CMC Vellore
Sample Paper 2012

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Medical Entrance Exam
Solved Paper 2012

Physics

1. Identify the false statement from the following
   (a) If cohesive force = adhesive force, then angle of contact, $\theta = 90°$
   (b) If cohesive force < adhesive force, then angle of contact, $\theta < 90°$
   (c) If cohesive force > adhesive force, then angle of contact, $\theta > 90°$
   (d) If the radius of capillary is reduced to half, then the rise of liquid column becomes four times

2. In the case of a diatomic gas, if heat is given at constant pressure then the part of energy which is used for expansion of gas is
   (a) $\frac{2}{7}$
   (b) $\frac{2}{5}$
   (c) $\frac{3}{7}$
   (d) $\frac{3}{5}$

3. Among the following which is dimensionally correct?
   (a) Pressure = Force per unit volume
   (b) Pressure = Energy per unit volume
   (c) Pressure = Energy per unit area
   (d) Pressure = Force per unit volume per unit time

4. If pressure of CO_2 (real gas) in a container is given by $p = \frac{RT}{2V - b} - \frac{a}{4b^2}$
   Then, mass of the gas in the container is
   (a) 44 g
   (b) 33 g
   (c) 22 g
   (d) 5g

5. The relative velocity of two consecutive layers is 8 cms^{-1} and the perpendicular distance between the layers is 0.1 cm. The velocity gradient is
   (a) 0.8 s^{-1}
   (b) 0.08 s^{-1}
   (c) 8.0 s^{-1}
   (d) 80 s^{-1}

6. When a projectile is fired with initial velocity u at an angle of projection θ, then its range is R. If the initial velocity is doubled at same angle of projection, then the new range will be
   (a) R
   (b) $\frac{R}{2}$
   (c) $2R$
   (d) $4R$

7. If a resistance of $R\,\Omega$ is connected in series with an inductor L and the phase angle between voltage and current is $\frac{\pi}{4}$, then the value of inductive reactance is
   (a) zero
   (b) R
   (c) $\frac{R}{2}$
   (d) $\frac{R}{4}$

8. If two waves of equal amplitude and frequency interfere each other then the ratio of intensity when the two waves arrive in phase to that when they arrive 90° out of phase is
   (a) $\sqrt{2}:1$
   (b) $1:1$
   (c) $4:1$
   (d) $2:1$

9. In a transistor, forward bias is always smaller than the reverse bias because it
   (a) helps to produce large voltage gain
   (b) helps to maintain a constant base current
   (c) helps in avoiding excessive heating of transistor
   (d) None of the above

10. If the total power rating of a group of electric lamps is 1000 W and they are connected across an AC voltage

$$E = 200 \sin (310t + 60°)$$

Then, the rms value of the circuit current is
(a) $10\sqrt{2}$ A
(b) $20\sqrt{2}$ A
(c) 10A
(d) 20A

11. For a particle starting from rest, the acceleration varies with time according to relation,

$$A = - a\omega^2 \sin \omega t$$

The displacement of this particle at a time t will be
(a) $a \omega \cos \omega t$
(b) $a \sin \omega t$
(c) $a \omega \sin \omega t$
(d) $-\frac{1}{2} (a\omega^2 \sin \omega t) t^2$

12. If a body is moving with uniform speed v in a circle of radius r, then tangential acceleration will be
(a) zero
(b) $\frac{v}{r}$
(c) $\frac{v^2}{r}$
(d) $\frac{v}{r^2}$

13. By using the equation $\tan \theta = \frac{rg}{v^2}$, the value of θ (angle of banking) for a cyclist taking a curve can be calculated. But the equation is (symbols have their usual meanings)
(a) dimensionally correct only
(b) numerically correct only
(c) both dimensionally and numerically correct
(d) neither dimensionally nor numerically correct

14. The point at which the gravitational potential and the gravitational field due to earth is zero is at
(a) earth's surface
(b) a height R_e from earth's surface (R_e = radius of earth)
(c) a point below the earth's surface
(d) infinity

15. If the breaking force for a wire is F, then the value of breaking force on increasing the thickness of wire 2 times will be
(a) F
(b) $2F$
(c) $4F$
(d) $8F$

16. The Young's modulus of a material is 3 times its modulus of rigidity, the volume elasticity is
(a) zero
(b) infinity
(c) 2×10^{10} N-m^{-2}
(d) 3×10^{10} N-m^{-2}

17. An arc of radius r carries charge. The linear density of charge is λ and the arc subtends an angle of $60°$ at the centre. What is the value of electric potential at the centre?
(a) $\frac{\lambda}{16 \varepsilon_0}$
(b) $\frac{\lambda}{8 \varepsilon_0}$
(c) $\frac{\lambda}{12 \varepsilon_0}$
(d) $\frac{\lambda}{4 \varepsilon_0}$

18. Newton's law of cooling is a special case of
(a) Planck's law
(b) Kirchhoff's law
(c) Wien's law
(d) Stefan's law

19. At a certain temperature, if the r.m.s. velocity of O_2 is 400 m/s then at the same temperature the r.m.s. velocity of H_2 molecules will be
(a) 400 m/s
(b) 1600 m/s
(c) 3200 m/s
(d) 6400 m/s

