfrac{A}{2}\right)$. The angle minimum deviation is

(a) $180° - A$ (b) $180° - 2A$ (c) $180° - 3A$ (d) $180° - 4A$

50. Two coherent light sources S_1 and S_2 ($\lambda = 6000$ Å) are 1 mm apart from each other. The screen is placed at a distance of 25 cm from the sources. The width of the fringes on the screen should be

(a) 0.015 cm
(b) 0.013 cm
(c) 0.01 cm
(d) 0.10 cm

Chemistry

1. If a LPG cylinder contains mixture of butane and isobutane, then the amount of oxygen that would be required for combustion of 1 kg of it will be

(a) 2.50×10^3 g
(b) 4.50×10^3 g
(c) 1.80×10^3 g
(d) 3.58×10^3 g

2. A radioactive isotope having a half-life of 3 days was received after 12 days. It was found that there were 3 g of the isotope in the container. Find the initial weight of the isotope, when it was packed.

(antilog 1.203 = 16)

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

3. The pairs of compounds which cannot exists together in a solution is

(a) $NaHCO_3$ and $NaOH$
(b) Na_2CO_3 and $NaOH$
(c) Na_2CO_3 and $NaHCO_3$
(d) $NaHCO_3$ and $NaCl$

4. The wave number of hydrogen atom in Lymen series is 82200 cm^{-1}. The electron goes from

(a) $n_3 \to n_2$
(b) $n_2 \to n_1$
(c) $n_4 \to n_3$
(d) None of these

5. At room temperature, the reaction between NO and O_2 to give NO_2 is fast while that of between CO and O_2 is slow. It is because

(a) the intrinsic energy of the reaction $2\,NO + O_2 \rightleftharpoons 2\,NO_2$ is less
(b) CO is smaller in size than that of NO
(c) CO is poisonous
(d) the activation energy for the reaction $2\,NO + O_2 \rightleftharpoons 2NO_2$ is less

6. If 5 L of H_2O_2 produces 50 L of O_2 at NTP, H_2O_2 is

(a) 50 Volume
(b) 10 Volume
(c) 5 Volume
(d) None of the above
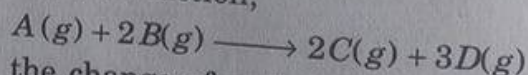
7. For the reaction,
$$A(g) + 2B(g) \longrightarrow 2C(g) + 3D(g)$$
the change of enthalpy at 27°C is 19 kcal. The value of ΔE is

(a) 21.2 kcal
(b) 17.8 kcal
(c) 18.4 kcal
(d) 20.6 kcal

8. A chemist wishes to prepare a buffer solution of pH = 2.90 that efficiently resists a change in pH yet contains only small concentration of buffering agents. Which one of the following weak acid along with its salt would be best to use

(a) m-chlorobenzoic acid ($pK_a = 3.98$)
(b) Acetoacetic acid ($pK_a = 3.58$)
(c) 2.5-dihydrobengoic acid ($pK_a = 2.97$)
(d) p-chlorocimanic acid ($pK_a = 4.41$)

9. The equilibrium constants for the reaction,

$$Br_2 \rightleftharpoons 2 Br \longrightarrow 1$$

at 500 K and 700 K are 1×10^{-10} and 1×10^{-5} respectively. The reaction is

(a) endothermic   (b) exothermic

(c) fast   (d) slow

10. 1 mL of 0.01 N HCl is added to 999 mL solution of 0.1 N Na_2SO_4. The pH of the resulting solution will

(a) 2   (b) 7

(c) 5   (d) 1

11. The molarity of a solution in which 5.3 g Na_2CO_3 is dissolved in 500 mL will be

(a) 1.0M   (b) 0.1 M

(c) 0.20M   (d) 0.2 M

12. An organic compound crystallises in an ortho rhombic system with two molecules per unit cell. The unit cell dimensions are 12.05, 15.05 and 2.69 Å. If the density of the crystal is 1.419 g cm^{-3}, then molar mass of compound will be

