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UPCPMT 2013

Sample Paper



UP CPMT

Medical Entrance Exam

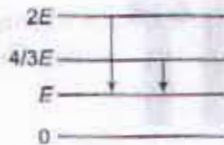
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Physics

- In case of a forced vibration, the resonance wave becomes very sharp when the
 - restoring force is small
 - damping force is small
 - quality factor is small
 - applied periodic force is small
- The velocity-time graph of robber's car and a chasing police car are shown in the following graph. Police car crosses the robber's car
 - 10 s after it starts
 - 15 s after it starts
 - 20 s after it starts
 - Never crosses
- When a boy is playing on a swing in the sitting position, the time period of oscillations of the swing is T . If the boy stands up, the time period of oscillation of the spring will be
 - more than T
 - less than T
 - equal to T
 - cannot be predicted
- To make the frequency of an oscillator double, one have to
 - half the mass
 - quadruple the mass
 - double the mass
 - reduce the mass to one-fourth
- A beaker is completely filled with water at 4°C . It will over flow
 - when cooled but not when heated
 - when heated but not when cooled
 - both when heated or cooled
 - neither when heated nor when cooled
- In kinetic theory of gases, it is assumed that molecular collisions are
 - for negligible duration
 - inelastic
 - one-dimensional (head on)
 - unable to exert mutual force
- If two mono-chromatic and phase related beams of light having intensities I and $4I$ superimposed on each other, then the possible maximum and minimum intensities in the resultant beam obtained are
 - $5I$ and $3I$
 - $9I$ and $3I$
 - $9I$ and I
 - $5I$ and I
- What is the value of $\bar{A} + A$ in the boolean algebra?
 - A
 - 0
 - 1
 - \bar{A}
- The energy levels of a certain atom are represented in adjoining figure. During the transition from $2E$ to E level, a photon of wavelength λ is emitted. The wavelength of photon produced during transition from $\frac{4}{3}E$ level to E will be



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- (a) 3λ (b) $\lambda/3$
(c) $3\lambda/3$ (d) $4\lambda/3$

10. Rest mass energy of electron is 0.51 MeV. If a moving electron has a kinetic energy of 9.69 MeV, then the ratio of the mass of the moving electron to its rest mass will be

- (a) 1 : 2 (b) 1 : 19
(c) 19 : 1 (d) 20 : 1

11. A star whose mass is more than 5 times the solar mass is converted after death into

- (a) nebula (b) black hole
(c) neutron star (d) red giant

12. The depletion layer in the *p-n* junction region is caused by

- (a) drift of holes
(b) drift of electrons
(c) diffusion of carriers
(d) migration of impurity ions

13. A sphere of 4 cm radius is suspended with in a hollow sphere of 6 cm radius. If the inner sphere is charged to a potential 3 e.s.u while the outer sphere is earthed, then the charge on the inner sphere will be

- (a) $\frac{1}{4}$ e.s.u (b) 30 e.s.u
(c) 36 e.s.u (d) 54 e.s.u

14. The unit of viscosity in the CGS system is poise (P) and that in SI is poiseuille (Pl). Which of the following statement is correct?

- (a) $1P = 1Pl$ (b) $1P = 10Pl$
(c) $10P = 1Pl$ (d) None of these

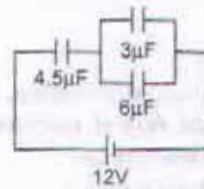
15. The number of molecules in a litre of a gas at temperature of 27°C and a pressure of 10^6 dyne/cm² is

- (a) 2.4×10^{20}
(b) 2.4×10^{21}
(c) 2.4×10^{22}
(d) 2.4×10^{23}

16. A long vertical wire in which a current is flowing produces a neutral point with the earth's magnetic field at a distance of 5 cm from the wire. If the horizontal component of earth's magnetic induction is 0.18 G, then the current in the wire is

- (a) 0.9 A (b) 0.45 A
(c) 0.09 A (d) 4.5 A

17. In the adjoining, the potential difference across the $4.5\mu\text{F}$ capacitor is



- (a) 4 V (b) 8 V
(c) 8 V (d) 4.5 V

18. If 5000 lines of induction enters in a given closed surface and 3000 lines leaves it then the net charge enclosed with in the surface is

- (a) 2000 C
(b) -2000 C
(c) $+1.77 \times 10^{-8}$ C
(d) -1.77×10^{-8} C

19. Liquid rises to a height of 2 cm in a capillary tube and the angle of contact between the solid and the liquid is zero. If the tube is depressed more now so that top of capillary is only 1 cm above the liquid, then the apparent angle of contact between the solid and the liquid is

- (a) 0° (b) 30°
(c) 60° (d) 90°

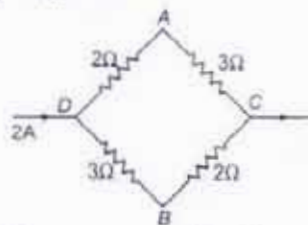
20. A rubber cord *L* metre long and having A metre² area of cross section is suspended vertically. If the wire extends 1 m under its own weight, then change in length (*l*) is (Density of rubber = *D* kg/m³ and Young's modulus of rubber = *E* N/m²)

- (a) $\frac{L^2 Dg}{2E}$ (b) $\frac{L^2 Dg}{E}$
(c) $\frac{L^2 Dg}{4E}$ (d) *L*



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21. A current of 2A flows in the arrangement of conductors as shown in adjoining figure. The potential difference between points A and B ($V_A - V_B$) will be



- (a) +1V (b) -1V
(c) +2V (d) -2V
22. A cell of emf E and internal resistance r supplies current for the same time t through external resistance R_1 and R_2 separately. If the heat developed in both the cases is the same, then the internal resistance r will be
- (a) $r = \sqrt{R_1 + R_2}$ (b) $r = \sqrt{R_1 R_2}$
(c) $r = \frac{R_1 + R_2}{2}$ (d) $r = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$
23. A wheel having moment of inertia $2 \text{ kg}\cdot\text{m}^2$ about its vertical axis, rotates at the rate of 60 rpm about this axis. The torque which can stop the wheel's rotation in one minute would be
- (a) $\frac{\pi}{15} \text{ N}\cdot\text{m}$ (b) $\frac{2\pi}{15} \text{ N}\cdot\text{m}$
(c) $\frac{\pi}{18} \text{ N}\cdot\text{m}$ (d) $\frac{\pi}{12} \text{ N}\cdot\text{m}$
24. Two particles are projected upwards with the same initial velocity v_0 in two different angles of projection such that their horizontal ranges are the same. The ratio of the heights of their highest point will be
- (a) $\tan^2 \theta_1$ (b) $v_0^2 \sin^2 \theta_1$
(c) $v_0 \sin \theta_1$ (d) $v_0 / \cos \theta_1$
- (where, θ_1 is the angle of projection of the first particle)
25. A beam of light consisting of red, green and blue colours is incident on a right angled prism as shown in figure. The refractive indices of the material of the prism for above

red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The prism will



- (a) separate part of the blue colour from the red and green
(b) separate part of the red colour from the green and blue colours
(c) separate all the three colours from one another
(d) None of the above
26. A vessel consists of two plane mirrors at right angles as shown in figure. The vessel is filled with water. The total deviation in incident ray is
-
- (a) 0° (b) 60°
(c) 90° (d) 180°
27. If μ_0 be the permeability and k_0 be the dielectric constant of a medium, then its refractive index is given by
- (a) $\mu_0 k_0$ (b) $\frac{1}{\mu_0 k_0}$
(c) $\sqrt{\mu_0 k_0}$ (d) $\frac{1}{\sqrt{\mu_0 k_0}}$
28. In photoelectric effect, the photoelectric current
- (a) depends both an intensity and frequency of incident beam
(b) does not depend on frequency but depends only on intensity of incident beam
(c) increases when frequency of incident beam increases
(d) decreases when frequency of incident beam increases
29. The phenomenon of radioactivity
- (a) increases on applied pressure
(b) is exothermic change which increases or decreases with temperature
(c) is nuclear process which does not depend on external forces
(d) None of the above

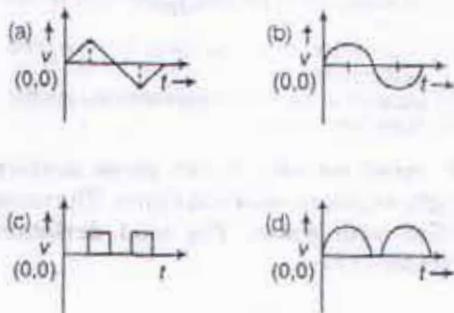


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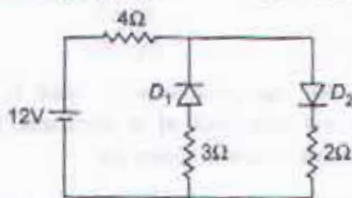
30. An atom bomb weighing 1 kg explodes releasing 9×10^{13} J of energy. What percentage of mass is converted into energy?

- (a) 0.1% (b) 1%
(c) 2% (d) 10%

31. Out of the following curves, which one represents a digital signal?



32. The circuit has two oppositely connected ideal diodes in parallel as shown in figure. What is the current flowing in the circuit?

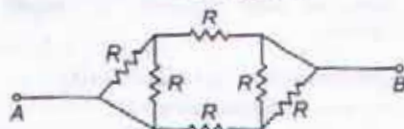


- (a) 1.33 A (b) 1.71 A (c) 2.00 A (d) 2.31 A

33. Modulation is the process of superposing

- (a) low frequency radio signal on low frequency audio waves
(b) low frequency audio signal on high frequency radio waves
(c) high frequency radio signal on low frequency audio signal
(d) None of the above

34. The equivalent resistance between A and B of network shown in figure is



- (a) $\frac{3R}{4}$ (b) $\frac{4R}{3}$
(c) $6R$ (d) $2R$

35. The work done in turning a magnet of magnetic moment M by an angle of 90° from the magnetic meridian is n times the corresponding work done to turn it through an angle of 60° . The value of n is

- (a) 1 (b) 2
(c) $1/2$ (d) $1/4$

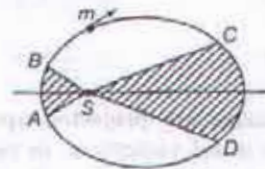
36. Two coils have the mutual inductance 0.05 H. The current changes in the first coil as $I = I_0 \sin \omega t$, where $I_0 = 1$ A and $\omega = 100\pi$ rad/s. The maximum emf induced in secondary coil is

- (a) 2.5 V (b) 10 V
(c) 6π V (d) 5π V

37. The power factor of an A.C. circuit having resistance R and inductance L connected in series to an A.C. source of angular frequency ω is

- (a) zero (b) $\omega L/R$
(c) $\frac{R}{\sqrt{R^2 + \omega^2 L^2}}$ (d) $R/\omega L$

38. In the adjoining figure, a planet m revolves in elliptical orbit about the sun S . The shaded area SCD is twice that of shaded area SAB . If t_1 is the time for the planet to move from C to D and t_2 is the time to move from A to B , then



- (a) $t_1 > t_2$ (b) $t_1 = t_2$
(c) $t_1 = 4t_2$ (d) $t_1 = 2t_2$

39. A satellite of mass m is circulating around the earth with constant angular velocity. If the radius is R_0 and mass of earth is M , then the angular momentum about the centre of the earth is

- (a) $m = \sqrt{GM/R_0}$
(b) $M = \sqrt{GmR_0}$
(c) $m = \sqrt{GMR_0}$
(d) $M = \sqrt{GM/R_0}$



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40. A simple pendulum is suspended from the roof of a trolley, which moves in a horizontal direction with an acceleration a , then the time period T is given by, $T = 2\pi\sqrt{l/g'}$, where g' is equal to

- (a) g
- (b) $\sqrt{g^2 + a^2}$
- (c) $\sqrt{g^2 - a^2}$
- (d) $(g + a)$

41. As per Bohr model, the minimum energy (in eV) required to remove an electron from the ground state of doubly ionised Li-atom ($Z = 3$) is

- (a) 1.51
- (b) 28.7
- (c) 53.9
- (d) 122.4

42. If an X-ray tube is operated at 15 kV, then the upper limit of the speed of the electron striking the target and lower limit of the X-ray produced will be

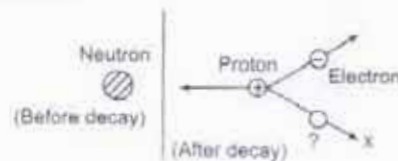
- (a) 7.26×10^7 m/s, 0.825 \AA
- (b) 3×10^8 m/s, 1.08 \AA
- (c) 2.7×10^8 m/s, 2.05 \AA
- (d) None of the above

43. Two masses M and $M/2$ are joined together by means of a light inextensible string passed over a pulley as shown in adjoining figure. If the bigger mass is released, then the smaller one will ascend with an acceleration of



- (a) a
- (b) $\frac{g}{2}$
- (c) $\frac{g}{3}$
- (d) $\frac{3g}{2}$

44. The adjoining figure shows the decay of neutron.



The particle generated in x -direction is

- (a) anti-neutrino
- (b) neutrino
- (c) α -particle
- (d) None of these

45. If v is velocity of recession of a galaxy and r is its distance from us then

- (a) $v = r$
- (b) $v = \frac{1}{r}$
- (c) $v = r^2$
- (d) $v = \frac{1}{r^2}$

46. When 500 kg of water is heated from 20°C to 100°C , then the increase in mass of the water will be

- (a) 3.2×10^{-3} kg
- (b) 1.87×10^{-8} kg
- (c) 0.96×10^{-9} kg
- (d) 2.8×10^{-3} kg

47. If the centripetal acceleration a_c of a particle of mass m moving in a circular path of constant radius r varies with time as $a_c = k^2 r t^2$, where k is a constant then the power delivered to the particle by the forces acting on it will be

- (a) $mkrt$
- (b) $m^2 k^2 r^2 t^2$
- (c) $mk^2 r t^3$
- (d) $mkr^2 t^2$

48. A lift starting from rest with a constant upward acceleration moves 1.5m in the 0.4 s. If a person standing in the lift holds a packet of 2 kg by a string then the tension in the string due to motion is

- (a) 5.89 N
- (b) 77.1 N
- (c) 6.71 N
- (d) None of the above



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49. The density of a metal at normal pressure is ρ . Its density when it is subjected to an excess pressure p is ρ' . If B is the bulk modulus of the metal, then the ratio ρ'/ρ is
- (a) $1 + p/B$ (b) $1 + B/p$
(c) $\frac{1}{1 - B/p}$ (d) $\frac{1}{1 - p/B}$
50. A pipe closed at one end produced a fundamental note of 412 Hz. It is then cut into equal lengths, the fundamental notes produced by the two pieces are
- (a) 824 Hz, 1648 Hz (b) 206 Hz, 412 Hz
(c) 206 Hz, 824 Hz (d) 412 Hz, 824 Hz

Chemistry

1. 5 moles of a gas in a closed vessel was heated from 300 K to 600 K. The pressure of the gas is doubled. The number of moles of the gas at 600 K is

- (a) 5 (b) 2.5
(c) 10 (d) 20

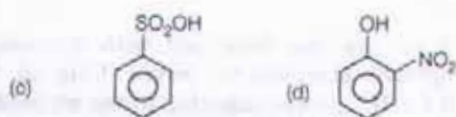
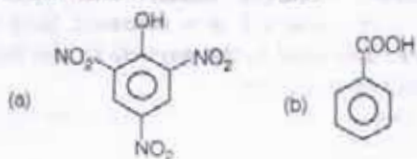
2. The molar concentration of chloride ions in the resulting solution of 300 mL of 3.0 M NaCl and 200 mL of 4.0 M BaCl₂ will be


- (a) 1.7 M (b) 1.8 M
(c) 5.0 M (d) 3.6 M

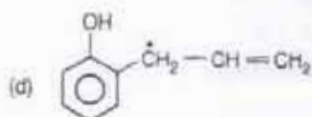
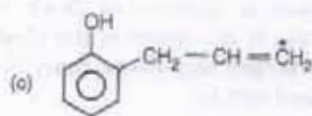
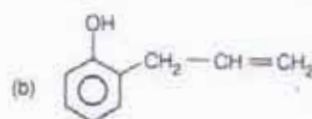
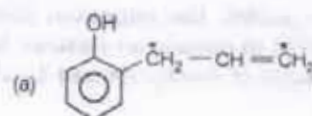
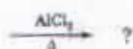
3. Gas that cannot be collected over water is

- (a) N₂ (b) SO₂
(c) O₂ (d) PH₃

4. Which of the following is not soluble in sodium carbonate solution?



5.  - CH₂ - CH = $\dot{C}H_2$



6. The enthalpy of hydrogenation of cyclohexene is $-119.5 \text{ kJ mol}^{-1}$. If resonance energy of benzene is $-150.4 \text{ kJ mol}^{-1}$, its enthalpy of hydrogenation would be