20. The moment of inertia of a thin circular lamina of mass 1 kg and diameter 0.2 m rotating about one of its diameter is
(a) 2.5×10^{-3} kg-m^2
(b) 4×10^{-2} kg-m^2
(c) 5×10^{-3} kg-m^2
(d) 5.5×10^{-2} kg-m^2

21. If the kinetic energy of a body is decreased by 36%, then its momentum is decreased by
(a) 6%
(b) 8%
(c) 20%
(d) 36%

22. A man is riding on a cycle with velocity 7.2 km/h up a hill having a slope 1 in 20. The total mass of the man and cycle is 100 kg. The power of the man is
(a) 98 W
(b) 125 W
(c) 175 W
(d) 200 W

23. When a ring of mass 10 kg and diameter 0.4 m is rotated about its axis it makes 2100 rev/min. The angular momentum of the ring will be
(a) $0.4 \, kg \, m^2 s^{-1}$
(b) $4.4 \, kg \, m^2 s^{-1}$
(c) $44 \, kg \, m^2 s^{-1}$
(d) $88 \, kg \, m^2 s^{-1}$

24. Two electric bulbs one rated 40 W-200 V and other 100 W -200 V are connected in a house wiring circuit. Which one of the following statement about them is correct?
(a) The resistance of the filaments in both the bulbs are same
(b) The resistance of filament in 40 W bulb is more than the resistance of 100 W bulb
(c) The resistance of the filament in 100 W bulb is more than the resistance of 40 W bulb
(d) None of the above

25. In the hydrogen atom, the electron is making 6.6×10^{15} rps. If the radius of the orbit is 0.53×10^{-10} m, then magnetic field produced at the centre of the orbit is
(a) 0.14 T
(b) 1.4 T
(c) 12.5 T
(d) 140 T

26. According to Boolean Algebra $\overline{\overline{A} \, \overline{B}} \, A$ equals to
(a) A
(b) $A + B$
(c) $\overline{A + B}$
(d) $\overline{\overline{A} \, \overline{B}}$

27. The mobility of free electrons is greater than that of free holes because
(a) they are light
(b) they require low energy to continue their motion
(c) they carry negative charge
(d) they mutually collide less

28. A light ray is incident by grazing one of the face of a prism and after refraction ray does not emerge out, what should be the angle of prism while critical angle is C?
(a) $A > 2C$
(b) $A < 2C$
(c) $A = 2C$
(d) None of these

29. A man can see only between 75 cm to 200 cm. The power of lens to correct the near point will be
(a) $-3 \, D$
(b) $-8/3 \, D$
(c) $+3 \, D$
(d) $+8/3 \, D$

30. A double convex lens made up of a material of refractive index μ_1 is immersed inside two liquids of refractive indices μ_2 and μ_3 as shown in figure. If $\mu_2 > \mu_1 > \mu_3$ and a wide parallel beam of light incident on the lens from the left, then the lens will give rise to

(a) a convergent beam and a divergent beam
(b) two different divergent beams
(c) two different convergent beams
(d) a single convergent beam

31. A radioactive nucleus is being produced at a constant rate α per second. Its decay constant is λ. If N_0 is the number of nuclei at time $t = 0$, then maximum number of nuclei possible are
(a) N_0
(b) $N_0 + \dfrac{\alpha}{\lambda}$
(c) $\dfrac{\alpha}{\lambda}$
(d) $\dfrac{\lambda}{\alpha} + N_0$

32. The bob of a simple pendulum of mass m and length l is dropped from the horizontal position strikes a block of the same mass elastically placed on a horizontal frictionless table. The kinetic energy of the block will be
(a) zero
(b) mgl
(c) $\dfrac{mgl}{2}$
(d) $2mgl$

33. Metallic ropes are suspended on the carriers which take inflammable material because
(a) they keep the body of the carrier in contact with the earth
(b) they keep the centre of gravity of the carrier nearer to the earth
(c) they controlled the speed of the carrier
(d) nothing should be placed under the carrier

34. The terminal potential difference of a cell is greater than its emf when it is
(a) in open circuit
(b) being charged
(c) being discharged
(d) being either charged or discharged

35. If a magnet is suspended at an angle 30° to the magnetic meridian, it makes an angle of 45° with the horizontal. The real dip is

(a) $\tan^{-1}\left(\dfrac{3}{\sqrt{2}}\right)$ (b) $\tan^{-1}\left(\dfrac{\sqrt{3}}{2}\right)$

(c) $\tan^{-1}(\sqrt{3})$ (d) $\tan^{-1}\left(\dfrac{2}{\sqrt{3}}\right)$

36. A Cu disc of radius 0.1 m rotates about its centre with 10 rps in a uniform magnetic field of 0.1 T. The emf induced across the radius of the disc is

(a) 10π mV   (b) 20π mV

(c) $\dfrac{\pi}{10}$ V   (d) $\dfrac{2\pi}{10}$ V

37. The coefficient self inductance of a solenoid is 0.18 mH. If a core of soft iron of relative permeability 900 is inserted, then the coefficient of self-inductance will becomes

(a) 0.0002 mH   (b) 0.006 mH

(c) 5.4 mH   (d) 162 mH

38. If a resonant AC circuit contains a capacitor of capacitance 10^{-6} F and an inductor of 10^{-4} H, then the frequency of electrical oscillations will be

(a) 10 Hz   (b) 10^2 Hz

(c) $\dfrac{10}{2\pi}$ Hz   (d) $\dfrac{10^5}{2\pi}$ Hz

39. Threshold frequency for a metal is 10^{15} Hz. If light of wavelength 4000 Å falls on its surface, then which of the following statement is correct?