(a) 207 g mol^{-1} (b) 209 g mol^{-1}

(c) 308 g mol^{-1} (d) 317 g mol^{-1}

13. Which of the following has maximum bond energy?

(a) $C=C$ (b) $C=O$

(c) $O=O$ (d) $N=O$

14. Among the following compounds both coloured and paramagnetic one is

(a) $K_2Cr_2O_7$ (b) $VOSO_4$

(c) $(NH_4)_2 \cdot [TiCl_2]$ (d) $K_3[Cu(CN)_4]$

15. The correct order of ionization energies is

(a) Cu > Ag > Au   (b) Cu > Au > Ag

(c) Au > Cu > Ag   (d) Ag > Au > Cu

16. The shape of $[PtCl_3(C_2H_4)]^-$ and the hybridisation of Pt respectively are

(a) tetrahedral, sp^3 (b) trigonal pyramidal, sp^3

(c) square planar, $d\,sp^2$ (d) square planar, d^2sp^3

17. Which of the following is most acidic?

(a) H_2O (b) H_2S

(c) H_2Se (d) H_2Te

18. In Kjeldahl's method of estimation of nitrogen, $CuSO_4$ act as

(a) oxidising agent   (b) reducing agent

(c) catalytic agent   (d) hydrolysis agent

19. What is the correct IUPAC name of
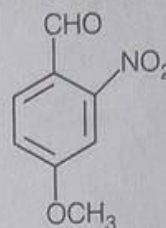
(a) 4-methoxy-2-nitrobenzaldehyde

(b) 4-formyl-3-nitroanisole

(c) 4-methoxy-6-nitrobenzaldehyde

(d) 2-formyl-5-methoxynitrobenzene

20. Zinc is used to protect iron from corrosion because

(a) E_{red} of Zn < E_{red} of iron

(b) $E_{oxidation}$ of Zn < $E_{oxidation}$ of iron

(c) $E_{oxidation}$ of Zn = $E_{oxidation}$ of iron

(d) Zinc is cheaper than iron

21. The structure shows
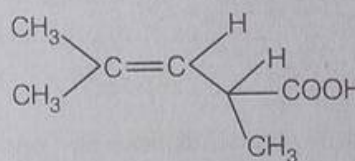
(a) geometrical isomerism

(b) optical isomerism

(c) geometrical and optical isomerism

(d) tautomerism

22. 50 g of saturated aqueous solution of potassium chloride at 30°C is evaporated to dryness, When 13.2 g of dry KCl was obtained. The solubility of KCl in water at 30°C is
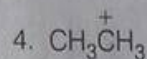
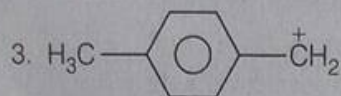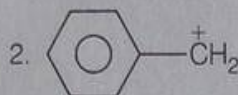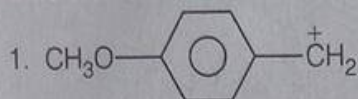(a) 35.87 g   (b) 25.62 g

(c) 28.97 g   (d) 27.81 g

23. Which of the following compound is not aromatic?

(a) 1, 3-cyclobutadiene   (b) Pyridine

(c) Furan   (d) Thiophene

24. Which are of the following is a false statement?
    (a) Cell fluid is an example of sol
    (b) Butter is an example of gel
    (c) Hair cream is an example of emulsion
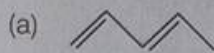   (d) Cheese is an example of foam

25. Out of

    1. $CH_3O-\langle O \rangle-\overset{+}{C}H_2$

    2. $\langle O \rangle-\overset{+}{C}H_2$

    3. $H_3C-\langle O \rangle-\overset{+}{C}H_2$

    4. $CH_3\overset{+}{C}H_3$

    Relative stabilities order is
    (a) $4 < 2 < 3 < 1$
    (b) $2 < 4 < 3 < 1$
    (c) $4 < 2 < 1 < 3$
    (d) $2 < 4 < 1 < 3$

26. In the extraction of copper, metal is formed is the Bessemer converter due to reaction
    (a) $2\,Cu_2S + 2Cu_2O \longrightarrow 6\,Cu + SO_2$
    (b) $2\,Cu_2O \longrightarrow 4\,Cu + O_2$
    (c) $Cu_2S \longrightarrow 2\,Cu + S$
    (d) $Fe + Cu_2O \longrightarrow 2\,Cu + FeO$

27. The cumulated alkadiene is
    (a)
    (b)
    (c)
    (d)

28. One faraday of current was passed through the electrolytic cells placed in series containing solution of Ag^+, Ni^{2+} and Cr^{3+} respectively. The ratio of amounts of Ag, Ni and Cr deposited will be
    (At. wt. of Ag = 108, Ni = 59, Cr = 52)
    (a) $108 : 29.5 : 17.4$
    (b) $17.4 : 29.5 : 108$
    (c) $1 : 2 : 3$
    (d) $108 : 59 : 52$

29. Oxidation number of chlorine atom in Ca(OCl) Cl is
    (a) -1
    (b) $+1, -1$
    (c) 0
    (d) $-1, 0$

30. At equilibrium, if $K_p = 1$, then
    (a) $\Delta G° > 1$
    (b) $\Delta G° < 1$
    (c) $\Delta G° = 0$
    (d) $\Delta G° = 1$