- (a) $-269.9 \text{ kJ mol}^{-1}$ (b) $-358.5 \text{ kJ mol}^{-1}$
(c) $-508.9 \text{ kJ mol}^{-1}$ (d) $-208.1 \text{ kJ mol}^{-1}$

7. The degree of dissociation of PCl₅ (α) obeying the equilibrium;



is related to the pressure (p) at equilibrium by

- (a) $\alpha = p$ (b) $\alpha = \frac{1}{\sqrt{p}}$
(c) $\alpha = \frac{1}{p^2}$ (d) $\alpha = \frac{1}{p^4}$



8. What will be the % of the N_2H_4 that has reacted with water in solution, when 0.32 g of N_2H_4 are dissolved in water and the total volume was made 4 L (given, K_b for $N_2H_4 = 6 \times 10^{-6}$ M)

- (a) 3% (b) 3.6%
(c) 2% (d) 0.489%

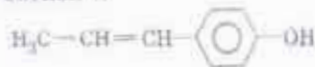
9. A gas X is passed through water to form a saturated solution. The aqueous solution on treatment with silver nitrate gives a white precipitate. The saturated aqueous solution also dissolves magnesium ribbon with evolution of colourless gas Y . ' X ' and ' Y ' are respectively

- (a) CO_2, Cl_2 (b) O_2, CO_2
(c) Cl_2, H_2 (d) N_2, H_2

10. C—Cl bond of chlorobenzene in comparison to C—Cl bond of methyl chloride is

- (a) longer and weaker
(b) shorter and stronger
(c) shorter and weaker
(d) longer and stronger

11. The reaction of



with HBr gives

- (a) $CH_3-CH_2-CH_2-\text{C}_6\text{H}_4-OH$
(b) $CH_3-CH_2-\underset{Br}{CH}-\text{C}_6\text{H}_4-OH$
(c) $CH_3-\underset{Br}{CH}-CH_2-\text{C}_6\text{H}_4-OH$
(d) $CH_3-CH_2-\underset{Br}{CH}-\text{C}_6\text{H}_4-Br$

12. The reaction, $A + B \rightleftharpoons C + D$, is studied in 1 L vessel at $250^\circ C$. The initial concentration of A was $3n$ and that of B was n . When equilibrium was attained, equilibrium concentration of C was found to

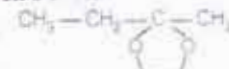



be equal to the equilibrium concentration B , then concentration of D at equilibrium will be

- (a) $\frac{n}{2}$ (b) $(3n - \frac{n}{2})$
(c) $(n - \frac{n}{2})$ (d) n

13. Identify the correct statement among the following

- (a) Ozone reacts with SO_2 to give SO_3
(b) Silicon reacts with NaOH (aq) in the presence of air to give Na_2SiO_3 and water
(c) Cl_2 reacts with excess of NH_3 to give N_2 and HCl
(d) Br_2 reacts with hot and concentrated NaOH solution to give NaBr, $NaBrO_3$ and H_2O

14. Which of the following would readily give Tollen's test?

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

15. Ozonolysis of  gives

- (a) butane 1,4-diene (b) butane 1,4-dial
(c) Butanoic acid (d) None of these

16. K_{sp} and solubility of MX_4 (mol/litre) are related by

- (a) $s = [K_{sp}/256]^{1/5}$ (b) $s = [128 K_{sp}]^{1/4}$
(c) $s = [256 K_{sp}]^{1/3}$ (d) $s = -[K_{sp}/128]^{1/4}$

17. The dipole moment of diatomic molecules AB and CD are 10.41 and 10.27 Debye respectively while their bond distances are 2.82 Å and 2.67 Å respectively then

- (a) bonding is nearly covalent in both the molecules
(b) bonding is 100% ionic in both the molecules
(c) AB has more ionic character than CD
(d) AB has lesser ionic bond character than CD



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18. Which one of the following arrangements represent the correct order of electron gain enthalpy (with negative sign) of the given atomic species?

- (a) $F < Cl < O < S$
- (b) $S < O < Cl < F$
- (c) $Cl < F < S < O$
- (d) $O < S < F < Cl$

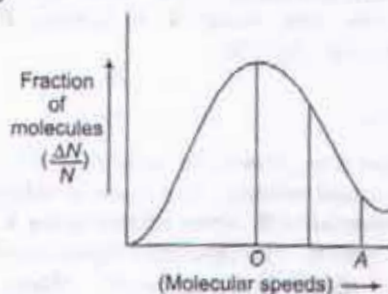
19. 3-methyl-2-pentene on reaction with HOCl gives

- (a) $\begin{array}{c} \text{Cl} \quad \text{OH} \\ | \quad | \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{CH}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
- (b) $\begin{array}{c} \text{CH}_3 \quad \text{OH} \\ | \quad | \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{CH}-\text{Cl} \\ | \\ \text{CH}_3 \end{array}$
- (c) $\begin{array}{c} \text{CH}_3 \quad \text{OH} \\ | \quad | \\ \text{Cl}-\text{CH}_2-\text{C}-\text{CH}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
- (d) $\begin{array}{c} \text{OH} \quad \text{Cl} \\ | \quad | \\ \text{CH}_3-\text{CH}_2-\text{C}-\text{CH}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$

20. 0.22 g of an alcohol (A) when treated with methyl magnesium iodide, we get 56 mL of methane at STP. (A) on dehydration gives alkene (B), which on ozonolysis gives acetone as one of the product along with (C). The structure of (B) is

- (a) $\begin{array}{c} \text{CH}_3-\text{C}=\text{CH}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
- (b) $\begin{array}{c} \text{CH}_3-\text{C}=\text{CH}-\text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
- (c) $\begin{array}{c} \text{CH}_3-\text{C}=\text{CH}-\text{CH}_2-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
- (d) $\begin{array}{c} \text{CH}_3-\text{C}=\text{C}-\text{CH}_2-\text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$

21. The Maxwell-Boltzmann distribution law of molecular speeds is graphically represented as



This curve has which of the following characteristics?

- 1. It has symmetrical distribution
- 2. The point A on X-axis represents the most probable speed
- 3. The area under the curve gives the total number of molecules
- 4. The maximum shifts to the right as the temperature increases

Choose the correct answer using the codes given below

- (a) 1, 2 and 3
- (b) 1, 3 and 4
- (c) 3 and 4
- (d) only 4

22. How many unit cells are present in a cubic shaped ideal crystal of NaCl of mass 1.0 g?

- (a) 1.28×10^{23} unit cells
- (b) 1.71×10^{23} unit cells
- (c) 2.57×10^{23} unit cells
- (d) 5.14×10^{23} unit cells

23. Hydrogen gas will not reduce

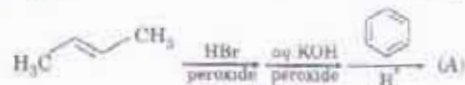
- (a) heated cupric oxide
- (b) heated ferric oxide
- (c) heated stannic oxide
- (d) heated aluminium oxide

24. Maximum heat of hydrogenation is shown by

- (a) $\text{H}_2\text{C}=\text{CH}-\text{CH}_3$
- (b) $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$
- (c) $\begin{array}{c} \text{H}_3\text{C}-\text{C}=\text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
- (d) $\text{H}_2\text{C}=\text{CH}_2$



25. Identify A in the given sequence of reaction



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

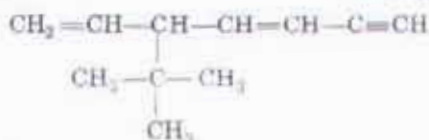
26. Carbon atom consists of electrons, protons and neutrons. If the mass attributed to neutron were halved and that attributed to the electron were doubled, the atomic mass of ${}^6\text{C}^{12}$ would be approximately

- (a) same (b) doubled
(c) halved (d) reduced by 25%
27. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom
- (a) He^+ ($n=2$) (b) Li^{2+} ($n=2$)
(c) Li^{2+} ($n=3$) (d) Be^{3+} ($n=2$)

28. A sodium salt on treatment with MgCl_2 gives white precipitate only on heating. The anion of sodium salt is

(a) HCO_3^- (b) CO_3^{2-} (c) NO_3^- (d) SO_3^{2-}

29. Write the IUPAC name for the following

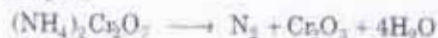


- (a) 3-(2-methyl-2-propyl)-hept-1,4-diene-6-yne
(b) 3-(2-dimethylethyl) hept-1,4-diene-6-yne
(c) 5-isobutylhept-3,6-diene-1-yne
(d) 6-dimethyl-5-vinylhept-3-ene-1-yne

30. Which of the following compounds does not show Lassaigne's test for nitrogen?

- (a) Urea (b) Hydrazine
(c) Sodium cyanide (d) Azobenzene

31. Equivalent weight of $(\text{NH}_4)_2\text{C}_2\text{O}_7$ in the change is



- (a) Mol. wt./6 (b) Mol. wt./3
(c) Mol. wt./4 (d) Mol. wt./2

32. When KMnO_4 acts as an oxidising agent and ultimately forms MnO_4^{2-} , MnO_2 , Mn_2O_3 and Mn^{2+} then, the number of electrons transferred in each case respectively are

- (a) 4, 3, 1, 5 (b) 1, 5, 3, 7
(c) 1, 3, 4, 5 (d) 3, 5, 7, 1

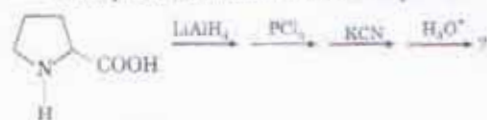
33. Which salt would give SO_2 with hot and dilute H_2SO_4 and also decolourises Br_2 water?

- (a) Na_2SO_3 (b) NaHSO_3
(c) Na_2SO_4 (d) Na_2S

34. The most stable conformation of ethylene chlorohydrin at room temperature is

- (a) fully eclipsed (b) partially eclipsed
(c) gauche (d) staggered

35. The final product in the reaction sequence



- (a)
- (b)
- (c) $\text{H}_2\text{N}(\text{CH}_2)_6\text{COOH}$
- (d)

36. The molar conductance of acetic acid at infinite dilution, if that of CH_3COONa , NaCl and HCl are 91.0, 126.5 and $426.2 \text{ S cm}^2 \text{ mol}^{-1}$ respectively, is

- (a) 517.2 (b) 552.7
(c) 390.7 (d) 217.5



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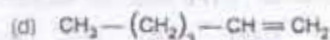
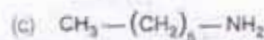
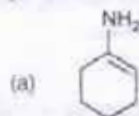
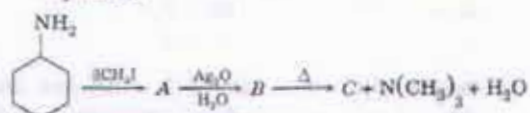
37. The aqueous solution that has the lowest vapour pressure at a given temperature is

- (a) 0.1 molal sodium phosphate
- (b) 0.1 molal barium chloride
- (c) 0.1 molal sodium chloride
- (d) 0.1 molal glucose

38. In metallurgy, flux is a substance used to convert

- (a) infusible impurities to fusible mass
- (b) mineral into silicate
- (c) fusible impurities to infusible material
- (d) soluble particles to insoluble impurities

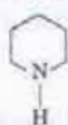
39. Identify the final product (c) of the reaction sequence.



40. Which of the following nitrogen containing compound will give a product not having nitrogen with HNO_2 ?

- (a) 1° amine
- (b) 2° amine
- (c) 3° amine
- (d) Aniline

41. The order of basicity in the following compound is



- (a) IV > I > III > II
- (b) III > I > IV > II
- (c) II > I > III > IV
- (d) I > III > II > IV

42. For which one of the following ions, the colour is not due to a *d-d*-transition?

- (a) CrO_4^{2-}
- (b) $[\text{Cu}(\text{NH}_3)_4]^{2+}$
- (c) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
- (d) $[\text{CoF}_6]^{3-}$

43. For a certain reaction, a plot of $\frac{[C_0 - C]}{C}$

against time t , yields a straight line. C_0 and C are concentrations of reactants at $t = 0$ and $t = t$ respectively. The order of reaction is

- (a) zero
- (b) 1
- (c) 2
- (d) 3

44. Two substances A and B are present such that $[A] = 4[B]$ and half-life of A is 5 min and of B is 15 min. If they start decaying at the same time following first order, how much time later will the concentration of both of them would be same?

- (a) 15 min
- (b) 10 min
- (c) 5 min
- (d) 12 min

45. Which of the following is a polyamide molecule?

- (a) Terylene
- (b) Rayon
- (c) Nylon-6
- (d) Polystyrene

46. Which ion has least flocculation value for a positive sol?

- (a) $[\text{Fe}(\text{CN})_6]^{4-}$
- (b) Cl^-
- (c) SO_4^{2-}
- (d) PO_4^{3-}

47. An example of autocatalysis is

- (a) oxidation of NO to NO_2
- (b) oxidation of SO_2 to SO_3
- (c) decomposition of KClO_3 into KCl and O_2
- (d) oxidation of oxalic acid by acidified KMnO_4

48. Cellulose is a straight chain polysaccharide composed of only

- (a) D-glucose units joined by α -glycosidic linkage
- (b) D-glucose units joined by β -glycosidic linkage
- (c) D-galactose units joined by α -glycosidic linkage
- (d) D-galactose units joined by β -glycosidic linkage



49. Among $[\text{Ni}(\text{CO})_4]$, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Ni}(\text{Cl}_4)]^{2-}$
- (a) $[\text{Ni}(\text{CO})_4]$ and $[\text{Ni}(\text{Cl}_4)]^{2-}$ are diamagnetic and $[\text{Ni}(\text{CN})_4]^{2-}$ is paramagnetic
(b) $[\text{Ni}(\text{Cl}_4)]^{2-}$ and $[\text{Ni}(\text{CN})_4]^{2-}$ are diamagnetic and $[\text{Ni}(\text{CO})_4]$ is paramagnetic
(c) $[\text{Ni}(\text{CO})_4]$ and $[\text{Ni}(\text{CN})_4]^{2-}$ are diamagnetic and $[\text{Ni}(\text{Cl}_4)]^{2-}$ is paramagnetic
(d) $[\text{Ni}(\text{CO})_4]$ is diamagnetic and $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Ni}(\text{Cl}_4)]^{2-}$ are paramagnetic
50. BOD is
- (a) waste decomposed in 5 days
(b) oxygen used in 5 days
(c) micro-organisms killed in 5 days
(d) dissolved oxygen left after 5 days

Zoology

1. Spermatids are transformed into spermatozoa by
- (a) spermatogenesis (b) spermatosis
(c) meiosis (d) spermaton
2. Number of brain cells dead at the age of 70 years constitute
- (a) 10% (b) 20%
(c) 30% (d) 55%
3. A gamete normally contains
- (a) many alleles of a gene
(b) all alleles of a gene
(c) two alleles of a gene
(d) one allele of a gene
4. Discontinuous variations are
- (a) essential features
(b) acquired characters
(c) non-essential changes
(d) mutations
5. Down's syndrome is due to the trisomy of chromosome
- (a) 21st (b) 18th
(c) 23rd (d) 15th
6. In open vascular system, the circulating fluid is called
- (a) perilymph
(b) blood
(c) haemolymph
(d) lymphatic fluid
7. Albinism is
- (a) polygenic (b) recessive
(c) multiple allelism (d) dominant
8. Har Gobind Khurana also contributed to genetic engineering by synthesising
- (a) pBR 322 (b) viroid
(c) pBR 42 (d) artificial gene
9. Which of the following cannot determine phylogenetic relationships?
- (a) Physiology (b) Morphology
(c) Biogeography (d) Embryology
10. In the immune system, interferons are a part of
- (a) physiological barriers (b) cellular barriers
(c) physical barriers (d) cytokine barriers
11. Which of the following disease is caused by allergic reactions?
- (a) Leprosy (b) Typhoid
(c) Asthma (d) Tetanus
12. Humoral immunity system is mediated by
- (a) B-cells (b) T-cells
(c) NK-cells (d) Plasma cells
13. Oxidation process of alcohol in body is carried out mainly by
- (a) lungs (b) brain (c) kidneys (d) liver
14. Which is the most recent domestication?
- (a) Buffalo (b) Sheep
(c) Turkey (d) Silkworm
15. Nucleic acid segment tagged with a radioactive molecule is called
- (a) clone
(b) probe
(c) plasmid
(d) vector

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16. Which of the following diagnostic techniques uses x-rays?