(a) Photo electrons come out with zero speed.

(b) Photo electrons come out with 10^3 m/s speed.

(c) Photo electrons come out with 10^5 m/s speed.

(d) No photo electric emission takes place.

40. In a semiconductor the concentrations of electrons and holes are 8×10^{18} m^{-3} and 5×10^{18} m^{-3} respectively. If the mobilities of electrons and holes are 2.3 m^{2}V^{-1}s^{-1} and 0.01 m^{2}V^{-1}s^{-1} respectively, then semiconductor is

(a) n-type and its resistivity is 0.034 Ω-m

(b) n-type and its resistivity is 0.34 Ω-m

(c) p-type and its resistivity is 0.034 Ω-m

(d) p-type and its resistivity is 0.34 Ω-m

41. The periodic time of a particle executing SHM is 4 s. The time taken by it to go from its mean position to half the maximum displacement (amplitude) is

(a) 1s   (b) 2s

(c) $\dfrac{1}{3}$ s   (d) $\dfrac{2}{3}$ s

42. When three masses 700g, 500g and 400g are suspended at the end of a spring as shown, they are in equilibrium. If the mass of 700g is removed, then system oscillates with a period of 3 s. if further 500 g mass is also removed then the system will oscillate with a period of

(a) 1s   (b) 2s

(c) 3s   (d) 4s

43. In steady state of thermal conduction, temperature of the ends A and B of a 20 cm long rod are 100°C and 0°C respectively. What will be the temperature of the rod at a point at a distance of 6 cm from the end A of the rod?

(a) 5°C   (b) 70°C

(c) −30°C   (d) −50°C

44. If three rings each of mass m and radius r are arranged as shown in figure, then the moment of inertia of the system about the axis XX' will be
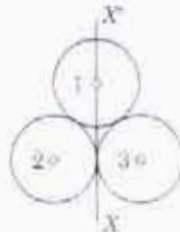

(a) $3\,mr^2$ (b) $\dfrac{3}{2}mr^2$

(c) $7\,mr^2$ (d) $\dfrac{7}{2}mr^2$

45. If a body of mass 10 kg is dropped to the ground from a height of 5 m, then the work done by the gravitational force is
    (Take $g = 9.8$ m/s^2)

    (a) + 490 J   (b) −490 J
    (c) −980 J   (d) + 980 J

46. A mass of 10 kg is sliding along a rough horizontal surface. If the coefficient of friction is $\frac{1}{\sqrt{3}}$, then the least force which acts at an angle of 30° to horizontal is
    (Take $g = 10$ m/s^2)

    (a) 25 N   (b) 50 N
    (c) $\frac{50}{\sqrt{3}}$ N   (d) 100N

47. The velocity of a particle is given by $(10 + 2t^2)$ ms. The average acceleration of the particle between 2 s and 5 s will be

    (a) 2 m/s^2 (b) 4 m/s^2
    (c) 10 m/s^2 (d) 14 m/s^2

48. At the highest point of the path of a projectile, its

    (a) kinetic energy is minimum
    (b) kinetic energy is maximum
    (c) potential energy is minimum
    (d) total energy is maximum

49. If a body of mass m is projected at an angle of 45° with the horizontal, then total change in momentum when it strikes the ground will be (Take air resistance negligible)

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

50. A body moves from rest with a constant acceleration. Which one of the following graphs represents the variation of its kinetic energy K with the distance travelled x?
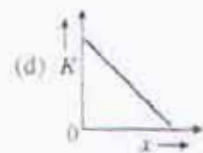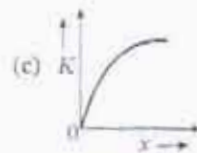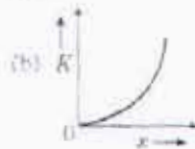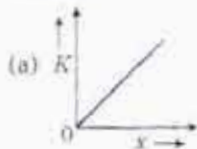
51. An earth satellite is moved from one stable circular orbit to a further stable orbit, then among the following which one will increase?

    (a) Linear orbital speed
    (b) Centripetal acceleration
    (c) Gravitational potential energy
    (d) Gravitational force

52. The value of g at the surface of the earth is 9.8 m/s^2. At a place 480 km above the surface of earth, the value of g will be
    (Take radius of earth = 6400 km)

    (a) 4.2 m/s^2 (b) 7.2 m/s^2
    (c) 8.4 m/s^2 (d) 9.8 m/s^2

53. Two long freely hanging wires firstly joined in parallel and then in series. When the two combinations are connected with a battery, then which type of force acts between the two wires in two cases?