31. Manganese salt $+ PbO_2 +$ conc. $HNO_3 \rightarrow$ the solution acquires purple colour. The colour is due to
    (a) $Mn (NO_3)_2$
    (b) $Pb(NO_3)_2$
    (c) $HMnO_4$
    (d) MnO

32. Which of the following pairs of ions cannot be separated by H_2S in dilute HCl?
    (a) Bi^{3+}, Sn^{4+}
    (b) Al^{3+}, Hg^{2+}
    (c) Cu^{2+}, Zn^{2+}
    (d) Ni^{2+}, Cu^{2+}
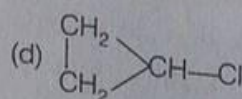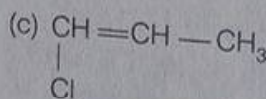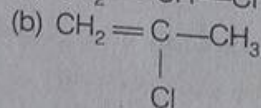
33. A magnetic moment of 1.73 BM will be shown by which one among the following compounds
    (a) $[Cu(NH_3)_4]^{2+}$
    (b) $[Ni(CN)_4]^{2-}$
    (c) $TiCl_4$
    (d) $[CoCl_6]^{4-}$

34. The ratio of the difference in energy between the first and second Bohr orbit to that between the second and third Bohr orbit is
    (a) $\dfrac{1}{2}$
    (b) $\dfrac{1}{27}$
    (c) $\dfrac{4}{9}$
    (d) $\dfrac{27}{5}$

35. An organic compound C_3H_5Cl (A) when treated with magnesium in dry ether gives (B) which on treating with CO_2 followed by acid hydrolysis gives $C_4H_6O_2$ (C). (C) is also obtained on oxidation of a hydrocarbon (D) C_8H_{12}. Structure of A is
    (a) $CH_2 = CH - CH_2 - Cl$
    (b) $CH_2 = \underset{\underset{Cl}{|}}{C} - CH_3$
    (c) $\underset{\underset{Cl}{|}}{CH} = CH - CH_3$
    (d) $\underset{CH_2}{\overset{CH_2}{\big|}} \!\!\!> CH - Cl$
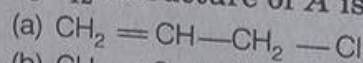
36. Which of the following is bacteriostatic?
    (a) Penicillin
    (b) Erythromycin
    (c) Aminoglycoside
    (d) Ofloxacin

37. Glucose is added to 1 L water to such an extent that $\Delta T_f / K_f$ becomes equal to 10^{-3}, the weight of glucose $(C_6H_{12}O_6)$ added is
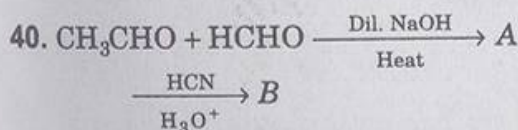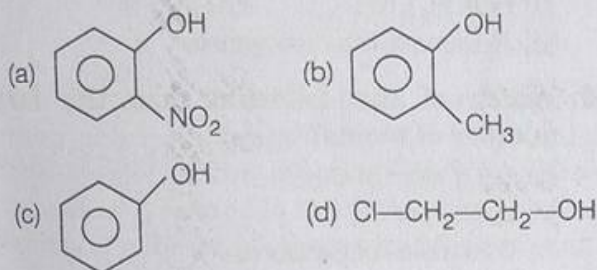   (a) 180 g
   (b) 18 g
   (c) 1.8 g
   (d) 0.18 g

38. Phenol $+ CCl_4 + KOH \longrightarrow X$;

   Which of the following statement is true for X?
   (a) It gives effervescence with $NaHCO_3$
   (b) Gives silver mirror with Tollen's reagent
   (c) Does not give the red colour with $FeCl_3$
   (d) All of the above

39. Which of the following compounds is most acidic?

   (a) (b)

   (c) (d) $Cl-CH_2-CH_2-OH$

40. $CH_3CHO + HCHO \xrightarrow[\text{Heat}]{\text{Dil. NaOH}} A$

   $\xrightarrow[H_3O^+]{HCN} B$

   The structure of the compound B is

   (a) $CH_2{=}CH-\underset{\underset{OH}{|}}{CH}-COOH$

   (b) $CH_2{=}CH-\underset{\underset{CN}{|}}{CH}-OH$

   (c) $CH_3-CH_2-\underset{\underset{CN}{|}}{CH}\cdot OH$

   (d) $CH_3-\underset{\underset{Cl}{|}}{\overset{\overset{CN}{|}}{CH}}-COOH$

41.