- (a) PET (b) CT scan
(c) ECG (d) Sonography

17. Match the following columns and choose the correct combination from the given option.

Column I (Population Interaction)	Column II (Examples)
A. Mutualism	1. Ticks on dogs
B. Commensalism	2. <i>Balanus</i> and <i>Chthamalus</i>
C. Parasitism	3. Sparrow and any seed
D. Competition	4. Epiphyte on a mango branch
E. Predation	5. <i>Orchid</i> , <i>ophrys</i> and bees

Codes

A	B	C	D	E
(a) 1	5	4	3	2
(b) 2	1	5	4	3
(c) 3	2	1	5	4
(d) 4	3	2	1	5

18. In an aquatic ecosystem. The trophic level equivalent to cows in grassland is

- (a) phytoplanktons (b) zooplanktons
(c) nekton (d) benthos

19. The animal, extincted from india is

- (a) lion (b) cheetah
(c) deer (d) peacock

20. Minamata disease is a pollution related disease. In results from

- (a) Oil spills is sea
(b) DDT pollution
(c) release of industrial waste containing mercury
(d) accumulation of arsenic

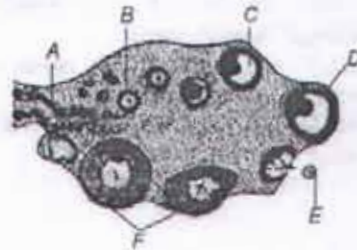
21. The polyestrous mammal is

- (a) man (b) rabbit
(c) cat (d) horse

22. How many sperm cells are present in an average (3 mL) ejaculation?

- (a) 200 million (b) 300 million
(c) 400 million (d) 400 million

23. Identify the correct labelling in the given diagram.



- (a) A–Blood vessels, B–Primary follicle, C–Tertiary follicle, D–Graafian follicle, E–Ovum, F–Corpus luteum
(b) A–Primary follicle, B–Blood vessels, C–Tertiary follicle, D–Graafian follicle, E–Ovum, F–Corpus luteum
(c) A–Blood vessels, B–Primary follicle, C–Tertiary follicle, D–Ovum, E–Graafian follicle, F–Corpus luteum
(d) A–Ovum, B–Graafian follicle, C–Corpus luteum, D–Blood vessels, E–Primary follicle, F–Tertiary follicle

24. Black water fever is caused by

- (a) *Plasmodium malariae* (b) *P. ovale*
(c) *P. falciparum* (d) *P. vivax*

25. Which one is not a coelenterate?

- (a) Sea fan (b) Sea feather
(c) Sea cucumber (d) Sea pen

26. Eggs of cockroach give rise to

- (a) nymph (b) caterpillar
(c) larva (d) pupa

27. The animal with bilateral symmetry in young stage and radial pentamerous symmetry in adult stage belong to the phylum

- (a) Annelida
(b) Mollusca
(c) Echinodermata
(d) Cnidaria

28. Which of the following character is present essentially in chordates?

- (a) Dorsal heart
(b) Pharyngeal gill slits
(c) Ventral spinal chord
(d) Blood flow in forward direction in ventral blood vessels



29. Tendons and ligaments are a kind of
(a) muscular tissue (b) connective tissue
(c) epidermal tissue (d) nervous tissue
30. The nucleolus is the site of formation of
(a) spindle fibres (b) chromosomes
(c) ribosomes (d) peroxisomes
31. Which one is a sweetest sugar?
(a) Glucose (b) Fructose (c) Sucrose (d) Maltose
32. NADP is
(a) an enzyme
(b) a part of soluble RNA
(c) a part of transfer RNA
(d) a coenzyme
33. Pepsinogen is secreted by
(a) chief cell (b) oxyntic cell
(c) mast cell (d) goblet cell
34. Residual volume in the lungs of an average human is
(a) 500 mL (b) 3-4.5 L (c) 1000 mL (d) 1500 mL
35. Haemoglobin is
(a) an oxygen carrier in human blood
(b) a protein used as food supplement
(c) an oxygen scavenger in root nodule
(d) a plant protein with high lysine content
36. Angiotensinogen is a protein produced and secreted by
(a) macula densa cells
(b) liver cells
(c) endothelial cells
(d) juxtaglomerular cells
37. Volkmann's canal occurs in
(a) bone (b) cartilage
(c) liver (d) internal ears
38. Which one of the following is not present on temporal lobe?
(a) Auditory area (b) Olfactory area
(c) Broca's area (d) Wernicke's area
39. Due to deficiency of which hormone, bones become weak in females?
(a) ACTH (b) TSH
(c) Progesterone (d) Oestrogen

40. Match the items in column I with column II and choose the correct option.

Column I	Column II
A Tidal volume	1 2500 to 3000 mL of air
B Inspiratory reserve volume	2 100 mL of air
C Expiratory reserve volume	3 500 mL of air
D Residual volume	4 3400 to 4800 mL of air
E Vital capacity	5 1200 to 1500 mL of air

Codes

	A	B	C	D	E
(a) 3	4	2	1	5	5
(b) 3	1	2	5	4	4
(c) 3	1	4	5	4	4
(d) 5	4	2	1	3	3

41. The phenomenon of metacombly is exhibited by
(a) *Euglena* (b) *Noctiluca*
(c) *Physarum* (d) Sponges
42. A coelom (body cavity) derived from blastocoel is known as
(a) schizocoel (b) enterocoel
(c) haemocoel (d) pseudocoel
43. Identify the following diagram and tick the correct one.



- (a) Gel electrophoresis showing DNA fragments
(b) *E. coli* cloning vector pBR 322 showing restriction sites
(c) Polymerase chain reaction
(d) None of the above
44. The colour of the body in earthworm is brown due to presence of
(a) porphyrin (b) haemoglobin
(c) blood (d) haemocyanin



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45. Which one of the following is a true fish?
(a) Star fish (b) Dog fish
(c) Jelly fish (d) Cuttle fish
46. Mammals have
(a) dorsal heart (b) developed brain
(c) ventral brain (d) ventral spinal cord
47. Non-cellular layer that connects inner surface of the epithelial tissue to the connective tissue is
(a) endodermis
(b) cuticle
(c) connective tissue
(d) basement membrane
48. Which one of the following statement is not correct with reference to a normal number being?
(a) Human saliva is slightly alkaline
(b) An adult human may secrete 1-1.5 L of saliva per day
(c) Saliva is secreted by six pairs of salivary glands in humans
(d) Salivary enzyme (ptyalin) breaks down cooked starch into maltose
49. The movement of chloride ions into erythrocytes from the plasma to maintain osmotic balance during transport of gases is known as
(a) chlorination
(b) Hamburger phenomenon
(c) bicarbonate shift
(d) CO_2 transport
50. The basic unit of muscle contraction is
(a) collagen (b) sarcomere
(c) bands (d) myofibrils

Botany

1. Tissue differentiation is well developed in
(a) bryophytes (b) fungi
(c) all algae (d) virus
2. Walking fern is the name used for
(a) *Equisetum* (b) *Adiantum*
(c) *Selaginella* (d) *Psilotum*
3. Pea plant belongs to the family
(a) Solanaceae (b) Poaceae
(c) Fabaceae (d) Compositae
4. Inferior ovary is found in
(a) carrot (b) rose (c) citrus (d) pea
5. When the flower is regular and radially symmetrical, it is called
(a) zygomorphic (b) assymmetric
(c) unisexual (d) actinomorphic
6. Thermonastic movement is related to
(a) high temperature (b) light
(c) touch (d) chemicals
7. The control of leaf, flower and fruit abscission and promotion of fruit ripening are the functions of
(a) gibberellins (b) ethylene
(c) auxin (d) cytokinin
8. The short day plants will not flower, if critical dark period is interrupted even with a brief exposure of
(a) yellow light (b) blue light
(c) green light (d) red light
9. Which is the major photo synthetic pathway in plants?
(a) C_3 (b) C_4
(c) CAM (d) None of these
10. Which bacterium is responsible for oxidation of ammonia to nitrite in soil?
(a) *Nitrobacter*
(b) *Clostridium*
(c) *Nocardia*
(d) *Nitrosomonas*
11. Which condition favours guttation?
(a) High humidity
(b) Low humidity
(c) More transpiration
(d) Bright sunlight
12. The plastids which store oil are
(a) amyloplasts
(b) rhodoplasts
(c) chloroplast
(d) elaioplasts



13. Idioblasts are specialised, non-green large sized
(a) sclerenchyma cells (b) parenchyma cells
(c) collenchyma cells (d) aerenchyma cells
14. Syncarpous ovary can be seen in
(a) mustard (b) wheat
(c) maize (d) buttercup
15. The process of sexual reproduction which involves meiosis and syngamy is called
(a) spermatosis (b) spermatosis
(c) agamospermy (d) diplospory
16. One gene produces many effects in case of
(a) heterosis (b) gene penetrance
(c) pleiotropic genes (d) epistasis
17. Who gave the coupling and repulsion hypothesis?
(a) Hugo de Vries (b) Bateson
(c) C. Sten (d) Doolzhynsky
18. The mechanism of switching off and switching on of the genes depending on the requirement of the cells is called
(a) gene regulation (b) gene expression
(c) inducible system (d) repressible system
19. Cosmid is
(a) extragenetic material in mycoplasma
(b) circular DNA in bacteria
(c) extra DNA in bacteria
(d) fragment of DNA inserted in bacteria for forming copies
20. Plants grown on sandy soil are grouped under
(a) lithophytes (b) psammophytes
(c) hydrophyte (d) xerophytes
21. Which process is related to the digestive tract of detritivores?
(a) Pulverisation (b) Osmosis
(c) Diffusion (d) Humification
22. A food chain starts with
(a) nitrogen-fixing organism
(b) photosynthesis
(c) respiration
(d) decomposers
23. The terminator gene technology causes
(a) failure of seed sowing after one generation
(b) breakage of seed dormancy
(c) early flowering in plants
(d) None of the above
24. Micorrhiza is useful for plants mainly due to
(a) fixing atmospheric nitrogen
(b) killing insect pests
(c) providing resistance for abiotic stress
(d) enhanced absorption of nutrients from soil
25. Which of the following is a pribnow box?
(a) 5'TAATTAG' (b) 5'TATAAT3'
(c) 5'ATATTA2' (d) 5'AATAAT3'
26. Inheritance of flower colour is an example of incomplete dominance, which is seen in
(a) *Antirrhinum* (b) *Pisum*
(c) *Solanum* (d) *Hibiscus*
27. Alleles are
(a) alternate forms of a gene
(b) homologous chromosomes
(c) pair of sex chromosomes
(d) None of the above
28. In the L.S. of the embryo of gram, which one is shows the correct labelling?





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- (a) A-Scutellum, B-Coleoptile, C-Shoot apex, D-Epiblast E-Redicle, F-Root cap, G-Coleorhiza
(b) A-Root cap, B-Shoot apex, C-Scutellum, D-Coleoptile E-Epiblast F-Redicle G-Coleorhiza
(c) A-Coleorhiza, B-Redicle, C-Epiblast, D-Coleoptile E-Root cap F-Scutellum G-Shoot apex
(d) None of the above
29. Which propagates through buds at leaf tip?
(a) *Begonia* (b) *Bryophyllum*
(c) *Adiantum* (d) *Agave*
30. Walter Sutton is famous for his contribution to
(a) genetic engineering
(b) totipotency
(c) quantitative genetics
(d) chromosomal theory of inheritance
31. Bacterium responsible for retting of jute and flax is
(a) *Lactobacillus* (b) *Clostridium*
(c) *Bacillus* (d) *Agrobacterium*
32. The juvenile stage of moss is
(a) meiospore (b) capsule
(c) protonema (d) sporophyte
33. One of these is not related to dicots
(a) two cotyledons
(b) leaves reticulated
(c) secondary growth absent
(d) pollen with three furrows
34. The characteristic inflorescence of family-Asteracea is
(a) umbel (b) spadix (c) catkin (d) capitulum
35. Stipules remain persistent throughout the whole life of the leaves in
(a) *Michelia* (b) *Cassia*
(c) *Hibiscus* (d) *Oryza*
36. Pepo is a fruit of
(a) Cruciferae (b) Leguminosae
(c) Cucurbitaceae (d) Liliaceae
37. Intercalary meristem produces
(a) secondary growth
(b) primary growth
(c) apical growth
(d) secondary thickening
38. Which one is the sweetest sugar?
(a) Sucrose (b) Glucose
(c) Fructose (d) Maltose
39. Crop rotation is used by farmers to increase
(a) soil fertility
(b) community area
(c) organic content of soil
(d) nitrogenous content in the soil
40. Hydroponics is a system of growing plants in
(a) soil less cultures
(b) acidic soils
(c) soil less cultures with alkaline pH
(d) soil less cultures with acidic pH
41. In higher plants, the shape of the chloroplast is
(a) discoid (b) cup-shaped
(c) girdle-shaped (d) reticulate
42. Acetyl Co-A binds to oxaloacetic acid to form
(a) formaldehyde (b) citrate
(c) acetate (d) isocitrate
43. Which of the following can induce flowering in long day plants?
(a) IBA (b) IAA (c) GA_3 (d) NAA
44. When its terminal bud is removed, a plant grows more
(a) tall (b) bushy (c) slowly (d) rapidly
45. Coralloid roots in *Cycas* are inhabited by
(a) *Anabaena* (b) fungi
(c) *Triticum* (d) *Iemna*
46. Compound spike inflorescence is present in plants of
(a) onion (b) potato
(c) wheat (d) cucumber
47. When the parts of a flower whorl are found in a particular basic number of its multiple, the flower is called
(a) heteromerous (b) isomerous
(c) epigynous (d) parigynous
48. The most common type of compound leaves occurring in nature are
(a) bipinnate (b) tripinnate
(c) trifoliate (d) decomposed



49. Plants which require human help for cultivation are called
- (a) cultigens
(b) indulines
(c) predators
(d) domesticated
50. Trophic levels in ecosystem is formed by
- (a) only bacteria
(b) only plants
(c) only herbivores
(d) organisms linked in food chain

हिन्दी

1. हिन्दी वर्णमाला में वर्णों की कुल संख्या है
- (a) 50 (b) 52
(c) 57 (d) 55
2. इनमें से कौन-सी ध्वनि अन्तःस्वय नहीं है?
- (a) व (b) घ
(c) र (d) ल
3. इनमें से 'ऊष्म' वर्ण कौन-सा है?
- (a) त (b) फ
(c) र (d) घ
4. निम्न में कौन सही है?
- (a) इ, उ को वर्णमाला में स्थान प्राप्त है
(b) पहला तथा तीसरा वर्ण 'महाप्राण' होता है
(c) च, छ, ज, झ स्पर्श-संघर्षी हैं
(d) य, र, ल, व ऊष्म वर्ण हैं
5. निम्न में से कौन सही शब्द है?
- (a) पुरुष (b) पुरुष
(c) पुरुष (d) पुरुष
6. 'क + ए' से निर्मित रूप है
- (a) का (b) के (c) कै (d) को
7. 'अनुत्तान' का सम्बन्ध है
- (a) उच्चारण के समय से
(b) उच्चारण के उत्तर-चढ़ाव से
(c) उच्चारण में निकली वायु से
(d) उच्चारण के कम्पन से
8. निम्न में कौन सही है?
- (a) अल्पप्राण में मुख से वायु की कम मात्रा निकलती है
(b) महाप्राण में मुख से वायु की कम मात्रा निकलती है
(c) अल्पप्राण में खास स्वर पर बल पड़ता है
(d) महाप्राण में शब्द के प्रथम स्वर पर बल पड़ता है
9. निम्न में कौन 'महाप्राण' नहीं है?
- (a) श (b) स (c) छ (d) घ
10. निम्न में से किस युग्म को अर्द्धस्वर कहा जाता है?
- (a) य, व (b) य, र (c) व, फ (d) ग, घ
11. कौन-सा वर्ण ओष्ठ्य नहीं है?
- (a) प (b) न (c) म (d) ब
12. निम्न में कौन असत्य है?
- (a) त ओष्ठ्य व्यंजन है (b) श ऊष्म व्यंजन है
(c) फ ओष्ठ्य व्यंजन है (d) क्ष संयुक्त व्यंजन है
13. 'ज्ञ' को वर्णमाला में माना जाता है
- (a) संयुक्त व्यंजन (b) द्विगुण व्यंजन
(c) स्वर (d) व्यंजन
14. निम्न में से कौन अन्तःस्वय व्यंजन वर्ण नहीं है?
- (a) घ (b) र
(c) ल (d) ब
15. वर्णमाला में किसे 'स्पर्श संघर्षी' भी कहा जाता है?
- (a) क वर्ण को (b) ट वर्ण को
(c) च वर्ण को (d) प वर्ण को
16. निम्न में से कौन व्यंजन वर्ण 'दन्त्य' नहीं है?
- (a) त (b) द (c) ध (d) फ
17. निम्न में से कौन स्पर्श व्यंजन नहीं है?
- (a) क (b) च (c) प (d) घ
18. विसर्ग (:) का प्रयोग कैसे शब्दों में होता है?
- (a) तत्सम (b) तद्भव (c) देशज (d) विदेशी
19. निम्न में किस शब्द में रुढ़ मात्रा प्रयुक्त हुई है?
- (a) रेनु (b) रेनु (c) रेणु (d) रेणु
20. किस स्वर का कोई मात्रा-चिह्न नहीं है?
- (a) अ (b) आ (c) ए (d) ओ
21. निम्न में से कौन 'अघोष' वर्ण नहीं है?
- (a) क (b) ट (c) स (d) ल
22. निम्न में से कौन-सा युग्म 'कण्ठतालव्य' है?
- (a) ए, ऐ (b) च, छ (c) य, व (d) त, थ
23. 'श' का उच्चारण स्थान है
- (a) तालव्य (b) मूर्धन्य (c) कण्ठ्य (d) दन्त्य
24. 'ध' का उच्चारण स्थान क्या है?
- (a) कंठ (b) तालु (c) ओष्ठ (d) दन्त्य