    (a) Repulsive force in both cases
    (b) Attractive force in both cases
    (c) Repulsive force when in parallel and attractive force when in series
    (d) Attractive force when in parallel and repulsive force when in series

54. Which one of the following curves represents the curve between magnetic moment and temperature of the magnet?
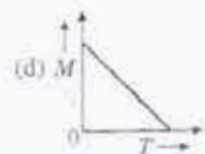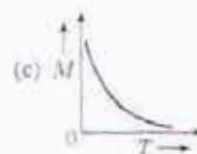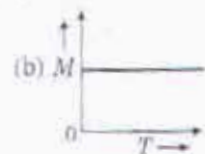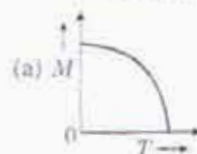
55. An electric motor draws a current of 10 A when operated on 60 V DC supply. If the efficiency of the motor is 50%, then the resistance of the motor windings is
    (a) 15 Ω   (b) 30 Ω
    (c) 3 Ω   (d) 6 Ω

56. In a series L-C-R circuit, having $C = 2\mu F$, $L = 1$ mH and $R = 10 \Omega$, when the current in the circuit is maximum at that time the ratio of energies stored in the capacitor and the inductor will be
    (a) 1 : 2   (b) 2 : 1
    (c) 1 : 5   (d) 5 : 1

57. In the following reaction, what is the value of x?
    $$_{12}Mg^{24} + _2He^4 \longrightarrow _{14}Si^x + _0n^1$$
    (a) 22   (b) 26
    (c) 27   (d) 28

58. If before the saturation state of a diode, for the plate voltages 400 V and 200 V the currents are i_1 and i_2 respectively, then the ratio of i_1/i_2 is
    (a) 2/1   (b) 1/2
    (c) $\sqrt{2}/4$ (d) $2\sqrt{2}/1$

59. If the logic gates are combined as shown in figure and the logic states of inputs A, B, C are as follows $A = B = C = 0$ and $A = B = 1$, $C = 0$, then the logic states of output D are
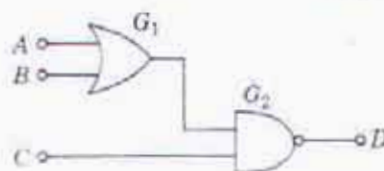
    (a) 1, 0   (b) 1, 1
   (c) 0, 1   (d) 0, 0

60. Two waves $y_1 = a \sin 2000\pi t$ and $y_2 = a \sin 2008 \pi t$ produces beats, the number of beats heard per second will be
    (a) 0   (b) 1
    (c) 4   (d) 5

Chemistry

1. 4.5 g of aluminium (at. mass 27 u) is deposited at cathode from Al^{3+} solution by certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in solution by the same quantity of electric charge will be
   (a) 22.4 L   (b) 44.8 L
   (c) 5.6 L   (d) 11.2 L

2. The rate of a first order reaction is 1.5×10^{-2} mol L^{-1} min^{-1} at 0.5 M concentration of the reactant. The half-life of the reaction is
   (a) 0.383 min   (b) 23.1 min
   (c) 8.73 min   (d) 7.53 min

3. A substance $A_x B_y$ crystallises in a face centred cubic lattice in which A atom occupies each corner of cube and atom B occupies the centres of each face of the cube. Identify the correct composition of the substance $A_x B_y$
   (a) AB_3
   (b) $A_4 B_3$
   (c) $A_3 B$
   (d) Composition cannot be specified

4. The helical structure of protein is stabilised by
   (a) dipeptide bonds   (b) hydrogen bonds
   (c) ether bonds   (d) peptide bonds

5. The monomer of the polymer
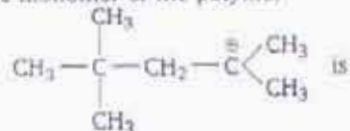
is
   (a) $H_2C = C \Big\langle \begin{smallmatrix} CH_3 \\ CH_3 \end{smallmatrix}$
   (b) $(CH_3)_2C = C(CH_3)_2$
   (c) $CH_3CH = CH \cdot CH_3$
   (d) $CH_3CH = CH_2$

6. The enzyme which hydrolyses triglycerides to fatty acids and glycerol is called
   (a) maltase   (b) lipase
   (c) zymase   (d) pepsin

19. Which one of the following alkenes will react faster with H_2 under catalytic hydrogenation conditions? (R = Alkyl substituent)

(a)   (b)

(c)   (d)
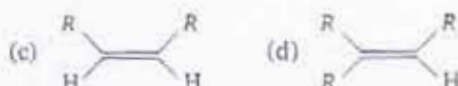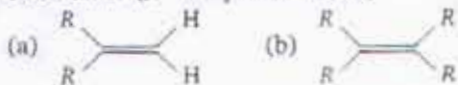
20. The major organic product formed from the following reaction

(i) CH_3NH_2
(ii) $LiAlH_4$ (iii) H_2O ..... is

(a)

(b)

(c)

(d)

21. In the compound

1 COOH
H —2— OH
OH —3— H
4 COOH
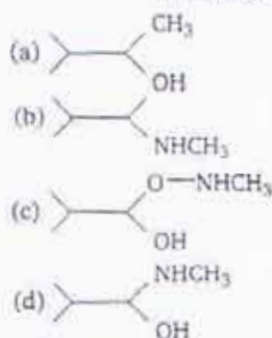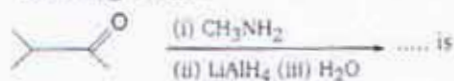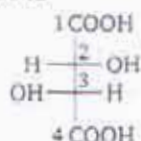
configuration at C_2 and C_3 atoms are
(a) S, S   (b) R, S
(c) S, R   (d) R, R