   The compound B is

   (a) (b)

   (c) (d)
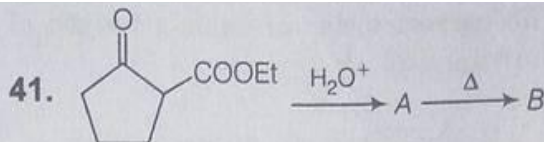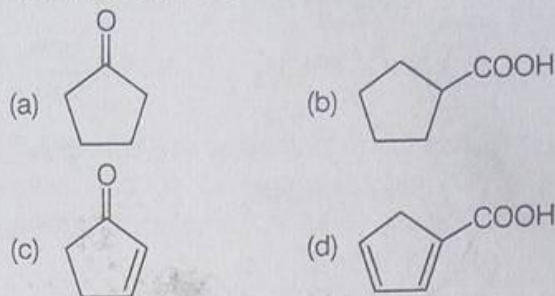
42. The dipole moment of HBr is 1.6×10^{-30} cm and inter atomic spacing is 1 Å. The % ionic character of HBr is
   (a) 7 (b) 10 (c) 25 (d) 27

43. The reactant X in the reaction

   $X \xrightarrow[(CH_3CO)_2O]{CH_3COONa}$ Cinnamic acid is

   (a) (b)

   (c) (d)
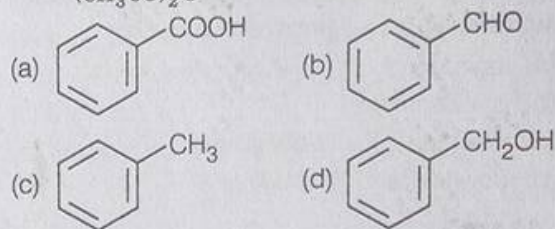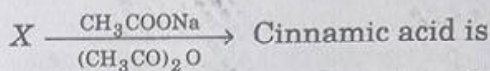
44. Which one of the following have linear structure?
   (I) I_3^- (II) NO_2^- (III) I_3^+ (IV) SO_2
   (V) N_3^-
   (a) I, II and III
   (b) I and V
   (c) II, III and IV
   (d) All of these

45. Identify the final product B of the reaction

   $C_6H_5COOH + NaH\overset{*}{C}O_3 \rightarrow$ gas (A)

   $\xrightarrow[\text{(ii) } H_2O^+]{\text{(i) } CH_3MgBr} (B)$
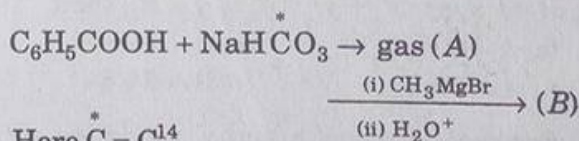
   Here $\overset{*}{C} = C^{14}$

   (a) $\overset{*}{C}H_3COOH$
   (b) $C_6H_5\overset{*}{C}OOH$
   (c) $CH_3\overset{*}{C}OOH$
   (d) $H\overset{*}{C}OOCH_3$

46. The correct order of basic strength of the following are

1. —NHCOCH$_3$

2. —C—NHCH$_3$ (with C=O)

3. —C—CH$_2$NH$_2$ (with C=O)

4. H$_2$N— —C—CH$_3$ (with C=O)
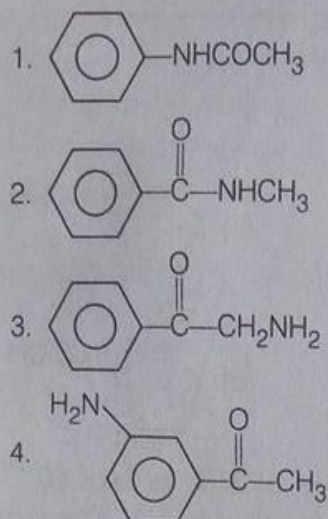
(a) $1 > 2 > 3 > 4$
(b) $4 > 2 > 3 > 1$
(c) $3 > 4 > 2 > 1$
(d) $3 > 2 > 4 > 1$

47. The polypeptides are obtained by assembling the peptide units by
(a) ionic bond
(b) covalent bond
(c) intermolecular H-bonding
(d) covalent and H-bonding

48. A positive carbylamine test is given by
I. N, N-dimethylaniline
II. 2, 4-dimethylaniline
III. N-methyl-*o*-methylaniline
IV. *p*-methylbenzyl amine

(a) (II) and (IV)
(b) (I) and (IV)
(c) (II) and (III)
(d) (I) and (II)

49. In the reaction sequence,

X is

X is
(a) cyclohexanone
(b) caprolactum
(c) $HO(CH_2)_6NH_2$
(d) Hexamethyline disocyanate