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25. निम्न में से कौन ऋम्-व्यंजन नहीं है?
(a) र (b) ष (c) स (d) र
26. शब्द किसे कहते हैं?
(a) एक या एक से अधिक सार्थक वर्ण समूह को
(b) एक या एक से अधिक वर्णों के मेल को
(c) ध्वनि की छोटी इकाई को
(d) भाषा की सबसे छोटी इकाई को
27. महाराष्ट्र में किस भाषा का प्रयोग अधिक होता है?
(a) अंग्रेजी (b) हिन्दी (c) मराठी (d) मैथिली
28. किसने कहा था कि 'शब्द की ज्योति न जली होती तो विश्व अन्धकारमय होता'?
(a) महर्षि दण्डी (b) आचार्य शुक्ल
(c) भरत मुनि (d) आचार्य द्विवेदी
29. व्याकरण से किसके अस्तित्व की जानकारी नहीं मिलती?
(a) ध्वनि (b) शब्द (c) वाक्य (d) लिपि
30. हिन्दी को मानक रूप प्रदान करने का सर्वप्रथम प्रयास किसने किया?
(a) किशोरीदास वाजपेयी (b) किशोरीलाल गोस्वामी
(c) श्यामसुन्दर दास (d) डॉ. नगेन्द्र
31. स्वामी दयानन्द सरस्वती ने किस की रचना हिन्दी भाषा में की?
(a) योग चरिण्ट (b) सुधासागर
(c) सत्यार्थ प्रकाश (d) वेदान्त धर्म
32. भाषा की सार्थक लघुतम इकाई है
(a) ध्वनि (b) शब्द
(c) वाक्य (d) संयुक्त वाक्य
33. अशोक के शिलालेख ब्राह्मी लिपि तथा किस भाषा में उत्कीर्ण हैं?
(a) संस्कृत (b) पालि (c) प्राकृत (d) हिन्दी
34. पूर्वी-हिन्दी का सम्बन्ध माना गया है
(a) मागधी अपभ्रंश (b) अर्द्ध-मागधी अपभ्रंश
(c) शौरसेनी अपभ्रंश (d) इनमें से कोई नहीं
35. राजकीय कार्यों में प्रयुक्त होने वाली भाषा कहलाती है
(a) राजभाषा (b) राष्ट्रभाषा
(c) मानक भाषा (d) लोकभाषा
36. हिन्दी की उपभाषाएँ कितनी हैं?
(a) तीन (b) चार (c) दो (d) पाँच
37. निम्न में से कौन पूर्वी हिन्दी की बोली नहीं है?
(a) ब्रज (b) अवधी
(c) बघेली (d) छत्तीसगढ़ी
38. निम्नलिखित में से किसने मैथिली में भी रचनाएँ कीं?
(a) जयदेव (b) विद्यापति
(c) सुरदास (d) बिहारी
39. निम्नलिखित में से कौन-सा प्रान्त हिन्दी क्षेत्र के अन्तर्गत नहीं आता?
(a) हरियाणा (b) उत्तराखण्ड
(c) गुजरात (d) झारखण्ड
40. बिहारी हिन्दी के अन्तर्गत कौन-सी बोली नहीं आती?
(a) मैथिली (b) मगही
(c) भोजपुरी (d) अवधी
41. कौन-सी बोली हिन्दी की उपभाषा 'पहाड़ी' की नहीं है?
(a) गढ़वाली (b) कुमाऊँनी
(c) कोकणी (d) इनमें से कोई नहीं
42. निम्न में से कौन सत्य है?
(a) हिन्दी भारत की राष्ट्रभाषा तथा राजभाषा दोनों है
(b) तमिलनाडु की राजकीय भाषा हिन्दी है
(c) इण्डोनेशिया की आधी आबादी हिन्दी बोलती है
(d) अवधी बिहार के दक्षिणी जिलों में बोली जाती है
43. 'भाषा' संस्कृत की किस धातु से निष्पत्ति हुई है?
(a) भष् (b) भाष्
(c) भाश् (d) भक्
44. 'मागधी' निम्न में से किस भाषा को कहा जाता है?
(a) प्राकृत (b) पालि
(c) संस्कृत (d) हिन्दी
45. आचार्य हेमचन्द्र ने किसके व्याकरणों की रचना की?
(a) प्राकृत तथा अपभ्रंश (b) संस्कृत तथा प्राकृत
(c) अपभ्रंश तथा हिन्दी (d) संस्कृत तथा हिन्दी
46. 'व्याकरण-दर्पण' किसकी रचना है?
(a) शिवभूजन सहाय (b) किशोरीदास वाजपेयी
(c) रामचन्द्र शुक्ल (d) श्यामसुन्दर दास
47. बिहार की राजधानी 'पटना' किस बिहारी बोली क्षेत्र में स्थित है?
(a) मैथिली (b) भोजपुरी (c) मगही (d) अंगिका
48. 'देवनागरी' किस भाषा की लिपि नहीं है?
(a) हिन्दी (b) नेपाली
(c) मराठी (d) उर्दू
49. निम्नलिखित में से कौन हिन्दी की उपभाषा नहीं है?
(a) पश्चिमी
(b) पूर्वी
(c) पहाड़ी
(d) दक्षिणी
50. मध्यकाल में काव्य-भाषा के रूप में सर्वाधिक प्रचलित बोली थी
(a) राजस्थानी
(b) मगही
(c) ब्रजभाषा
(d) बघेली



Answers

Physics

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

Chemistry

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

Zoology

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

Botany

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

हिन्दी

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



Hints & Solutions

Physics

1. The resonance wave becomes very sharp when damping force is small.

2. From graph, velocity of robber's car = 10 m/s

Let police car crosses it after T second.

Distance travelled by robber's car = $10T$ m

Police car is moving with a constant acceleration of 1 m/s^2 as it attains a velocity of 10 m/s in 10 s after starting from rest.

Distance travelled in t second

$$= \frac{1}{2} \cdot a \cdot t^2 = \frac{1}{2} t^2.$$

When the police car crosses the robber's car, distance travelled by the both cars should be same from the starting point of chase.

$$\therefore \frac{1}{2} t^2 = 10t$$

$$\Rightarrow t = 20\text{ s.}$$

3. As the boy stands up, the centre of gravity of the pendulum is raised up, decreasing the effective length of the pendulum of the swing and hence the time period T decreases.

4. Frequency of oscillator $n = \frac{1}{2\pi} \sqrt{\frac{K}{m}}$

$$\text{We get, } \frac{n_2}{n_1} = \sqrt{\frac{m_1}{m_2}}$$

$$\therefore 2 = \sqrt{\frac{m_1}{m_2}}$$

$$\text{or } m_2 = \frac{1}{4} m_1$$

5. Density of water is maximum at 4°C . Therefore, volume will increase both when it is heated or cooled.

6. In kinetic theory of gases, it is assumed that time taken in a collision is negligible compared to the average time taken in free travel between any two collisions, to be precise.

7. As $I \propto A^2$ or $I = KA^2$

$$\text{We get, } \frac{A_1}{A_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{I}{4I}} = \frac{1}{2}$$

$$\Rightarrow A_1 = \frac{1}{2} A_2$$

$$\text{Now, } I_{\text{max}} = K(A_1 + A_2)^2$$

$$= K(A_1 + 2A_1)^2 = K9A_1^2 = 9I$$

$$\text{and } I_{\text{min}} = K(A_1 - A_2)^2 = K(A_1 - 2A_1)^2$$

$$= KA_1^2 = I$$

$$\therefore \frac{I_{\text{max}}}{I_{\text{min}}} = \frac{9I}{I} = 9:1$$

8. $\bar{A} + A$ should always be equal to 1. As addition of inputs like 1 to 0 or 0 to 1 always gives 1.

9. When transition takes place from higher energy level to lower energy level, the energy difference $\Delta E = hv = \frac{hc}{\lambda} \therefore \lambda = \frac{hc}{\Delta E}$

$$\text{So, } \frac{\lambda_2}{\lambda_1} = \frac{\Delta E_1}{\Delta E_2}$$

$$\text{When } \Delta E_1 = 2E - E = E; \lambda_1 = \lambda$$

$$\text{and for } \Delta E_2 = \frac{4}{3}E - E = \frac{E}{3}$$

$$\frac{\lambda_2}{\lambda} = \frac{E}{\frac{E}{3}} = 3 \Rightarrow \lambda_2 = 3\lambda$$

10. Given, rest mass energy,

$$m_0c^2 = 0.51\text{ MeV} \quad \dots(i)$$

$$\text{Kinetic energy, } mc^2 - m_0c^2 = 9.69\text{ MeV} \quad \dots(ii)$$

Adding Eqs. (i) and (ii),

$$(m_0c^2 + mc^2 - m_0c^2) = (0.51 + 9.69)\text{ MeV}$$

$$\Rightarrow mc^2 = 10.20\text{ MeV} \quad \dots(iii)$$

Dividing Eq. (iii) by Eq. (i) we get

$$\frac{mc^2}{m_0c^2} = \frac{10.20}{0.51} \Rightarrow \frac{m}{m_0} = \frac{20}{1}$$



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11. A star whose mass is more than five times the solar mass is converted into black hole because a black hole is a corpse of a dead star of mass more than five solar masses.

12. The depletion is the $p-n$ junction region is caused due to the diffusion of carriers on either side of the junction.

13. Let the charge on the inner sphere be Q , then the charge induced on the inner surface of the outer sphere is $-Q$.

\therefore Electric potential V of the inner sphere is given by

$$V = \frac{Q}{4} - \frac{Q}{6}$$

But $V = 3 \therefore 3 = \frac{Q}{4} - \frac{Q}{6}$

$$\Rightarrow Q \left[\frac{1}{4} - \frac{1}{6} \right] = 3$$

$$\Rightarrow \frac{Q}{12} = 3$$

$$\Rightarrow Q = 36 \text{ e.s.u}$$

14. We have, $1P = 1 \text{ g/cm/s}$

$$\therefore 1P^2 = 10 \text{ g/cm/s} \\ = 10P$$

15. The number of molecules (n) in a volume (V) at pressure p and temperature T is given by

$$n = \frac{pV}{KT}$$

Here, $p = 10^6 \text{ dyne/cm}^2$, $V = 1000 \text{ cm}^3$

$$T = 273 + 27 = 300 \text{ K}$$

$$K = 1.38 \times 10^{-16} \text{ ergs per molecule per K.}$$

$$\therefore n = \frac{(10^6)(1000)}{1.38 \times 10^{-16} \times 300} = 2.4 \times 10^{22}$$

16. Let the wire carries current I ampere, then the magnetic induction due to this wire at a distance $r = 5 \text{ cm}$ is given as

$$B = \frac{\mu_0}{4\pi} \times \frac{2(I)}{5 \times 10^{-2}} \text{ Tesla}$$

$$= (10^{-7}) \times \frac{2I}{5 \times 10^{-2}} \times 10^4 \text{ Gauss}$$

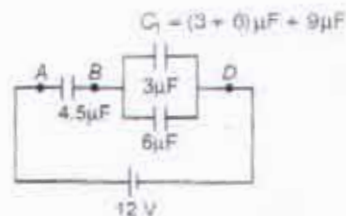
or $B = 4I \times 10^{-2} \text{ Gauss}$

At the neutral point, the magnetic induction due to earth's horizontal component is equal and opposite to that due to current carrying conductor

$$\therefore 4I \times 10^{-2} = 0.18$$

$$\Rightarrow I = \frac{0.18}{4 \times 10^{-2}} = 4.5 \text{ A}$$

17. The given circuit capacitance between B and D is



Capacitance between A and D

$$\frac{1}{C_2} = \frac{1}{4.5} + \frac{1}{9} = \frac{2+1}{9} = \frac{3}{9}$$

$$\Rightarrow C_2 = 3 \mu\text{F}$$

Charge on $C_2 = (3 \mu\text{F})(12 \text{ V}) = 36 \mu\text{C}$

So, the potential difference between A and B

$$= \frac{\text{Charge}}{\text{Capacitance}} \\ = \frac{36 \mu\text{C}}{4.5 \mu\text{F}} = 8 \text{ V}$$

18. Net outward electric flux through the closed surface

$$= (+3000) + (-5000) = -2000$$

But electric flux $\phi = \frac{q}{\epsilon_0}$

$$\therefore \frac{q}{\epsilon_0} = -2000$$

$$\Rightarrow q = -2000 \times 8.85 \times 10^{-12} \\ = -1.77 \times 10^{-8} \text{ C}$$

19. If a liquid can rise to a height h , but the tube has insufficient height h' , then the angle of contact increases from θ to θ' given by

$$\frac{h}{\cos \theta} = \frac{h'}{\cos \theta'}$$

Here, $h = 2 \text{ cm}$, $h' = 1 \text{ cm}$, $\theta = 30^\circ$



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$$\therefore \frac{2}{\cos 0} = \frac{1}{\cos \theta'}$$

$$\Rightarrow \frac{2}{1} = \frac{1}{\cos \theta'}$$

$$\text{or } \cos \theta' = \frac{1}{2}$$

$$\Rightarrow \theta' = 60^\circ$$

20. Volume of the rubber cord = AL

Weight of the rubber cord = $ALDg$.

$$\therefore \text{Stress} = \frac{ALDg}{A} = LDg$$

The weight of the rubber cord acts at the centre of gravity which is $\frac{L}{2}$ from the top.

$$\therefore \text{Strain} = \frac{l}{L/2} = \frac{2l}{L}$$

$$\text{So, Young's modulus, } E = \frac{\text{Stress}}{\text{Strain}} = \frac{LDg}{2l/L}$$

$$= \frac{L^2 Dg}{2l}$$

$$\text{or } l = \frac{L^2 Dg}{2E}$$

21. Resistance of upper part

$$DAC = 2 + 3 = 5\Omega$$

Resistance of lower part $DBC = 3 + 2 = 5\Omega$

Since the resistances of the two parts is equal, hence the current 2 A divide equally along these parts.