22. Which one of the following compounds is most acidic?
(a) $Cl—CH_2—CH_2—OH$

(b)

(c)

(d)
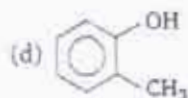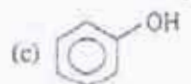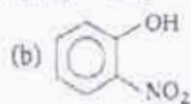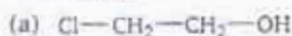
23. Number of atoms of oxygen present in 10.6 g of Na_2CO_3 will be
(a) 6.02×10^{23} (b) 12.04×10^{22}
(c) 1.806×10^{23} (d) 31.80×10^{28}

24. The surface tension of which of the following liquid is maximum?
(a) H_2O (b) C_6H_6
(c) CH_3OH (d) C_2H_5OH

25. Which of the following polymer can be used for lubrication and as an insulator?
(a) PVC   (b) PTFE
(d) SBR   (d) PMMA

26. State the product available in the following reaction.

$\xrightarrow{Sn, HCl} X \xrightarrow[0.5^\circ C]{NaNO_2, HCl}$

$Y \xrightarrow{CuCN}$
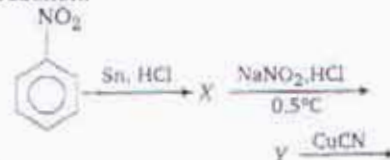
(a) cyanobenzene
(b) benzoic acid
(c) cyanoethane
(d) p-aminoazobenzene

27. The correct order of acid strength is
(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO < HClO_2 < HClO_3$
(c) $HClO_2 < HClO_3 < HClO_4 < HClO$
(d) $HClO_4 < HClO_3 < HClO_2 < HClO$

28. In the equation
$4M + 8CN^- + 2H_2O + O_2 \longrightarrow 4[M(CN)_2]^-$
$+ 4OH^-$
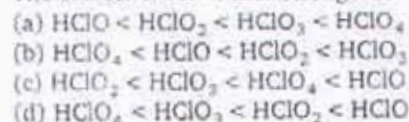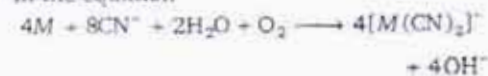
Identify the metal M.
(a) Copper   (b) Iron
(c) Silver   (d) Zinc

29. Which one of the following is expected to exhibit optical isomerism?
(en = ethylenediamine)
(a) Cis-$[Pt (NH_3)_2Cl_2]$
(b) $Trans$-$[Co(en)_2Cl_2]$
(c) $Trans$-$[Pt (NH_3)_2Cl_2]$
(d) Cis-$[Co(en)_2Cl_2]$

30. The best method for the separation of naphthalene and benzoic acid from their mixture is
    (a) chromatography   (b) crystallisation
    (c) distillation   (d) sublimation

31. The standard emf of a galvanic cell involving cell reaction with $n = 2$ is found to be 0.295 V at 25° C. The equilibrium constant of the reaction would be
    (a) 2.0×10^{11} (b) 4.0×10^{12}
    (c) 1.0×10^{2} (d) 1.0×10^{10}
    (Given, $F = 96500\,C\,mol^{-1}$,
        $R = 8.314\,JK^{-1}\,mol^{-1}$)

32. Milk is
    (a) fat dispersed in water
    (b) fat dispersed in milk
    (c) fat dispersed in fat
    (d) water dispersed in milk

33. The magnetic moment of Cu^{2+} ion is
    (a) 5.63 BM   (b) 4.19 BM
    (c) 3.9 BM   (d) 1.73 BM

34. The hydrogen electrode is dipped in a solution of pH = 3 at 25°C. The potential of the cell would be (the value of $2.303\,RT/F$ is 0.059V)
    (a) 0.177 V   (b) 0.087 V
    (c) −0.177 V   (d) 0.059 V

35. If the bond energies of H—H, Br—Br and H—Br are 433, 192 and 364 kJ mol^{-1} respectively, then ΔH° for the reaction
    $$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$$ is
    (a) −261 kJ   (b) + 103 kJ
    (c) + 261 kJ   (d) −103 kJ
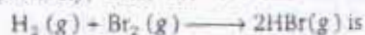
36. Which of the following molecules has trigonal planar geometry?
    (a) IF_3 (b) PCl_3
    (c) NH_3 (d) BF_3

37. Which of the following compounds is obtained when HCHO is reacted with ammonia?
    (a) Urotropine
    (b) Formaldehyde ammonia
    (c) Methyl amine
    (d) Ethyl amine

38. Which one of the following structures represents the peptide chain?
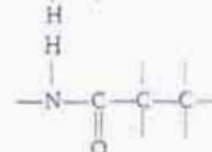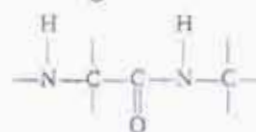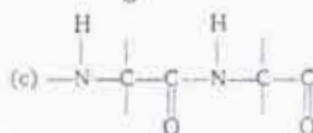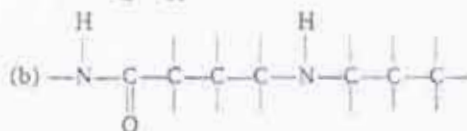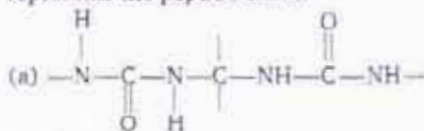
39. Which of the following is responsible for depletion of the ozone layer in the upper strata of the atmosphere?
    (a) Polyhalogens   (b) Ferocenes
    (c) Fullerenes   (d) Freons