50. Which of the following has the largest number of atoms?
(a) 0.5 g atom of Cu
(b) 0.635 g of Cu
(c) 0.25 moles of Cu atoms
(d) 1 g of Cu

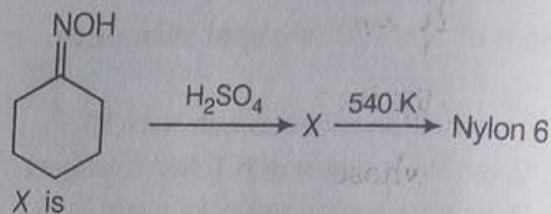# Mathematics

1. The set $(A \cup B \cup C) \cap (A \cap B' \cap C') \cap C'$ is equal to
(a) $B \cap C'$
(b) $A \cap C$
(c) $B' \cap C'$
(d) None of these

2. If $A = \{(x, y) : x^2 + y^2 \le 1; x, y \in R\}$ and $B = \{(x, y) : x^2 + y^2 \ge 4; x, y \in R\}$, then
(a) $A - B = \phi$
(b) $B - A = \phi$
(c) $A \cap B \ne \phi$
(d) $A \cap B = \phi$

3. For real numbers x and y, we define xRy iff $x - y + \sqrt{5}$ is an irrational number. The relation R is
(a) reflexive
(b) symmetric
(c) transitive
(d) None of these

4. If the real valued function $f(x) = \dfrac{a^x - 1}{x^n(a^x + 1)}$ is even, then n is equal to
(a) 2
(b) $\dfrac{2}{3}$
(c) $\dfrac{1}{4}$
(d) 3

5. If $(5 + 2\sqrt{6})^{(x^2 - 3)} + (5 - 2\sqrt{6})^{(x^2 - 3)} = 10$, then x is equal to
(a) ± 3 or $\pm \sqrt{3}$
(b) ± 5 or $\sqrt{5}$
(c) ± 4 or $\sqrt{4}$
(d) ± 2 or $\pm \sqrt{2}$

6. The value of the expression $1 \cdot (2 - \omega)(2 - \omega^2) + 2 \cdot (3 - \omega)(3 - \omega^2) + \ldots$ $\ldots + (n - 1)(n - \omega)(n - \omega^2)$, where ω is an imaginary cube root of unity is

(a) $\left\{\dfrac{n(n + 1)}{2}\right\}^2$

(b) $\left\{\dfrac{n(n + 1)}{2}\right\}^2 - n$

(c) $\left\{\dfrac{n(n + 1)}{2}\right\}^2 + n$

(d) None of the above

7. A series, whose nth term is $\left(\dfrac{n}{x}\right) + y$, then sum of r terms will be

(a) $\left\{\dfrac{r(r + 1)}{2x}\right\} + ry$

(b) $\left\{\dfrac{r(r - 1)}{2x}\right\}$

(c) $\left\{\dfrac{r(r - 1)}{2x}\right\}^2 - xy$

(d) $\left\{\dfrac{r(r + 1)}{2x}\right\} - rx$

8. Let $S_1, S_2, \ldots S_n$ be squares such that for each $n \geq 1$, the length of a side of S_n equals the length of the diagonal of S_{n+1}. If the length of a side of S_1 is 10 cm, then the least value of n for which the area of S_n less than 1 sq cm

(a) 7

(b) 8

(c) 9

(d) 10

9. If p, q and r are positive and are in AP, the roots of the quadratic equation $px^2 + qx + r = 0$ are real for

(a) $\left|\dfrac{r}{p} - 7\right| \geq 4\sqrt{3}$

(b) $\left|\dfrac{p}{r} - 7\right| < 4\sqrt{3}$

(c) all p and r

(d) no p and r

10. The value of x, for which the 6th term in the expansion of

$$\left\{ 2^{\log_2 \sqrt{(9^{x-1} + 7)}} + \dfrac{1}{2^{\left(\frac{1}{5}\right)} \log_2 (3^{x-1} + 1)} \right\}^7$$

is 84, is equal to

(a) 4

(b) 3

(c) −2

(d) 1

11. $\Delta_1 = \begin{vmatrix} x & b & b \\ a & x & b \\ a & a & x \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} x & b \\ a & x \end{vmatrix}$ are the given determinants, then

(a) $\Delta_1 = 3(\Delta_2)^2$

(b) $\dfrac{d}{dx}(\Delta_1) = 3\Delta_2$

(c) $\dfrac{d}{dx}(\Delta_1) = 3(\Delta_2)^2$

(d) $\Delta_1 = 3\Delta_2^{3/2}$

12. If A and B are square matrices of the same order and A is non-singular, then for a positive integer n, $(A^{-1}BA)^n$ is equal to