So, current in part $DAC =$ current in part $DBC = \frac{2}{2} = 1\text{ A}$

$$\therefore V_D - V_A = 1 \times 2 = 2\text{ V} \quad \dots(i)$$

$$\text{and } V_D - V_B = 1 \times 3 = 3\text{ V} \quad \dots(ii)$$

$$\therefore (V_D - V_B) - (V_D - V_A) = 3 - 2 = 1$$

$$\text{or } V_A - V_B = 1\text{ V}$$

22. Heat produced in the resistance R_1

$$Q_1 = \left(\frac{E}{R_1 + r} \right)^2 R_1 t$$

Heat produced in the resistance R_2

$$Q_2 = \left(\frac{E}{R_2 + r} \right)^2 R_2 t$$

That developed in both the cases is the same

$$\therefore Q_1 = Q_2$$

$$\therefore \left(\frac{E}{R_1 + r} \right)^2 R_1 t = \left(\frac{E}{R_2 + r} \right)^2 R_2 t$$

$$\Rightarrow \frac{R_1}{(R_1 + r)^2} = \frac{R_2}{(R_2 + r)^2}$$

$$\Rightarrow R_1 (R_2 + r)^2 = R_2 (R_1 + r)^2$$

$$\Rightarrow R_1 (R_2^2 + 2R_2 r + r^2)$$

$$= R_2 (R_1^2 + 2R_1 r + r^2)$$

$$\Rightarrow R_1 R_2^2 + 2R_1 R_2 r + R_1 r^2$$

$$= R_2 R_1^2 + 2R_2 R_1 r + R_2 r^2$$

$$\Rightarrow R_1 R_2 (R_2 - R_1) = r^2 (R_2 - R_1)$$

$$\Rightarrow r = \sqrt{R_1 R_2}$$

23. We have, $\omega_2 = \omega_1 + \alpha t$

$$\Rightarrow \omega_1 = \omega_2 - \alpha t$$

Here, $\omega_1 = 0$

$$\text{and } \omega_2 = 60 \text{ rpm} = \frac{60 \times 2\pi}{60} \text{ rad/s}$$

$$\Rightarrow 0 = 2\pi \times \frac{60}{60} - \alpha \cdot 60$$

$$\text{or } \alpha = \frac{2\pi}{60}$$

$$\therefore \text{Torque, } \tau = I\alpha = 2 \times \frac{2\pi}{60} = \frac{\pi}{15} \text{ N-m}$$

24. As the horizontal ranges are the same.

$$\therefore \frac{v_0^2 \sin 2\theta_1}{g} = \frac{v_0^2 \sin 2\theta_2}{g}$$

$$\text{So, } \sin 2\theta_1 = \sin 2\theta_2$$

$$\text{or } 2\theta_1 = \pi - 2\theta_2$$

$$\Rightarrow \theta_1 + \theta_2 = \pi/2$$

$$\therefore (R_1)_{\max} = \frac{v_0^2 \sin^2 \theta_1}{2g}$$

$$\text{and } (R_2)_{\max} = \frac{v_0^2 \sin^2 \theta_2}{2g}$$

$$\therefore \frac{(R_1)_{\max}}{(R_2)_{\max}} = \frac{\sin^2 \theta_1}{\sin^2 \theta_2}$$

$$= \frac{\sin^2 \theta_1}{\cos^2 \theta_1} = \tan^2 \theta_1$$



25. The critical angles $\left[C = \sin^{-1} \frac{1}{n} \right]$ for red ($n = 1.39$), green ($n = 1.44$) and blue ($n = 1.47$) lights are 46° , 44° and 43° respectively.

All colours will strike the hypotenuse face at 45° . Hence green and blue rays will totally reflected while red rays will get through.

26. Angle between the two plane mirrors, $\theta = 90^\circ$

As reflection is independent of medium

\therefore Deviation produced by the combination of two plane mirrors is $\delta = 2\pi - 2\theta$
 $= 2\pi - 2(\pi/2) = \pi = 180^\circ$

27. Refractive index of medium is given by

$$\mu = \frac{c}{v}, \text{ where } c = \frac{1}{\sqrt{\mu_0 \mu_r \epsilon_0}}$$

$$\text{and } v = \frac{1}{\sqrt{\mu_0 \mu_r \epsilon_0}}$$

$$\therefore \mu = \frac{1/\sqrt{\mu_0 \mu_r \epsilon_0}}{1/\sqrt{\mu_0 \mu_r \epsilon_0}} = \sqrt{\mu_r \epsilon_r}$$

Here, $\mu_r = \mu_0$ and $\epsilon_r = \epsilon_0$

$$\therefore \mu = \sqrt{\mu_0 \epsilon_0}$$

28. Photoelectric current only depends upon the intensity of incident beam and is independent of frequency of incident beam.

29. Phenomenon of radioactivity is a nuclear process which does not depend on external forces.

30. From $E = (\Delta m)c^2$

$$\Delta m = \frac{E}{c^2} = \frac{9 \times 10^{13}}{(3 \times 10^8)^2} = 10^{-3} \text{ kg}$$

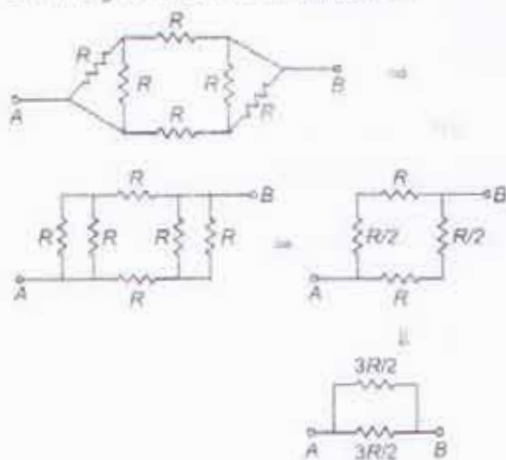
$$\therefore \frac{\Delta m}{m} \times 100 = \frac{10^{-3}}{1} \times 100 = 0.1\%$$

31. A digital signal has only two values of voltage variation with time in its value either zero or maximum.

32. The diode D_1 is reverse biased and D_2 is forward biased. The resistance of D_1 becomes infinite and of D_2 is zero. Therefore current in the circuit, $i = \frac{emf}{\text{total resistance}} = \frac{12}{4+2} = 2 \text{ A}$

33. Modulation is the process of superposing the low frequency audio signal on high frequency radio waves for good communication.

34. The given circuit can be redrawn as



\therefore Equivalent resistance across A and B

$$R_{eq} = \frac{(3R/2)(3R/2)}{\left(\frac{3R}{2} + \frac{3R}{2}\right)} = \frac{3R}{4}$$

35. $W = -MB(\cos \theta_2 - \cos \theta_1)$

$$\text{So, } W_1 = -MB(\cos 90^\circ - \cos 0^\circ) = MB$$

$$\text{and } W_2 = -MB(\cos 60^\circ - \cos 0^\circ) = -\frac{1}{2} MB$$

$$\text{Given } W_1 = nW_2$$

$$\therefore n = \frac{W_1}{W_2} = \frac{MB}{-1/2 MB} = -2$$

36. Given, $M = 0.05 \text{ H}$

$$i = I_0 \sin \omega t$$

$$\therefore \frac{di}{dt} = I_0 \cos \omega t$$

$$\Rightarrow \left(\frac{di}{dt}\right)_{\text{max}} = I_0 \cos 0 = 1 \times 10 \pi \text{ A/s}$$

$$\text{So, } a_{\text{max}} = M \left(\frac{di}{dt}\right)_{\text{max}} = 0.05 \times 10 \pi = 5\pi \text{ V}$$

37. Power factor, $\cos \phi = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$



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38. Since a real velocity of planet around the sun is constant, hence equal areas are swept in equal intervals of time.

As area $SCD = 2$ area SAB ,

\therefore Time taken to go from C to D (t_1) is double the time taken to go from A to B .

Thus, $t_1 = 2t_2$

39. Angular momentum = linear momentum \times perpendicular distance from the axis of rotation.

$$= \text{mass} \times \text{orbital velocity} \times \text{radius}$$

$$= m \times \sqrt{\frac{GM}{R_0}} \times R_0 = m \sqrt{GM R_0}$$

40. The bob is under the action of two perpendicular accelerations horizontal acceleration ' a ' and vertical downward acceleration ' g '. Thus resultant acceleration

$$g' = \sqrt{g^2 + a^2}$$

41. Minimum energy, $E = 13.6Z^2$ (eV)

$$= 13.6(3)^2 = 122.4 \text{ eV}$$

42. The maximum kinetic energy of an electron accelerated through a potential difference by V volts is

$$\frac{1}{2} m v_{\text{max}}^2 = eV$$

$$\Rightarrow v_{\text{max}} = \sqrt{2eV/m}$$

$$= \sqrt{\frac{2 \times (1.6 \times 10^{-19}) \times (15000)}{(9.1 \times 10^{-31})}}$$

$$= 7.26 \times 10^7 \text{ m/s}$$

Minimum wavelength of emitted X-rays is

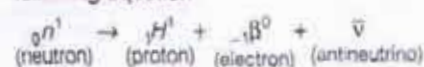
$$\lambda_{\text{min}} = \frac{hc}{eV} = \frac{(6.6 \times 10^{-34})(3 \times 10^8)}{(1.6 \times 10^{-19})(15000)}$$

$$= 0.825 \times 10^{-10} \text{ m} = 0.825 \text{ \AA}$$

43. Given, $m_1 = M, m_2 = M/2$

$$\therefore a = \frac{(m_1 - m_2)g}{(m_1 + m_2)} = \frac{(M - M/2)g}{(M + M/2)} = \frac{g}{3}$$

44. The decay of a neutron is represented by following equation



45. The relation $v = r$ is Hubble's law, used to find the distance of a galaxy from us.

46. Given, $m = 500 \text{ kg}$

Rise in temperature,

$$d\theta = (100^\circ - 20^\circ)C = 80^\circ C$$

Specific heat of water, $C = 10^3 \text{ cal kg}^{-1} \text{ C}^{-1}$

Heat energy gained by water, $E = mcd\theta$

$$= 500 \times 10^3 \times 80 \text{ cal}$$

$$= 4 \times 10^7 \times 4.2 \text{ J}$$

$$= 16.8 \times 10^7 \text{ J}$$

From, $E = mc^2$

Increase in mass of water,

$$m = \frac{E}{c^2} = \frac{16.8 \times 10^7}{(3 \times 10^8)^2}$$

$$= 1.87 \times 10^{-9} \text{ kg}$$

47. Centripetal acceleration,

$$a_c = \frac{v^2}{r} = k^2 \pi^2$$

$$\therefore v^2 = k^2 r^2 t^2$$

$$\text{Kinetic energy, } K = \frac{1}{2} m v^2 = \frac{1}{2} m k^2 r^2 t^2$$

$$t = 0, K = 0$$

According to work energy principle,

$$W = \Delta K = \frac{1}{2} m k^2 r^2 t^2 - 0 = \frac{1}{2} m k^2 r^2 t^2$$

\therefore Power delivered,

$$P = \frac{dW}{dt} = \frac{d}{dt} \left(\frac{1}{2} m k^2 r^2 t^2 \right) = \frac{1}{2} m k^2 r^2 (2t)$$

$$= m k^2 r^2 t$$

48. Given $u = 0, s = 1.5 \text{ m}, t = 0.4 \text{ s}$

$$\text{From } s = ut + \frac{1}{2} at^2$$

$$\Rightarrow 1.5 = 0 + \frac{1}{2} a(0.4)^2$$

$$\Rightarrow a = \frac{1.5 \times 2}{(0.4)^2} = 18.75 \text{ m/s}^2$$

As the string is moving upwards with in acceleration

$$\therefore T = m(g + a) = 2(9.8 + 18.75) = 57.1 \text{ N}$$



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49. Bulk modulus $\beta = \frac{\rho}{dV/V}$
 or $dV = \frac{\rho V}{\beta}$
 $\therefore \rho' = \frac{M}{V - dV}$
 $= \frac{M}{V - (\rho V/\beta)}$
 $= \frac{M}{V(1 - \rho/\beta)}$
 $= \frac{\rho}{(1 - \rho/\beta)}$
 $\therefore \frac{\rho'}{\rho} = \frac{1}{(1 - \rho/\beta)}$

50. The given situation can be shown as:



$$v = \frac{v}{4l} = 412 \text{ Hz}$$

$$\text{or } \frac{v}{l} = 4 \times 412 \text{ Hz}$$

$$\text{So, } v_1 = \frac{v}{2(l/2)} = \frac{v}{l} = 4 \times 412 = 1648 \text{ Hz}$$

$$\text{and } v_2 = \frac{v}{4\left(\frac{l}{2}\right)} = \frac{1}{2} \left(\frac{v}{l}\right) = \frac{1}{2} \times 1648 = 824 \text{ Hz}$$

Chemistry

1. From gas equation

$$pV = nRT$$

$$\text{or } n = \frac{pV}{RT}$$

$$\therefore 5 = \frac{p \times V}{R \times 300}$$

$$\text{At } T = 300 \text{ K, } n = 5 \text{ mol}$$

$$\text{At } T = 600 \text{ K and } p' = 2p$$

$$n' = \frac{2p \times V}{R \times 600}$$

$$\therefore n' = 5 \text{ mol}$$

2. The number of moles of chloride ion in 300 mL of 3.0 M NaCl = $\frac{3}{1000} \times 300 = 0.9 \text{ mol}$.

The number of moles of chloride ion in 200 mL of 4.0 M BaCl₂ solution = $\frac{4}{1000} \times 200 = 0.8 \text{ mol}$

mol



\therefore Moles of Cl⁻ ions = $0.8 \times 2 = 1.6 \text{ mol}$

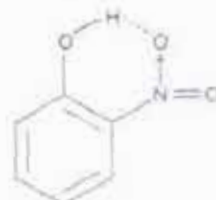
Total volume of solution = $200 + 300 = 500 \text{ mL}$

As $1.6 + 0.9 = 2.5$ moles of chloride ions are present in 500 mL solution.

\therefore Molar concentration of Cl⁻ ions in the resulting solution = $\frac{2.5}{500} \times 100 = 5.0 \text{ M}$

3. N₂ and PH₃ gases are sparingly soluble in water (= 2 mL/100 mL of water at STP), and O₂ is also slightly soluble in water (= 3 mL/100 mL of water at STP) whereas SO₂ gas is highly soluble in water and its solution is known as SO₂ water. Thus, SO₂ gas cannot be collected over water by displacing it from an inverted graduated cylinder.

4. Picric acid (2, 4, 6-trinitro phenol), benzenesulphonic acid and benzoic acid are strong acids in nature and react with alkali sodium carbonate to form their salts, whereas in o-nitrophenol, —NO₂ and —OH groups are located exactly right for the formation of intramolecular hydrogen bond, therefore o-nitrophenol doesn't remove its —H atom and doesn't react with sodium carbonate solution.



Intramolecular H-bond in o-nitrophenol



Equilibrium conc. $C(1-\alpha)$ $C\alpha$ $C\alpha$

$$\therefore K_b = \frac{[\text{NH}_2\text{NH}_3^+][\text{OH}^-]}{[\text{NH}_2\text{NH}_2]}$$

$$= \frac{C\alpha \times C\alpha}{C(1-\alpha)}$$

or $K_b = C\alpha^2$ ($\because \alpha \ll 1$)

or $\alpha = \sqrt{\frac{K_b}{C}}$

$$= \sqrt{\frac{6 \times 10^{-8}}{0.25 \times 10^{-2}}}$$

$$= 0.489 \times 10^{-2}$$

Degree of ionisation = 0.489×10^{-2}

% of N_2H_4 that has reacted with water
(% ionisation)

$$= (0.489 \times 10^{-2}) \times 100$$

$$= 0.489\%$$

9. Chlorine reacts with water forming HCl and HClO (hypo-chlorous acid). HClO further decomposes to give HCl and nascent oxygen



Thus, saturated aqueous solution of Cl_2 has HCl acid and HCl when reacts with AgNO_3 solution, gives white precipitate of AgCl.

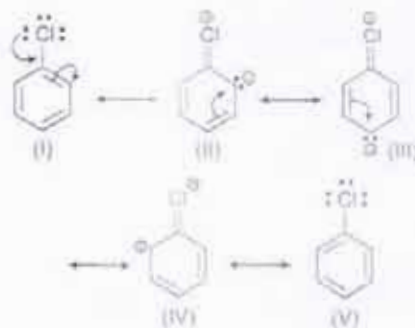


HCl solution also reacts with magnesium ribbon quite rapidly forming magnesium chloride and H_2 gas.



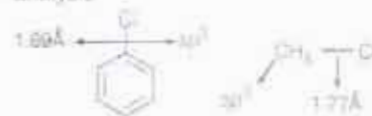
10. The C—Cl bond of chlorobenzene is shorter and stronger in comparison to C—Cl bond of methyl chloride due to following two reasons:

(i) In chlorobenzene lone pair of electrons present at chlorine atom conjugates with π -electrons of benzene ring, as a result of which, same double bond character is developed between the C—Cl bond and hence this bond becomes shorter and stronger.



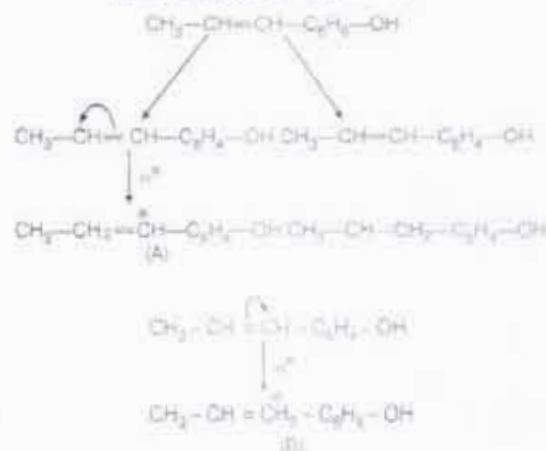
(i) In chlorobenzene, C-atom bearing chlorine is in sp^2 hybridised state, whereas in alkyl chloride, it is in sp^3 hybridised state. Since sp^2 hybrid orbital is smaller in size as compared to sp^3 hybrid orbital therefore C—Cl bond in chlorobenzene is shorter and hence, stronger than alkyl halide.