40. The radioactive isotope $^{60}_{27}Co$ which is used in the treatment of cancer can be made by (n, p) reaction. For this reaction the target nucleus is
    (a) $^{59}_{28}Ni$ (b) $^{59}_{27}Co$
    (c) $^{60}_{28}Ni$ (d) $^{60}_{27}Co$

41. Reaction of HBr with propene in the presence of peroxide gives
    (a) isopropyl bromide
    (b) 3-bromopropane
    (c) allylbromide
    (d) n-propylbromide

42. For a first order reaction, $A \rightarrow B$ the reaction rate at reactant concentration of 0.01 M is found to be 2.0×10^{-15} mol $L^{-1} s^{-1}$. The half-life period of the reaction is
    (a) 220 s   (b) 30 s
    (c) 300 s   (d) 347 s

43. At 90°C, pure water has $[H_3O^+] = 10^{-6}$ mol/L. The value of K_w at 90°C is
    (a) 10^{-6} (b) 10^{-4}
    (c) 10^{-12} (d) 10^{-14}

44. 50 mL of 0.1 M HCl and 50 mL of 0.2 M NaOH are mixed. The pH of the resulting solution is
    (a) 1.30   (b) 4.2
    (c) 12.70   (d) 11.70

45. Using anhydrous $AlCl_3$ as catalyst, which one of the following reactions produce ethylbenzene (PhEt)?
    (a) $H_3C—CH_2OH + C_6H_6$
    (b) $CH_3—CH=CH_2 + C_6H_6$
    (c) $H_2C=CH_2 + C_6H_6$
    (d) $H_3C—CH_3 + C_6H_6$

46. Which of the following contains cobalt?
    (a) Vitamin A   (b) Vitamin C
    (c) Vitamin B_{12} (d) Vitamin K

47. The product A is

(a)
(b)
(c)
(d)
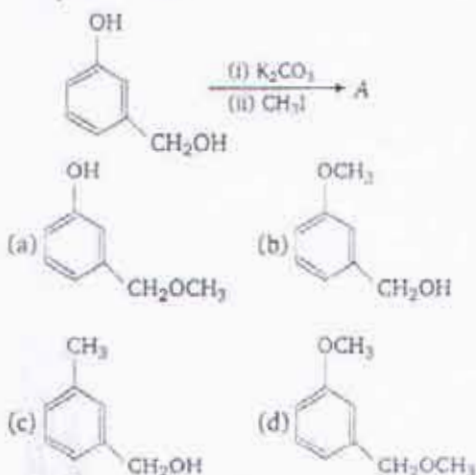
48. Alizarin is a
    (a) nitro dye
    (b) azo dye
    (c) anthraquinone dye
    (d) phthalein dye

49. Names of some compounds are given. Which one is not correct in IUPAC system?
    (a) $CH_3—CH—CH—CH_3$
         $\quad\quad\;\; OH \;\; CH_3$
         3-methyl-2-butanol
    (b) $CH_3—C≡C—CH(CH_3)_2$
         4-methyl-2-pentyne
    (c) $CH_3—CH_2—C—CH_2$
         $\quad\quad\quad CH_3 \;\; CH_2CH_3$
         2-ethyl-3-methyl-but-1-ene
    (d) $CH_3—CH_2—CH_2—CH—CH—CH_2CH_3$
         $\quad\quad\quad\quad\quad\quad\quad\;\; CH_2CH_3$
         3-methyl-4-ethylheptane
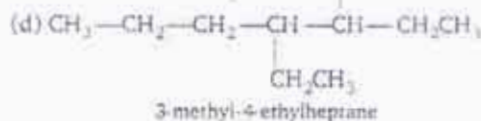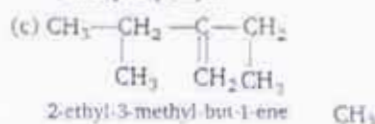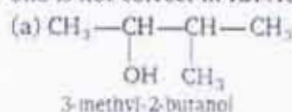
50. Which of the following is the electron deficient molecule?
    (a) B_2H_6 (b) C_2H_6
    (c) PH_3 (d) SiH_4

51. At 25°C the dissociation constant of a base, BOH is 1.0×10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be
    (a) 2.0×10^{-6} mol L^{-1}
    (b) 1.0×10^{-5} mol L^{-1}
    (c) 1.0×10^{-6} mol L^{-1}
    (d) 1.0×10^{-7} mol L^{-1}

52. Which of the following compounds is not aromatic?
    (a)
    (b)
    (c)
    (d)
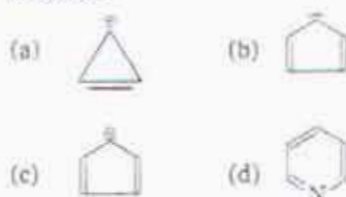
53. Two nodal planes are present in
    (a) $\pi 2p_x$
    (b) $\sigma 2p_z$
    (c) $\pi 2p_z$
    (d) $\pi 2p_y$