(a) $A^{-n}B^nA^n$

(b) $A^nB^nA^{-n}$

(c) $A^{-1}B^nA$

(d) $n(A^{-1}BA)$

13. The function $f(x) = \begin{cases} x^2/a, & 0 \leq x < 1 \\ a, & 1 \leq x < \sqrt{2} \\ \dfrac{2b^2 - 4b}{x^2}, & \sqrt{2} \leq x < \infty \end{cases}$

is continuous for $0 \leq x < \infty$, then the most suitable values of a and b are

(a) $a = 1, b = -1$

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

(c) $a = -1, b = 1$

(d) None of the above

14. If $f(x) = \begin{cases} 1, & x < 0 \\ 1 + \sin x, & 0 \leq x < \dfrac{\pi}{2} \end{cases}$, then at $x = 0$ the derivative $f'(x)$ is

(a) 1

(b) 0

(c) infinite

(d) not defined

15. If $\lim\limits_{x \to 0} \phi(x) = a^3$, $a \neq 0$, then $\lim\limits_{x \to 0} \phi\left(\dfrac{x}{a}\right)$ is

(a) a^2

(b) $1/a^3$

(c) $1/a^2$

(d) a^3

16. If $x = \sec\theta - \cos\theta$ and $y = \sec^n\theta - \cos^n\theta$, then $\left(\dfrac{dy}{dx}\right)^2$ is equal to

(a) $\dfrac{n^2(y^2 + 4)}{x^2 + 4}$

(b) $\dfrac{n^2(y^2 - 4)}{x^2}$

(c) $n\left(\dfrac{y^2 - 4}{x^2 - 4}\right)$

(d) $\left(\dfrac{ny}{x}\right)^2 - 4$

17. Let $P(x) = a_0 + a_1 x^2 + a_2 x^4 + a_3 x^6 + \ldots + a_n x^{2n}$ be a polynomial in a real variable x with $0 < a_0 < a_1 < a_2 < \ldots < a_n$. The function $P(x)$ has

(a) neither a maxima nor a minima
(b) only one maxima
(c) both maxima and minima
(d) only one minima

18. $\int \dfrac{dx}{9 + 16\sin^2 x}$ is equal to

(a) $\dfrac{1}{3}\tan^{-1}\left(\dfrac{3\tan x}{5}\right) + c$ (b) $\dfrac{1}{5}\tan^{-1}\left(\dfrac{\tan x}{15}\right) + c$

(c) $\dfrac{1}{15}\tan^{-1}\left(\dfrac{\tan x}{5}\right) + c$ (d) $\dfrac{1}{15}\tan^{-1}\left(\dfrac{5\tan x}{3}\right) + c$

19. $\int \dfrac{x^2 \, dx}{(x\sin x + \cos x)^2}$ is equal to

(a) $\dfrac{\sin x + \cos x}{x\sin x + \cos x} + c$ (b) $\dfrac{x\sin x - \cos x}{x\sin x + \cos x} + c$

(c) $\dfrac{\sin x - x\cos x}{x\sin x + \cos x} x$ (d) None of these

20. If $f(x) = A\sin\left(\dfrac{\pi x}{2}\right) + B$, $f'\left(\dfrac{1}{2}\right) = \sqrt{2}$ and $\int_0^1 f(x)\, dx = \dfrac{2A}{\pi}$, then A and B are

(a) $\dfrac{\pi}{2}, \dfrac{\pi}{2}$ (b) $\dfrac{2}{\pi}, \dfrac{3}{\pi}$

(c) $0, -4\pi$ (d) $\dfrac{4}{\pi}, 0$

21. Let $g(x) = \int_0^x f(t)\, dt$, where f is such that $\dfrac{1}{2} \le f(x) \le 1$ for $t \in [0,1]$ and $0 \le f(t) \le \dfrac{1}{2}$ for $t \in [1,2]$. Then, $g(2)$ satisfies the inequality

(a) $-\dfrac{3}{2} \le g(2) < \dfrac{1}{2}$ (b) $0 \le g(2) < 2$

(c) $\dfrac{1}{2} \le g(2) \le \dfrac{3}{2}$ (d) $2 < g(2) < 4$

22. For which of the following value of m, is the area of the region bounded by the curve $y = x - x^2$ and the line $y = mx$ equals to $\dfrac{9}{2}$?