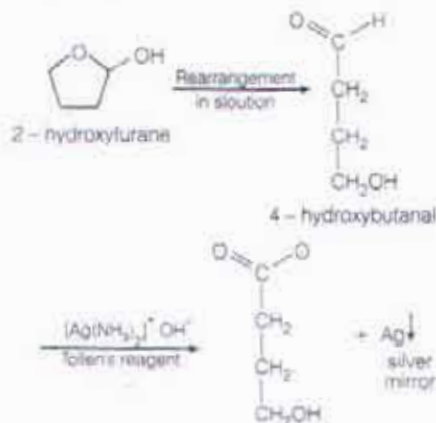
This has also been confirmed by X-ray analysis.



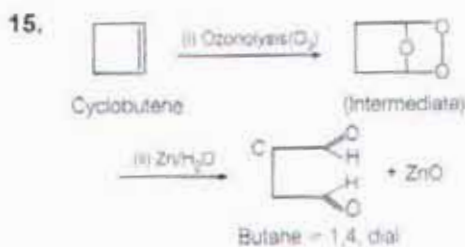
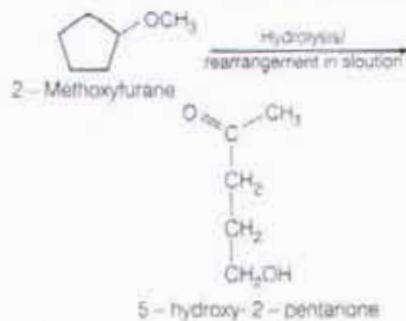
11. Here, major product is corresponding to the more stable carbocation.

Because of π -electrons between $>\text{C}=\text{C}<$ (double bond), it is the electrophile H^+ , which will first go to either carbon atom of doubly bonded carbons to give carbocations intermediates (A) and (B).

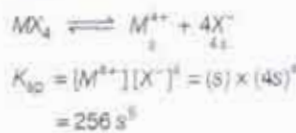




Whereas, option (d) is a hemiketal ring, which in the solution, rearranges into a ketone.



16. MX_4 ionises in the solution as



or
$$s = \left(\frac{K_{sp}}{256} \right)^{1/5}$$

17. Dipole moment (μ) = $q \times d$

or
$$q = \frac{\mu}{d}$$

\therefore Magnitude of charge on AB (q_{AB}) = $\frac{\mu_{AB}}{d_{AB}}$

$$= \frac{10.41}{2.81} = 3.69 \text{ esu}$$

and magnitude of charge on CD (q_{CD}) = $\frac{\mu_{CD}}{d_{CD}}$

$$= \frac{10.21}{2.67} = 3.84 \text{ esu}$$

As magnitude of charge is more on CD molecule than that of AB molecule, thus it has more ionic than AB.

18. In general, on moving down in a group, EA values decreases due to increase in size, because greater is the size of valence shell, lesser is the attraction and in turn lesser is the EA.

But in period II and III, this order is reversed due to the small size of period II elements. Thus,



Because O and F atoms have high electron density $\left(\frac{\text{charge}}{\text{volume}} \right)$ and so repel the test electrons.

Further, EA values increases as moving left to right along a period. It is because effective nuclear charge increases on moving left to right and more is the effective nuclear charge, more is the attraction of nucleus towards test electrons and thus more will be electron affinity. Thus, the overall increasing order of EA would be



19. According to Markownikoff's rule, "The addition of an unsymmetrical reagent to unsymmetrical alkene occurs in such a way that the negative part of the adding molecule goes to that carbon atom of the double bond which carries lesser number of hydrogen atoms".



collisions, though some molecules are speeded up. Some others are slowed down and hence the fraction of molecules possessing particular speed remains constant at constant temperature.

- The point A on X-axis doesn't represent the most probable speed, however, it represents threshold speed, i.e., the minimum speed which the colliding molecules must have in order that the collision between them may be effective.
- The area under the curve gives the total number of molecules. As velocity increases, distribution of molecules increases and it is maximum at most probable speed after which distribution of molecules decreases. Fraction of molecules with too high and too low velocities is very small but no molecule has zero velocity.
- The peak of the curve corresponds to a speed possessed by the maximum fraction of molecules and is called the most probable speed. As temperature increases, the most probable speed also increases, however, the fraction of molecules possessing most probable speed decreases with increase in temperature. Thus, the maximum shift to right as the temperature increases.

22. NaCl has fcc structure, hence, $n = 4$ for NaCl.

Also number of atoms in 58.5 g (1 mole) NaCl
 $= 6.023 \times 10^{23}$

\therefore Number of atoms in 1 g NaCl
 $= \frac{6.023 \times 10^{23}}{58.5}$

As in NaCl, there are 4Cl^- and 4Na^+ ions are in one unit cell.

\therefore Number of unit cells present in 1 mol (58.5 g)

$$\text{NaCl} = \frac{6.023 \times 10^{23}}{4}$$

and number of unit cells in 1 g NaCl

$$= \frac{6.023 \times 10^{23}}{4 \times 58.5}$$

$$= 2.57 \times 10^{21} \text{ unit cells}$$

23. Dihydrogen (H_2) acts as reducing agent and reduces oxides of less electropositive metals (generally less electropositive than Zn and placed above hydrogen in ECS). The product of the reaction is metal.

ECS for Metals

These metals are more reactive than hydrogen.	Potassium (K)	Decreasing standard reactivity
	Sodium (Na)	
	Calcium (Ca)	
	Magnesium (Mg)	
	Aluminium (Al)	
	Zinc (Zn)	
	Iron (Fe)	
Tin (Sn)		
Lead (Pb)		

Hydrogen [H]

These metals are less reactive than hydrogen.	Copper (Cu)	Least reactive metal
	Mercury (Hg)	
	Silver (Ag)	
	Gold (Au)	

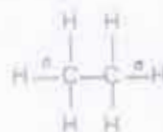
Although Cu is placed below hydrogen in ECS, yet H_2 gas reduces oxide of copper to copper metal, e.g.,



The oxides of strongly electropositive metals, e.g., alkali and alkaline earth metals and aluminium) are not reduced by H_2 gas.



24. Heat of hydrogenation is the amount of heat evolved when one mole of an unsaturated compound (generally alkene) is hydrogenated in presence of a catalyst. Thus, catalytic hydrogenation of an alkene is always negative.



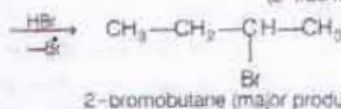
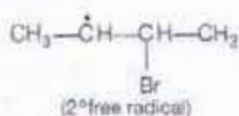
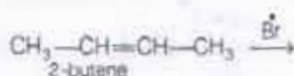
$$\Delta H^\circ = -136 \text{ kJ/mol}$$



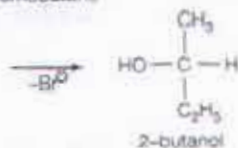
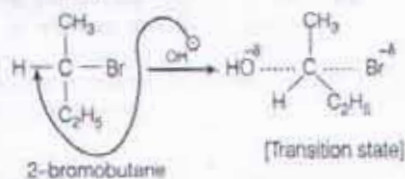
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The heat of hydrogenation of alkenes is a measure of the stability of carbon-carbon double bonds. All else being the same, the smaller the numerical value of heat of hydrogenation of an alkene, the more stable is the double bond therein. Based on heat of hydrogenation of alkenes, the trends in the stability of carbon-carbon double bonds is tetrasubstituted > trisubstituted > disubstituted > monosubstituted > unsubstituted.

25. (i) If addition of HBr over 2-butene is done in the presence of peroxide, the mechanism will be free radical mechanism and the major product will be 2-bromobutane.

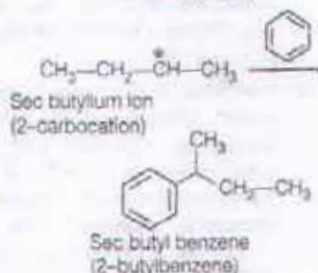
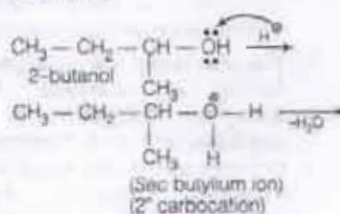


- (ii) The aqueous alkali hydrolysis of 2-bromobutane undergoes either by S_N1 and S_N2 mechanism depending upon reaction conditions. (Here, we consider only S_N2 path) and the product is same, i.e., 2-butanol.



- (iii) **Friedel-Craft alkylation** is used to introduce an alkyl group in benzene nucleus by an alkylating agent (alkyl halide, alcohol, or alkene) in the presence of a suitable catalyst ($AlCl_3$, $FeCl_3$, $SnCl_4$, BF_3 , or $ZnCl_2$).

Since, benzene undergoes electrophilic substitution reaction hence first we have to get stable electrophile which is formed as



26. (i) There is no change by doubling mass of electrons, because there are only 6-electrons in carbon atom which have negligible mass ($6/1837$ th of the mass of a proton).
- (ii) However, by reducing mass of neutron to half, total atomic mass becomes 6 (protons) + 3 (neutrons) instead of 6 (protons) + 6 (neutrons).

Thus, the new atomic mass of ${}^6_6C^{12}$ would be

$$\frac{9}{12} \times 100 = 75\%$$

Thus, the atomic mass of ${}^6_6C^{12}$ is reduced by 25%.

27. For H-like particles, the radii of the first stationary states are given by the expression

$$r_n = \frac{a_0 n^2}{Z}$$



(i) For H-atom, $n = 1$ and $Z = 1$

$$\therefore r_n = a_0 = \text{Bohr radius} = 52.9 \text{ pm}$$

(ii) For He^+ ion, $n = 2$ and $Z = 2$

$$\therefore r_n = \frac{a_0(2)^2}{2} = 2a_0$$

(iii) For Li^{2+} ion, $n = 2$ and $Z = 3$

$$\therefore r_n = \frac{a_0(2)^2}{3} = \frac{4a_0}{3}$$

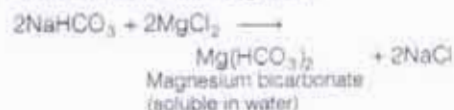
(iv) For Li^{2+} ion, $n = 3$ and $Z = 3$

$$\therefore r_n = \frac{a_0(3)^2}{3} = 3a_0$$

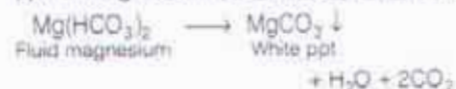
(v) For Be^{4+} ion, $n = 2$ and $Z = 4$

$$\therefore r_n = \frac{a_0(2)^2}{4} = a_0 = \text{Bohr radius} = 52.9 \text{ pm}$$

28. Sodium bicarbonate, on reaction with MgCl_2 produces magnesium bicarbonate, which is also known as fluid magnesia.



When the solution is boiled, a white-creamish ppt. of magnesium carbonate separates out.

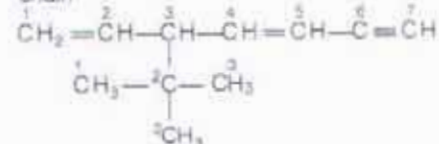


Whereas, Na_2CO_3 on treatment with MgCl_2 gives white ppt. of MgCO_3 without heating.

Sodium nitrate (NaNO_3) and sodium sulphate (Na_2SO_4) on treatment with MgCl_2 do not produce any precipitate, due to formation of soluble salts [$\text{Mg}(\text{NO}_3)_2$ and MgSO_4].

29. Organic compounds containing multiple bonds, side chain or substituents follow the order of preference as

Double bond > triple bond > substituent/side chain



3-(2-methyl-2-propyl)-hept-1,4-diene-6-yne

30. Diazonium salts (e.g. Azo benzene) usually lose N_2 on heating much before they have a chance to react with fused sodium metal. Therefore, diazobenzene does not show positive Lassaigne's test.

However in order to test the presence of nitrogen in hydrazine, during fusion with Na, same charcoal is added, since it does not contain its own carbon to form NaCN . Under these conditions, C of charcoal combines with N of the compound to form NaCN , which now gives a positive test for nitrogen.

31. 1 mole $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \equiv 1$ mole of Cr_2O_3

$$\equiv 1 \times 6 \text{ eq. of } \text{Cr}_2\text{O}_3$$

\therefore Reduction of $\text{Cr}_2\text{O}_7^{2-}$ to Cr^{3+} is a $6e^-$ change.



Therefore, equivalent weight of $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 = M/6$

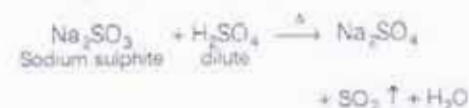
32. $\overset{+7}{\text{K}}\overset{+7}{\text{Mn}}\overset{-2}{\text{O}_4} + e^- \longrightarrow \overset{+6}{\text{Mn}}\overset{-2}{\text{O}_4}]^{2-}$
($1e^-$ change reaction)

$\overset{+7}{\text{K}}\overset{+7}{\text{Mn}}\overset{-2}{\text{O}_4} + 3e^- \longrightarrow \overset{+4}{\text{Mn}}\overset{-2}{\text{O}_4}$
($3e^-$ change reaction)

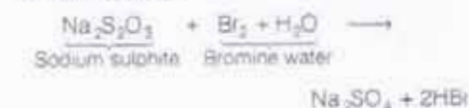
$\overset{+7}{\text{K}}\overset{+7}{\text{Mn}}\overset{-2}{\text{O}_4} + 4e^- \longrightarrow \frac{1}{2}\overset{+3}{\text{Mn}_2}\overset{-3}{\text{O}_3}$
($4e^-$ change reaction)

$\overset{+7}{\text{K}}\overset{+7}{\text{Mn}}\overset{-2}{\text{O}_4} + 5e^- \longrightarrow \overset{+2}{\text{Mn}^{2+}}$
($5e^-$ change reaction)

33. When sodium sulphite is treated with dilute H_2SO_4 and mixture is warmed, colourless SO_2 gas, with pungent suffocation smell like burning sulphur is evolved.



Sodium sulphite reduces bromine water into hydrobromic acid and changes it into a colourless liquid.



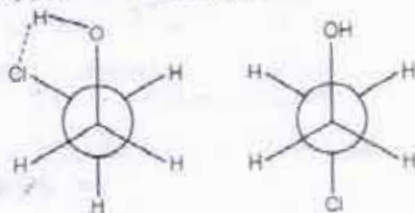


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34. The order of stability of different conformations of alkanes is

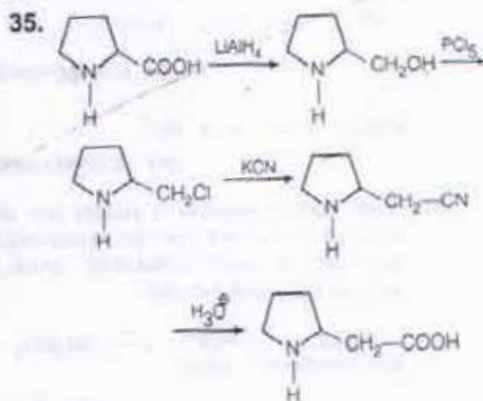
Anti (staggered form) > *Gauche* > eclipsed > full eclipsed. Thus *anti*-form or staggered conformation is most stable as there is minimum repulsions between the substituents attached tetrahedrally over two carbon atoms. *Gauche* conformation is also staggered but they have slightly (3.8 kJ/mol) more energy than *anti* form because the substituents are present at nearer position than the *anti* form.

However, if an electrostatic or hydrogen bond occurs between the substituents of carbon atoms, then the skew or *gauche* conformation may prove to be more convenient.



Gauche form of chloroethane (more stable due to H-bond)

Staggered form of chloroethane



36. According to Kohlrausch's law,

$$\Lambda^\circ \text{ for } \text{CH}_3\text{COOH} = \lambda_{\text{CH}_3\text{COO}^-}^\circ + \lambda_{\text{H}^+}^\circ$$

$$\Lambda^\circ \text{ for } \text{NaCl} = \lambda_{\text{Na}^+}^\circ + \lambda_{\text{Cl}^-}^\circ$$

$$= 126.5 \text{ Scm}^2\text{mol}^{-1} \quad \dots (i)$$

$$\Lambda^\circ \text{ for } \text{HCl} = \lambda_{\text{H}^+}^\circ + \lambda_{\text{Cl}^-}^\circ$$

$$= 426.2 \text{ Scm}^2\text{mol}^{-1} \quad \dots (ii)$$

$$\Lambda^\circ \text{ for } \text{CH}_3\text{COONa} = \lambda_{\text{CH}_3\text{COO}^-}^\circ + \lambda_{\text{Na}^+}^\circ$$

$$= 91.0 \text{ Scm}^2\text{mol}^{-1} \quad \dots (iii)$$

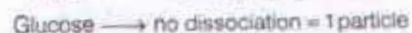
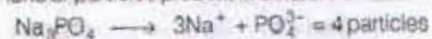
Adding Eqs. (ii) and (iii) and subtracting (i), we get

$$\lambda_{\text{H}^+}^\circ + \lambda_{\text{Cl}^-}^\circ + \lambda_{\text{CH}_3\text{COO}^-}^\circ + \lambda_{\text{Na}^+}^\circ - \lambda_{\text{Na}^+}^\circ - \lambda_{\text{Cl}^-}^\circ = 426.2 + 91.0 - 126.5 \text{ Scm}^2\text{mol}^{-1}$$

$$\text{or } \lambda_{\text{CH}_3\text{COO}^-}^\circ + \lambda_{\text{H}^+}^\circ = 390.7 \text{ Scm}^2\text{mol}^{-1}$$

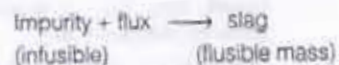
$$\text{i.e. } \Lambda^\circ \text{ for } \text{CH}_3\text{COOH} = 390.7 \text{ Scm}^2\text{mol}^{-1}$$

37. As all the solutions have same concentrations, thus relative lowering of vapour pressure depends upon the number of ions or particles present in different solutions.