54. Which of the following will be most readily dehydrated under acidic conditions?

(a)   (b)

(c)   (d)
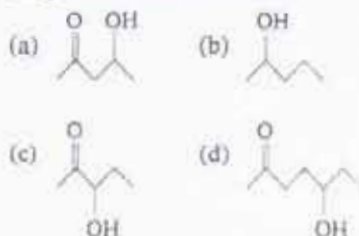
55. A solid compound 'X' on heating gives CO_2 gas and a residue. The residue mixed with water to give 'Y'. On passing an excess of CO_2 through 'Y' in water clear solution 'Z' is obtained. On boiling 'Z' compound 'X' is reformed. The compound 'X' is
   (a) $Ca(HCO_3)_2$ (b) $CaCO_3$
   (c) Na_2CO_3 (d) K_2CO_3
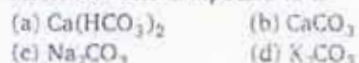
56. Four successive members of the first row transition elements are listed below with their atomic numbers. Which one of them is expected to have the highest third ionization enthalpy?
   (a) Vanadium $(Z = 23)$
   (b) Chromium $(Z = 24)$
   (c) Iron $(Z = 26)$
   (d) Manganese $(Z = 25)$
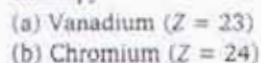
57. What is the oxidation state of phosphorus in Ca_3P_2?
   (a) +3   (b) –3
   (c) +5   (d) –5

58. The energy of second Bohr orbit of the hydrogen atom is -328 kJ mol^{-1}; hence the energy of fourth Bohr orbit would be
   (a) -41 kJ mol^{-1}
   (b) -1312 kJ mol^{-1}
   (c) -164 kJ mol^{-1}
   (d) -82 kJ mol^{-1}
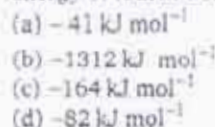
59. For d-electron, the orbital angular momentum is
   (a) $\dfrac{\sqrt{6}\,h}{2\pi}$ (b) $\dfrac{\sqrt{2}\,h}{2\pi}$
   (c) $\dfrac{h}{2\pi}$ (d) $\dfrac{2h}{\pi}$

60. Which one of the following forms micelles in aqueous solution above certain concentration?
   (a) Urea
   (b) Dodecyl trimethyl ammonium chloride
   (c) Pyridinium chloride
   (d) Glucose

Biology

1. Which of the following propagates through leaf-tip?
   (a) Walking fern
   (b) Sprout-leaf plant
   (c) *Marchantia*
   (d) Moss
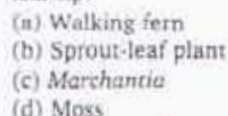
2. Common indicator organism of water pollution is
   (a) *Lemna pancicostata*
   (b) *Eichhornia crassipes*
   (c) *Escherichia coli*
   (d) *Entamoeba histolytica*
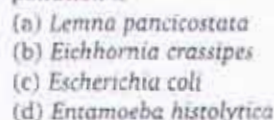
3. According to Oparin, which one of the following was not present in the primitive atmosphere of the earth?
   (a) Methane   (b) Oxygen
   (c) Hydrogen   (d) Water vapour

4. Which one of the following precedes re-formation of the nuclear envelope during M-phase of the cell cylce?
   (a) Decondensation from chromosomes and reassembly of the nuclear lamina
   (b) Transcription from chromosomes and reassembly of the nuclear lamina
   (c) Formation of the contractile ring and formation of the phragmoplast
   (d) Formation of the contractile ring and transcription from chromosomes
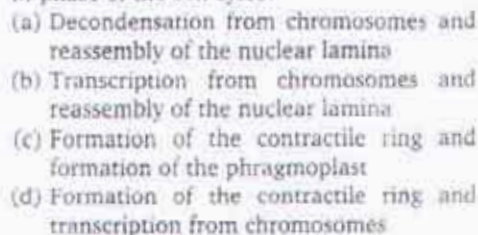
5. In transgenics, expression of transgene in target tissue is determined by
   (a) enhancer
   (b) transgene
   (c) promoter
   (d) reporter
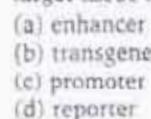
6. Restriction endonuclease
   (a) cuts the DNA molecule randomly
   (b) cuts the DNA molecule at specific sites
   (c) restricts the synthesis of DNA inside the nucleus
   (d) synthesizes DNA

7. Earthworms are
   (a) ureotelic when plenty of water is available
   (b) uricotelic when plenty of water is available
   (c) uricotelic under conditions of water scarcity
   (d) ammonotelic when plenty of water is available

8. Which one of the following has an open circulatory system?
   (a) *Pheretima*
   (b) *Periplaneta*
   (c) *Hirudinaria*
   (d) *Octopus*

9. Biradial symmetry and lack of cnidoblasts are the characteristics of
   (a) Starfish and sea anemone
   (b) *Ctenoplana* and *Beroe*
   (c) *Aurelia* and *Paramecium*
   (d) *Hydra* and starfish

10. In order to obtain virus-free plants through tissue culture, the best method is
    (a) protoplast culture
    (b) embryo rescue
    (c) anther culture
    (d) meristem culture