(a) -4
(b) -2
(c) 2
(d) 4

23. Solution of $2y\sin x \dfrac{dy}{dx} = 2\sin x \cdot \cos x - y^2 \cos x$, $x = \dfrac{\pi}{2}$, $y = 1$ is given by

(a) $y^2 = \sin x$ (b) $y = \sin^2 x$
(c) $y^2 = \cos x + 1$ (d) None of these

24. The solution of $x^2 \dfrac{dy}{dx} - xy = 1 + \cos\dfrac{y}{x}$ is

(a) $\tan\dfrac{y}{2x} = C - \dfrac{1}{2x^2}$ (b) $\tan\dfrac{y}{x} = C + \dfrac{1}{x}$

(c) $\cos\left(\dfrac{y}{x}\right) = 1 + \dfrac{C}{x}$ (d) $x^2 = (C + x^2)\tan y/x$

25. A rectangle $ABCD$ has its side AB parallel to line $y = x$ and vertices A, B and D lie on $y = 1$, $x = 2$ and $x = -2$, respectively. Locus of vertex 'C' is

(a) $x = 5$ (b) $x - y = 5$
(c) $y = 5$ (d) $x + y = 5$

26. The value of λ, for which the equation $6x^2 + 11xy - 10y^2 + x + 3 + y + \lambda = 0$ represents a pair of straight lines, is

(a) -15 (b) 0
(c) 2 (d) None of these

27. The locus of the centre of a circle, which touches externally the circle $x^2 + y^2 - 6x - 6y + 14 = 0$ and also touches the y-axis, is given by the equation

(a) $x^2 - 6x - 10y + 14 = 0$
(b) $x^2 - 10x - 6y + 14 = 0$
(c) $y^2 - 6x - 10y + 14 = 0$
(d) $y^2 - 10x - 6y + 14 = 0$

28. The range of values of r, for which the point $\left(-5 + \dfrac{r}{\sqrt{2}}, -3 + \dfrac{r}{\sqrt{2}}\right)$ is an interior point of the major segment of the circle $x^2 + y^2 = 16$ cut-off by the line $x + y = 2$, is

(a) $(-\infty, 5\sqrt{2})$
(b) $(4\sqrt{2} - \sqrt{14}, 5\sqrt{2})$
(c) $(4\sqrt{2} - \sqrt{14}, 4\sqrt{2} + \sqrt{14})$
(d) None of the above

29. A line L passing through the focus of the parabola $y^2 = 4(x-1)$, interseds the parabola in two distinet points. If 'm' be the slope of the line 'L' then

(a) $-1 < m < 1$

(b) $m < -1$ or $m > 1$

(c) $m \in R$

(d) None of the above

30. Tangent are drawn from the points on the line $x - y - 5 = 0$ to $x^2 + 4y^2 = 4$, then all the chords of contact pass through a fixed point, whose coordinate are

(a) $\left(\dfrac{4}{5}, -\dfrac{1}{5}\right)$

(b) $\left(\dfrac{4}{5}, \dfrac{1}{5}\right)$

(c) $\left(-\dfrac{4}{5}, \dfrac{1}{5}\right)$

(d) None of these

31. The coordinates of a point are $a \tan(\theta + \alpha)$ and $b \tan(\theta + \beta)$, where θ is variable, then locus of the point is

(a) hyperbola

(b) rectangular hyperbola

(c) ellipse

(d) None of the above

32. If $\sin x + \sin^2 x + \sin^3 x = 1$, then $\cos^6 x - 4\cos^4 x + 8\cos^2 x$ is equal to

(a) 4

(b) 1

(c) 0

(d) None of these

33. If $\sin x + \sin y = 3(\cos y - \cos x)$, then the value of $\dfrac{\sin 3x}{\sin 3y}$ is

(a) 1

(b) -1

(c) 0

(d) 3

34. If $\sin(\pi \cos \theta) = \cos(\pi \sin \theta)$, then $\cos\left(\theta \pm \dfrac{\pi}{4}\right)$ is equal to

(a) $\cos\dfrac{\pi}{4}$

(b) $\dfrac{1}{2}\cos\dfrac{\pi}{4}$

(c) $\cos\dfrac{\pi}{8}$

(d) None of these

35. The number of roots of the equation $x + 2\tan x = \dfrac{\pi}{2}$ in the interval $[0, 2\pi]$ is

(a) 1

(b) 2

(c) 3

(d) infinite

36. The sides of a triangle are three consecutive natural numbers and its largest angle is twice the smallest one, then the sides are

(a) 6, 7, 8

(b) 4, 5, 6

(c) 1, 2, 3

(d) 3, 4, 5

37. If in $\triangle ABC$, $\cos A + \cos B + \cos C = 3/2$, then triangle Δ is

(a) right angled

(b) isosceles

(c) acute

(d) equilateral

38. The top of a hill observed from the top and bottom of a building of height 'h' is at angles of elevation p and q, respectively. The height of hill