As Na_3PO_4 gives maximum particles (4) on dissociation, hence relative lowering of vapour pressure is maximum for Na_3PO_4 and it has lowest vapour pressure.

38. During the process of smelting, when the ore is heated with suitable reducing agent in order to obtain molten metal, some infusible impurities are also removed from molten metal by adding suitable substance known as flux, which may be acidic or basic depends upon the nature of impurity. The flux reacts with infusible impurities and give a fusible mass known as slag, which floats over molten metal.

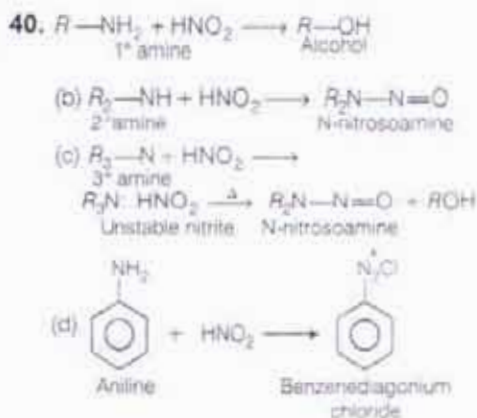
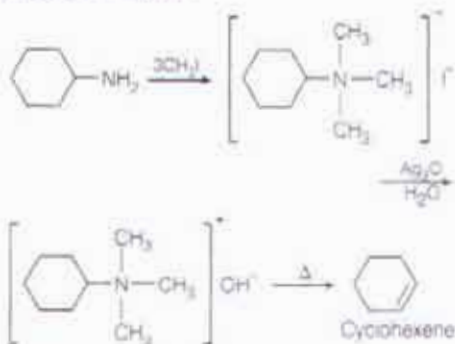


39. The reaction is an example of exhaustive methylation followed by Hofmann elimination reaction. In exhaustive methylation, amine is converted into its quaternary ammonium salt on treatment with excess of CH_3I . When this quaternary ammonium iodide is treated with



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moist Ag_2O , corresponding quaternary ammonium hydroxide is produced, which when heated goes on elimination reaction to produce an alkene.



Except 1^o amine, all others given compounds having nitrogen, when treated with HNO_2 .

41. In compound (ii) lone pair of electrons present at N-atom is in sp^3 orbital while in compounds (i) and (iii), it is present in sp^2 orbital. Since sp^2 -orbital has more 's' character than the sp^3 orbital hence availability of lone pair of electrons are more in sp^3 orbital than the sp^2 orbital for protonation, hence compound (ii) is less basic than (i) and (iii).

Among compounds (i) and (iii), (iii) contains an oxygen atom which has -I effect, as a result, it attracts lone pair of electrons present at N-atom towards itself. Consequently, the lone pair of electrons on N-atom in compound (iii) is less available for protonation than compound (i), hence (i) is more basic than

(iii). Compound (iv) is aromatic in character because lone pair of electrons on nitrogen atom is contributed towards the aromatic sextet formation and hence not available for the protonation. Thus, compound (iv) is least basic and hence correct option regarding basicity of given compounds is (d).

42. (a) In CrO_2^{4-} , the electronic configuration of Cr is $\text{Cr}^{6+} = [\text{Ar}] 3d^0 4s^0$

Thus, it has no unpaired electron.

- (b) In $[\text{Cu}(\text{NH}_3)_4]^{2+}$, the electronic configuration of Cu is $\text{Cu}^{2+} = [\text{Ar}] 3d^9 4s^0$

Thus it has one unpaired electron.

- (c) In $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, the electronic configuration of Ti is $\text{Ti}^{3+} = [\text{Ar}] 3d^3 4s^0$

Thus, it has one unpaired electron.

- (d) In $[\text{CoF}_6]^{3-}$, the electronic configuration of Co is $\text{Co}^{3+} = [\text{Ar}] 3d^6 4s^0$

Thus, it has a unpaired electron.

Thus, Cu^{2+} , Ti^{3+} and Co^{3+} have unpaired electrons and they are coloured due to $d-d$ transition. On the other hand Cr^{6+} doesn't have any unpaired electron, still it is coloured due to ligand to metal charge transfer (LMCT). In CrO_2^{4-} , an electron from a lone pair on an oxygen atom absorbs a photon and is promoted to an empty d -orbital of chromium. These transitions are strongly allowed but the maximum of the absorption is in the UV and only part of the absorption band tails into the violet or blue region of the visible spectrum and the colours of the anion i.e. yellow is the complementary colour.

43. $A \longrightarrow \text{products}$

$$\text{For second order reaction } -\frac{dC_A}{dt} = k [C_A]^2$$

On integrating

$$\frac{1}{C} = kt + I \quad (\text{where } I = \text{integration constant})$$

$$\text{at } t = 0, C_A = C_0$$

$$\therefore I = \frac{1}{C_0}$$



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by putting this value of t in formula

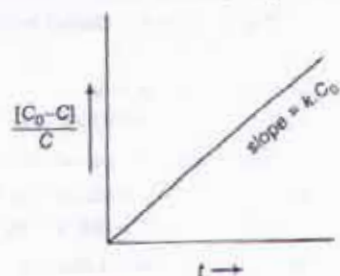
$$\frac{1}{C_A} = kt + \frac{1}{C_0}$$

or $\frac{1}{C_A} - \frac{1}{C_0} = kt$

or $\frac{[C_0 - C]}{C_0 C} = kt$

or $\frac{[C_0 - C]}{C} = k \cdot C_0 t$

So, the plot of $\frac{[C_0 - C]}{C}$ vs time t will be linear with slope $k \cdot C_0$ (according to $y = mx + c$).



[Graph for second order reaction]

44. Let number of half-lives for $A = n_1$
and number of half-lives for $B = n_2$

Amount of A left after n_1 half-lives = $\frac{[A_0]}{2^{n_1}}$

and amount of B left after n_2 half-lives = $\frac{[B_0]}{2^{n_2}}$

given that $\frac{[A_0]}{2^{n_1}} = \frac{[B_0]}{2^{n_2}}$ after A decays for n_1 half-lives and B decay for n_2 half-lives.

Also, the initial concentrations of both substances are related as $[A_0] = 4[B_0]$

or $4 = \frac{[A_0]}{[B_0]}$

or $4 = \frac{2^{n_1}}{2^{n_2}} \quad \left[\because \frac{[A_0]}{2^{n_1}} = \frac{[B_0]}{2^{n_2}} \right]$

or $2^2 = 2^{n_1 - n_2}$

$\therefore 2 = n_1 - n_2$

or $n_2 = n_1 - 2$

As half-life period ($t_{1/2}$) is the time in which half of the substance has decayed, Thus, the total time taken by both the substances A and B to reach at equal concentrations

$T = \text{number of half-lives} \times t_{1/2}$

for substance (A), time $T = n_1 \times t_{1/2} A$

for substance (B), time $T = n_2 \times t_{1/2} B$

or $\frac{n_1 \times t_{1/2} A}{n_2 \times t_{1/2} B} = 1$

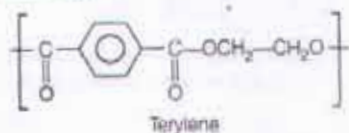
as $\frac{n_1}{n_2} = \frac{t_{1/2} B}{t_{1/2} A}$ or $\frac{n_1}{n_2} = \frac{15}{5} = 3$

or $n_1 = 3n_2$

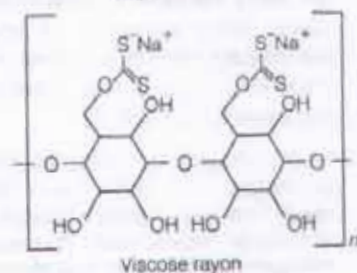
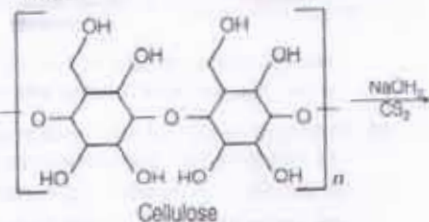
From (i) and (ii), it is clear that $n_1 = 3$ and $n_2 = 1$

Also $T = n_1 \times t_{1/2}$
 $= 3 \times 5 = 15 \text{ min.}$

45. (a) Terylene is an example of polyester as it contains ester functional groups which are polar in nature.

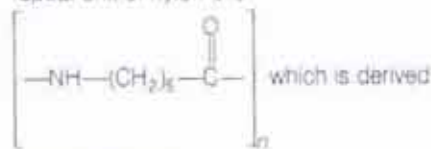


- (b) The reaction of cellulose with CS_2 and NaOH gives viscose a soluble polymer that can be corrected into rayon.



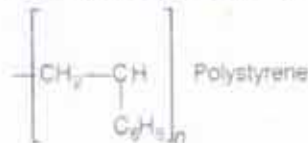


(c) Nylon - 6 is called polyamide as it contains amide linkage. The monomeric repeat unit of nylon-6 is



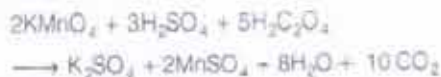
from caprolactam.

(d) Polystyrene is an addition polymer with monomer units ($\text{C}_6\text{H}_5\text{CH=CH}_2$)

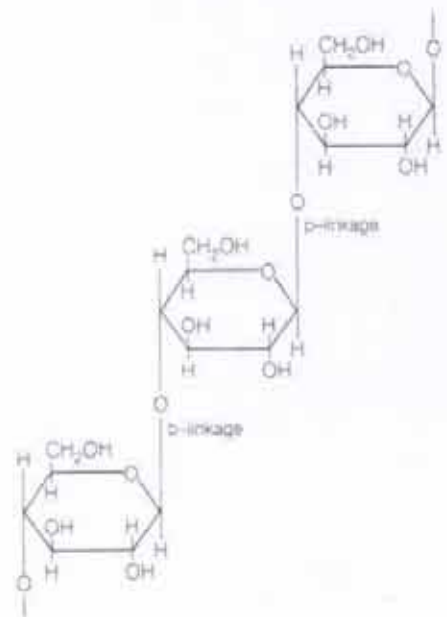


46. Greater the valency of the coagulating or the flocculating ion, greater is its power to bring about coagulation and smaller is its coagulation or flocculation value. Thus, for coagulation of positively charged sol tetravalent $[\text{Fe}(\text{CN})_6]^{4-}$ anions are more effective than trivalent anions (PO_4^{3-}) which are more effective than divalent (SO_4^{2-}) anions which in turn are more effective than monovalent (Cl^-) anions.

47. In oxidation of oxalic acid by acidified KMnO_4 , Mn^{2+} ions produced in the reaction act as autocatalyst. Thus, in the titration of oxalic acid solution with KMnO_4 solution in presence of dilute H_2SO_4 , the colour of KMnO_4 first fades slowly and then faster due to the formation of Mn^{2+} ions, which acts as autocatalyst.

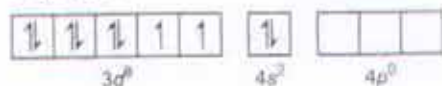


48. Cellulose is a linear polymer of β -D glucose in which C_1 of one glucose unit is connected to C_4 of the other through β -D glucosidic linkage as shown in figure.



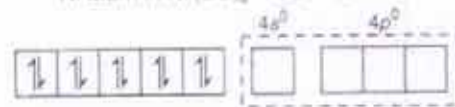
49. (i) In $[\text{Ni}(\text{CO})_4]$ Ni has zero oxidation state and exist as $\text{Ni}(0)$. Four ligands (CO) are attached to central metal atom Ni and require four orbitals.

Electronic configuration of $_{28}\text{Ni}$ atom = $3d^8, 4s^2$

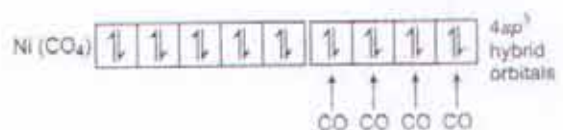


In presence of four CO ligands, which are strong ligands, the electrons pair up against Hund's rule

Ni atom in $[\text{Ni}(\text{CO})_4] = 3d^{10} 4s^0$



↓
 sp^3 hybridisation



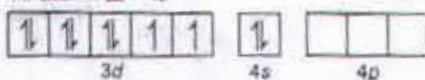


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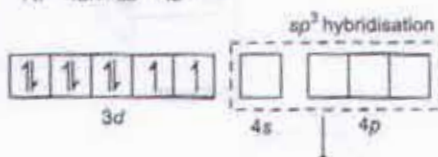
For sp^3 hybrid orbitals are arranged tetrahedrally so it is tetrahedral complex. All the electrons are paired so it is diamagnetic.

(iii) In $[\text{NiCl}_4]^{2-}$, Ni is in (II) oxidation state and its electronic arrangement is as follows

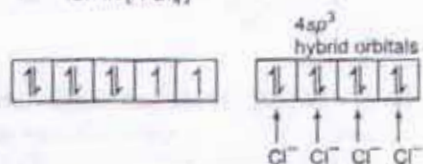
Ni-atom: $3d^8 4s^2$



Ni^{2+} ion: $3d^8 4s^0$



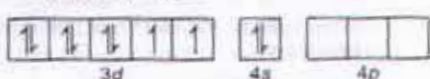
Ni^{2+} ion in $[\text{NiCl}_4]^{2-}$



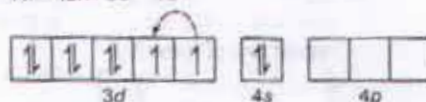
Geometry is tetrahedral and it will be paramagnetic in nature because there are two unpaired electrons.

(iii) $[\text{Ni}(\text{CN})_4]^{2-}$ Ni is in (II) oxidation state and electronic arrangement is as follows

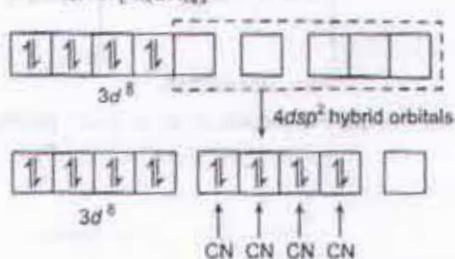
Ni-atom: $3d^8 4s^2$



Ni^{2+} ion: $3d^8 4s^0$



Ni^{2+} ion in $[\text{Ni}(\text{CN})_4]^{2-}$



CN^- is strong ligand so it pairs up $3d$ -electrons against Hund's rule. Due to dsp^2 hybridisation, the geometry of $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar and the complex is diamagnetic because all the electrons are paired.

50. Biochemical oxygen demand (BOD) is a measure of the dissolved oxygen that is required by the micro-organism to oxidise dissolved inorganic and organic compounds.

To determine BOD, water sample is first saturated with oxygen and is then incubated at constant temperature (20°C) for five days. Micro-organisms in the sample oxidise pollutants. The remaining amount of dissolved oxygen is determined and BOD is obtained by subtraction, thus the determination of BOD is often done in 5 days time.

Zoology

- The transformation of spermatids into spermatozoa is called spermiogenesis. The spermatozoa are later on known as sperms. The formation of sperms from germ cells called spermatogenesis.
- Around 20% of brain cells are degenerated at or around 70 years of ages in human being.
- A gamete normally contains many alleles of a gene, which are in various forms of a gene or Mendelian factors are present on the same locus.
- Mutations are suddenly ansed heritable changes in genes of an organism. Thus, these are discontinuous variations.
- Down's syndrome is a developmental defect produced due to trisomy of 21st autosomal chromosomal.
- In open vascular system, i.e., circulatory system, the circulating fluid is haemolymph. Open circulatory system is found in class-Insecta like cockroach.



7. Albinism is autosomal recessive genetic disorder in which gene responsible for disease lie on X-chromosome.
8. Gene synthesis is the process of synthesising an artificially designed gene into a physical DNA sequence. Gene synthesis was first demonstrated by Har Gobind Khurana in 1970 for a short artificial gene.
9. The study of morphology is not helpful in determining the phylogenetic relationships.
10. Physiological barriers like body temperature, pH of the body fluids and other body secretions prevent growth of several disease causing microorganism. Certain kinds of cells, when infected with a virus release interferons. Interferons (IFNs) make the cells resistant to viral infections.
11. The most common allergen for asthma is house dust, pollen grains, smoke, etc. Asthma is characterised by narrowing and inflammation of bronchi, bronchospasm and difficulty in breathing.
12. Humoral immunity is provided by the B-cells. They are the main antibody synthesising cells of the body. These cells respond to antigens secreting antibodies into the blood and lymph.
13. Liver the largest gland of body perform various function like various deamination, oxidation of alcohol into acetaldehyde, secretion of bile juice, gluconeogenesis, glycogenolysis, etc.
14. Domestication of Turkey has been started recently along with poultry. Actually Turkey domestication is a type of poultry. Rest all, sheep, buffalo and silkworm are being rearing from ancient times.
15. Probes are 15-30 bases long radioactively labelled oligonucleotides (RNA or DNA) used to detect complementary nucleotide sequences, used for disease diagnosis, etc.
16. CT scan is a radiologic technique for obtaining clear X-ray images of deep internal structures by focussing a specific plane of the body. CT scan uses X-rays in coordination with computer.

17.

	Column I	Column II
A	Mutualism	Epiphyte on mango branch
B	Commensalism	Sparrow and arly seed
C	Parasitism	Balerus and Chthecatus
D	Competition	Ticks dog
E	Predation	Orchid, Ophrys and bees

18. Zooplanktons are be microscopic animals that feed on the phytoplankton in an aquatic system. These are truly herbivorous and form the second trophic level equivalent to cows in grassland.
19. The cheetah (*Acinonyx jubatus*) is a member of cat family. It has been known to exist in India for a very long time. But due to hunting and other purposes, cheetah in India became extinct before the twentieth century.
20. The release of industrial water containing mercury in fishing water causes Minamata disease. It occurred in Minamata city, Japan in 1953, where more than 100 persons died or suffered serious nervous damage due to eating fish taken from Minamata bay.
21. Horse (female) show more than one oestrous cycle during oestrous period, i.e., polyoestrous mammal.
22. Ejaculation is the forceful expulsion of semen during sexual intercourse. On an average (3 mL) ejaculation of semen contains about 300 million spermatozoa.
23. A-Blood vessels, B-Primary follicle, C-Tertiary follicle, D-Graafian follicle, E-Ovum, F-Corpus luteum.
24. Black water fever is caused by *P. falciparum*. In this fever, urine becomes black due to excretion of haemoglobin in urine.
25. Sea fan, sea feather, sea pen belong to phylum-Coelenterata, while sea cucumber is a member of Echinodermata.
26. Egg of cockroach give rise to nymph. Ootheca is produced after copulation, which on maturation consists of eggs and develops into young organism stage called nymph. Caterpillar, pupa and larva are stage of development in silk moth and in some other insects.



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27. The adult Echinodermata have pentamerous radial symmetry derived from original bilateral symmetry.
28. Pharyngeal gill slit, presence of notochord, central neural tube are the primary characteristic feature of phylum-Chordata.
Which transformed into modified structures or remain same as in sub-phylum-Urochordata, Cephalochordata.
In vertebrate, notochord is present only in embryonal stage, which is converted into backbone or vertebral column in adult.
While pharyngeal gill slit is found in adult of some species.
29. Tendon is a non-elastic flexible tissue, which serves as an attachment of muscles to the bone. Ligaments connect bone to bone and is made up of elastic yellow fibres.
30. Nucleolus forms ribosomal subunits by wrapping the rRNA with ribosomal proteins. The ribosomal subunits later leave nucleus through the nuclear pores.
31. Fructose is the sweetest sugar. It is found in sweet fruits and honey.
32. NADP, FAD, FMN are co-enzymes.
33. Pepsinogen (inactive form of pepsin) is secreted by chief cell of stomach mucosa. Prorennin is also secreted by chief or zymogen cells. Oxyntic cells secrete HCl.
34. Residual volume is that part of air, which is left behind in lungs even after a forceful expiration during normal breathing process. It is about 1500 mL of inhaled air.
35. In human body, 98.5% of O_2 is transported by the respiratory pigment haemoglobin, which is present in erythrocyte of blood.
One molecule of haemoglobin can carry four molecules of O_2 .
36. Angiotensinogen is an inactive precursor of angiotensin. It is a large protein synthesised by the liver, secreted into blood stream and converted into angiotensin by renin.
37. Haversian canals are found in long bones of mammals. These canals are interconnected by transverse canals called Volkmann's canals.
38. Broca's area is present in frontal lobe. Temporal lobe consists of auditory olfactory and Wernicke's area.
39. Oestrogen regulates growth and development of female accessory reproductive organs, secondary sexual characters and sexual behaviours.
40. A. Tidal volumes-500 mL of air.
B. Inspiratory reserve volume 2500 to 3000 mL of air.
C. Expiratory reserve volume-100 mL of air.
D. Residual volume -1200 to 1500 mL of air.
E. Vital capacity - 3400 to 4800 mL of air.
41. *Euglena* exhibit the phenomenon of metaboly. It is a wriggling type of movement in which a wave of contraction and expansion passes from one end to the other end of the body.
42. Pseudocoelom is the persistent blastocoel or fluid-filled cavity of development stage (called blastula stage). Pseudocoelom is found in Rotifera, Ectoprocta, Aschelminthes, Nematoda and Acanthocephala.
43. The diagram shown *E. coli* cloning vector pBR 322 showing restriction sites (*Hind* III, *Eco* R I, *Bam* H I, *Sal* I, *Pvu* II, *Pst* I, *Cla* I), *ori* and antibiotic resistance genes (*amp^r* and *tet^r*). *Rep* codes for the proteins involved in the replication of the plasmid.
44. The porphyrin pigment gives dark brown colour to the earthworm. It protects the earthworm's body against bright and strong sunlight.
45. Dog fish or *Squaliodon* belongs to sub-class-Chondrichthyes of class-Pisces.
46. Brain is highly developed in mammals with corpus callosum connecting cerebral hemispheres.
47. A muscle may be attached to a single bone of different bones by one end or by both the ends either directly by epimysium or by the way of inelastic connective tissue cords called tendons.



48. There are three pairs of salivary glands in man, which secrete saliva into the oral cavity through ducts. About 1000-1500 mL of saliva is secreted per day.
49. To maintain electrostatic neutrality of plasma, many chloride ions diffuse from plasma into

RBCs and bicarbonate ions pass out. This is called Hamburger shift or chloride shift.

50. A sarcomere is the basic unit of a muscle's cross-striated myofibril. Sarcomeres are multi-protein complexes composed of three different filament systems.

Botany

1. Tissue differentiation is well developed in bryophytes, while in algae it is found in higher animals.
2. *Adiantum* as a walking fern *Selaginella* is known as club moss, *Psilotum* is related to extinct species of order- Psilophytales. *Equisetum* is called as horse tails.
3. Pea plant is a herb belongs to the family Fabaceae or Leguminosae.
4. In inferior position of ovary. The ovary is lower most, while the other whorls of flower like sepals, petals and androecium grow successfully above the ovary. Flowers containing inferior ovary are called inferior flowers.
5. When the flower is regular and radially symmetrical the condition of structural symmetry is called as actinomorphic, i.e., flower can be cut into two equal halves by any vertical section. It is more common in Solanaceae, Malvaceae and Liliaceae.
When flower is regular and it can be cut into two equal halves from one vertical plane only, it is termed as zygomorphic (%). It is common in Fabaceae and Asteraceae.
6. Thermonastic movements occurs in flowers which open during high temperature and close down during low temperatures. For example, tulips and *Crocus*.
7. Ethylene is found in roots, shoot apical meristems, leaf nodes, ageing flower and ripening fruits.
8. The maximum inhibition of flowering by red light occurs at about the middle of critical dark period. The inhibitory effect of red light can be overcome by a subsequent exposure with far red light.

9. C_3 cycle was discovered by Melvin Calvin, Andrew Benson and James Basstham in algae *Chlorella*. This pathway of carbon dioxide fixation is so named due to the formation of 3-carbon compound phosphoglycerate as first stable product.

C_3 cycle is found in majority of the plants, hence is considered as major pathway for CO_2 fixation.

10. *Nitrosomonas* is the most important agent of oxidation of ammonia to nitrite in soil. Nitrite to nitrate is oxidised by *Nitrobacter*.
11. Guttation is the loss of water in liquid state from uninjured parts of plants, usually from tips and margins of leaves. It occurs in night or early morning when there is high atmospheric humidity.
12. Elaioplasts store oils, amyloplasts store starch, rhodoplasts contain red pigments and chloroplast contain chlorophyll.
13. Idioblasts parenchyma are specialised non-green large sized parenchyma cells. They contain inclusions like tannins, oils, crystals, etc.
14. In syncarpous ovary, the number of carpels are two to many but they are fused. For examples, In mustard and China rose.
15. Amphimixis involves meiosis and syngamy. By meiosis, the diploid cells of the sporophyte give rise to haploid gametophytes which produce male and female gametes.
Syngamy is the fusion of haploid gametes which results in the restoration of diploid sporophytic generation.
16. When one gene regulate more than one trait at single time or produces many effect the alleles of the gene termed as pleiotrophic allele and gene is called as pleiotrophic gene.



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This effect is known as pleiotrophic effect, e.g., in *Drosophila melanogaster*, Epistasis, the integration between non-allelic genes is called epistasis.

Dominant gene is called epistatic and the gene that suppressed is termed as hypostatic gene, e.g., skin coat colour of mice.

17. Coupling and repulsion hypothesis was proposed by Bateson. He also coined the term genetics.

Hugo de Vries proposed popular 'the mutation theory', while Dobzhansky worked on pleiotrophy and in modern genetics.

18. Gene regulation occurs because of this certain proteins are synthesised in as few as 5-10 molecules, while others are formed in more than 100000 molecular per cell. There are many control points for the regulation of gene expression.

19. Cosmid is a fragment of DNA of about 40000 bp, it is inserted in bacteria along with DNA to produce copies for gene library.

20. Psammophytes are grown on sandy soils, lithophytes are grown on base soils, Hydrophytes are grown on aquatic habitat, Xerophytes are grown on dry habitats.

21. Organic remains of dead plants and animals are called detritus. Detrivores feed on large pieces of detritus. The smaller fragments are left. Pulverisation occurs in digestive tract of detrivores as a part of detritus comes out undigested.

Due to fragmentation, left over detritus comes out to have large surface area.

22. A food chain represent a sequence of organisms in an ecosystem. These organisms are dependent on one another for source of food-food chain are of two types, grazing food chain and detritus food chain

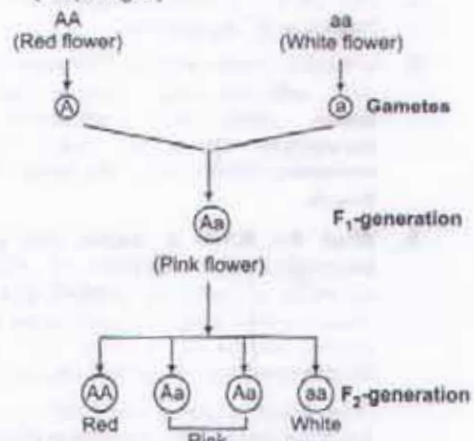
A predator food chain always starts with the autotrophic organisms (green plants) and ends with climax **carnivores**. Solar radiation in the ultimate source of energy in ecosystem and green plants trapes solar radiation in process of photosynthesis.

23. In terminator gene technology the plants are introduced a gene called terminator gene. It causes failure of seed setting after one generation. It will give the seed producer a monopoly over a particular variety.

24. Micorrhiza or Vesicular Arbuscular Mycorrhiza (VAM) is mutual association between root of higher plant like *Pinus* and fungal hyphae. Fungal hyphae spreads in a large area and facilitate the absorption of nutrient from soil by roots of plant and get organic food from plants.

25. Pribnow box is a short conserved about (6 bp) sequence of promoter site in prokaryotes 5'TATAAT3' sequence is available in almost all promoters, which lies at the sequence.

26. Incomplete dominance is seen in *Antirrhinum* (snapdragon).



27. Allelomorphs or alleles are the genes occupying same locus in homologous chromosomes, i.e., the alternate forms of a gene.

28. A-Scutellum, B-Coleoptile, C-Shoot apex, D-Epiblast, E-Redicle, F-Root cap, G-Coleorhiza.

29. *Begonia* propagates through adventitious buds, *Bryophyllum* propagate through plantlets at margins of leaves and *Agavae* is a bulbil (underground stem). *Adiantum* propagate through buds at left tip.



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30. Chromosomal theory of inheritance was proposed by Walter Sutton and T. Boveri in 1902. Sutton and Boveri made a correlation between Mendel's conclusion about genes and the behaviour of chromosome during mitosis and meiosis.
31. *Bacterium clostridium* is responsible to loose the fibre from stem of jute and flax; e. retting.
Lactobacillus bacterium is found in milk and is responsible for souring of milk. i.e., curdling is carried out with help of this bacterium.
Bacillus is a pathogenic form and cause several disease in plants and animals.
32. Protonema results from the germinating meiospore. When fully grown, it consists of a slender green, branching system of filaments called protonema.
33. In dicot secondary growth is often present. It is absent in monocots.
34. The axis of peduncle becomes, flattened called receptacle. It bears sessile, bract containing centripetally arranged florets, e.g., sunflower.
35. Stipules are small green lateral appendages present on either side of leaf base in most of the dicot plants. In member of family Asteraceae like *Hibiscus* and rose, *Pisum* these modified leaves a remain persistent throughout life of the leaves.
36. Pepo fruit is a characteristic feature of family-Cucurbitaceae, e.g., gourd, cucumber, melon, watermelon, and squash, etc. Pepo is a type of berry with hard rind.
This type of fleshy fruit develops from an inferior ovary syncarpous pistil with parietal placentation.
37. Intercalary meristem present at the base of internode. For example, grasses or at the base of leaf as in *Pinus*. It is responsible for growth in length in plant. This growth is known as primary growth.
38. Fructose is the sweetest sugar. It is found in sweet fruits and honey.
39. Crop rotation is the growing of alternate crops in the successive seasons on the same field. It increases the soil fertility because of different crops have different nutritional requirements.
40. Hydroponic is a system of growing plant in water culture of soil less culture. Actually this system of growing plant is used to determine the requirement of particular mineral nutrient by the particular plant.
Generally chelating agent like Na-EDTA (disodium salt of ethylene diaminetetra acetic acid).
41. Chloroplast are the green plastids, which take part in photosynthesis and temporary or permanent storage of starch. These are discoid in higher plants with diameter of 4-6 μm and thickness of 2-4 μm .
42. In Kreb's cycle, acetyl Co-A adds its two carbon fragments to oxaloacetate, a four carbon compound. The unstable bond of acetyl Co-A is broken as oxaloacetate displaces the coenzyme and attends to the acetyl group. The product is 6C-urate.
43. Gibberellic acid can reduce the flowering in long day plant. There are about more than 100 gibberellins reported from different organism such as fungi and higher plants. Like GA_1 , GA_2 , GA_3 , GA_4 , GA_5 , etc. GA_3 is used to internode elongation prior to flowering. IBA, IAA and NAA are synthetic auxins and promote cell division.
44. Terminal bud or axillary bud is found in meristematic zone of plants. Particularly in apical meristem, which is responsible to increase the length of plant. If it is removed would not grow tall and became bushy in appearance.
45. Coralloid roots in *Cycas* are bluish green in colour as these are inhabited by a blue green algae called *Anabaena cycadacearum*.
46. Compound spike may be sessile or stalked. The spikelet consists of a short axis called rachilla on which one to five sessile or short stalked flowers are borne.



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47. An isomerous flower may be dimersus (2 or multiple of 2), e.g., poppy or trimerous (3 or multiple of 3), e.g., *Argemone*.
48. Plant which cannot be grown without human help are termed as cultivated plants or cultigens. Like several crops are grown by man for commercial purpose and its own use.
49. A food chain in an ecosystem represent sequence of organisms, which are dependent on one another for their source of food. A food chain consists usually 3-4 trophic (biotic)

level; producers, consumers and decomposers.

Which are interlinked for their need of food and shelter. Producers, consumers occupy first and second, third level in a food chain, e.g.,

Green plant → Herbivore →
1st trophic level 2nd trophic level

Carnivore
III, IV trophic level

50. Trophic levels are the divisions or levels of food chain characterised by species method of obtaining food and energy.