(a) $\dfrac{h\cot q}{\cot q - \cot p}$

(b) $\dfrac{h\cot p}{\cot p - \cot q}$

(c) $\dfrac{h\tan p}{\tan p - \tan q}$

(d) None of these

39. If $\mathbf{a}$ and $\mathbf{b}$ are unit vectors and θ is the angle between them, then $|\mathbf{a} + \mathbf{b}| < 1$, if

(a) $\theta = \dfrac{\pi}{2}$

(b) $\theta < \dfrac{\pi}{3}$

(c) $\pi \geq \theta > \dfrac{2\pi}{3}$

(d) $\dfrac{\pi}{3} < \theta < \dfrac{2\pi}{3}$

40. The points, whose position vectors are $60\mathbf{i} + 3\mathbf{j}$, $40\mathbf{i} - 8\mathbf{j}$ and $a\mathbf{i} - 52\mathbf{j}$ collinear, if

(a) $a = 40$

(b) $a = -40$

(c) $a = 20$

(d) $a = -20$

41. In a $\triangle ABC$, $\mathbf{AB} = r\mathbf{i} + \mathbf{j}$, $\mathbf{AC} = s\mathbf{i} - \mathbf{j}$ if the area of triangle is of unit magnitude, then

(a) $|r - s| = 2$

(b) $|r + s| = 1$

(c) $|r + s| = 2$

(d) $|r - s| = 1$

42. If $\mathbf{a} = \mathbf{i} - \mathbf{j} + \mathbf{k}$, $\mathbf{a} \cdot \mathbf{b} = 0$, $\mathbf{a} \times \mathbf{b} = \mathbf{c}$, where $\mathbf{c} = -2\mathbf{i} - \mathbf{j} + \mathbf{k}$, then $\mathbf{b}$ is equal to

(a) $(1, 0, -1)$

(b) $(0, 1, 1)$

(c) $(-1, -1, 0)$

(d) $(-1, 0, 1)$

43. If $P(A) = 65$, $P(B) = 80$, then $P(A \cap B)$ lies in the interval

(a) $[.30, .80]$

(b) $[.35, .75]$

(c) $[.4, .70]$

(d) $[.45, .65]$

44. For any two independent events E_1 and E_2 in a space S, $P[(E_1 \cup E_2) \cap (E_1 \cap E_2)]$ is equal to

(a) $\leq \dfrac{1}{4}$

(b) $> \dfrac{1}{4}$

(c) $\geq \dfrac{1}{2}$

(d) $> \dfrac{1}{2}$

45. The resultant of P and Q is R. If Q is doubled, R is also doubled and if Q is reversed, R is again doubled. Then, $P^2 : Q^2 : R^2$ given by

(a) $2 : 2 : 3$

(b) $3 : 2 : 2$

(c) $2 : 3 : 2$

(d) $2 : 3 : 1$

46. Forces of magnitudes 3, P, 5, 10 and Q are respectively acting along the sides AB, BC, CD, AD and the diagonal CA of a rectangle $ABCD$, where $AB = 4$ m and $BC = 3$ m. If the resultant is a single force along the other diagonal BD, then P, Q and the resultant are

(a) $4, 10\dfrac{5}{12}, 12\dfrac{11}{12}$

(b) 5, 6, 7

(c) $3\dfrac{1}{2}, 8, 9\dfrac{1}{2}$

(d) None of the above

47. A stone is dropped from a certain height which can reach the ground in 5 s. If the stone is stopped after 3 s of its fall and then allowed to fall again, then the time taken by the stone to reach the ground for the remaining distance is

(a) 2 s

(b) 3 s

(c) 4 s

(d) None of these

48. A gun projects a ball at the angle of $45°$ with the horizontal. If the horizontal range is 39.2 m, then the ball will rise to

(a) 9.8 m

(b) 4.9 m

(c) 2.45 m

(d) 19.6 m

49. If $(\tan^{-1}x)^2 + (\cot^{-1}x)^2 = \dfrac{5\pi^2}{8}$, then x is equal to

(a) -1

(b) 1

(c) 0

(d) None of the above

50. $\dfrac{\alpha^3}{2}\operatorname{cosec}^2 \dfrac{1}{2}\left(\tan^{-1}\dfrac{\alpha}{\beta}\right) + \dfrac{\beta^3}{2}\sec^2\left(\dfrac{1}{2}\tan^{-1}\dfrac{\beta}{\alpha}\right)$ is equal to

(a) $(\alpha - \beta)(\alpha^2 + \beta^2)$

(b) $(\alpha + \beta)(\alpha^2 - \beta^2)$

(c) $(\alpha + \beta)(\alpha^2 + \beta^2)$

(d) None of the above

Answers

Physics

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

Chemistry

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

Mathmatics

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