11. Both sickle cell anaemia and Huntington's chorea are
    (a) bacteria-related diseases
    (b) congenital disorders
    (c) pollutant-induced disorders
    (d) virus-related diseases

12. Which one of the following pairs is not correctly matched?
    (a) Vitamin B_{12} — Pernicious anaemia
    (b) Vitamin B_6 — Loss of appetite
    (c) Vitamin B_1 — Beri-beri
    (d) Vitamin B_2 — Pellagra

13. Injury to vagus nerve in human is not likely to affect
    (a) tongue movements
    (b) gastrointestinal movements
    (c) pancreatic secretion
    (d) cardiac movements

14. Environment consists of
    (a) living objects of the surroundings
    (b) non-living objects of the surrounding
    (c) non-living objects, events and influences of the surroundings
    (d) living and non-living objects, events and influences of the surroundings

15. Study of pollen grains is called
    (a) Spermology
    (a) Anatomy
    (b) Palynology
    (d) Aerobiology

16. The major source of pollution up to 80% of total air pollution in metropolitan cities is
    (a) automobiles (traffic)
    (b) industries
    (c) pesticides
    (d) radioactivity and noise

17. Ultimate source of variations is
    (a) natural selection
    (b) sexual reproduction
    (c) mutations
    (d) hormonal actions

18. Which of the following statement is correct?
    (a) Xylem is made up of all living cells.
    (b) Xylem is made up of living and non-living cells.
    (c) Xylem is made up of non-living cells.
    (d) Xylem does not contain cells.

19. The boundry/transition between two or more communities sharply defined is called
    (a) epilimnion
    (b) biome
    (c) anticline
    (d) ecotone

20. Unit of distance between genes in a chromosome is known as
    (a) c-DNA
    (b) Morgan
    (c) Centi Morgan
    (d) Spacer

21. Age of the plant can be calculated by
    (a) measuring its height
    (b) counting leaf bases
    (c) counting annual rings
    (d) All of the above

22. In detritus food chain transfer of food is
    (a) detrite (dead organic matter) → detrivores → decomposers

(b) detrite → microbes → detrivores → decomposers

(c) detrivores → organic matter → microbes → decomposers

(d) grass → detrivores → decomposers

23. Criss-cross inheritance means
    (a) X-chromosome from male will pass to a male of next generation
    (b) X-chromosome from a male will pass to a female of next generation
    (c) X-chromosome from female will pass to female of next generation
    (d) None of the above

24. Cohesion force theory was proposed by
    (a) JC Bose (1850)
    (b) Dixon and Jolly (1950)
    (c) Benson and Calvin (1855)
    (d) Dixon and Jolly (1894)

25. The cell cultured *in vitro* gives rise to complete plant. This ability of plant cell is known as
    (a) growth
    (b) development
    (c) regeneration
    (d) totipotency

26. Living fossils means
    (a) primitive organized organisms
    (b) extinct organisms
    (c) organisms with ancestral characters and time has not changed them
    (d) connecting link between two groups

27. Biggest source of energy on earth surface is
    (a) coal
    (b) tides
    (c) atoms
    (d) solar radiation

28. The process of photosynthesis is
    (a) reductive, exergonic and catabolic
    (b) reductive, endergonic and catabolic
    (c) reductive, exergonic and anabolic
    (d) reductive, endergonic and anabolic

29. Which is the correct sequence of code transfer involved in the formation of polypeptide?
    (a) DNA-tRNA-rRNA-mRNA
    (b) tRNA-DNA-mRNA-rRNA
    (c) mRNA-tRNA-DNA-amino acid
    (d) DNA-mRNA-tRNA-amino acid

30. Cancer is the 'Bank of life' which of the following tumour form is non-cancerous?
    (a) Benign tumour
    (b) Malignant tumour
    (c) Carcinogens
    (d) All of these

31. The 'Cri-du-chat' syndrome is caused by change in chromosome structure involving
    (a) deletion
    (b) duplication
    (c) inversion
    (d) translocation

32. When synapsis is complete all along the chromosome, the cell is said to have entered a stage called
    (a) zygotene
    (b) pachytene
    (c) diplotene
    (d) diakinesis

33. How does pruning help in making the hedge dense?
    (a) It induces the differentiation of new shoots from the rootstock
    (b) It frees axillary buds from apical dominance
    (c) The apical shoot grows faster after pruning
    (d) It releases wound hormones

34. Which one of the following statements is correct?
    (a) Neurons regulate endocrine activity, but not vice versa.
    (b) Endocrine glands regulate neural activity and nervous system regulates endocrine glands.
    (c) Neither hormones control neural activity nor the neurons control endocrine activity.
    (d) Endocrine glands regulate neural activity but not vice versa.

35. Evolutionary history of an organism is known as
    (a) phylogeny
    (b) ancestry
    (c) paleontology
    (d) ontogeny

36. Sertoli cells are regulated by the pituitary hormone known as
    (a) FSH
    (b) GH
    (c) prolactin
    (d) LH

37. Pulmonary artery differs from pulmonary vein in having
    (a) no endothelium
    (b) strong valves
    (c) Brunner's cell
    (d) thick muscular walls

38. Cerebellum portion of brain is
    (a) concerned with maintainance of posture/equilibrium
    (b) responsible for olfactory functions
    (c) controls optic functions
    (d) Both (a) and (c)

39. Which of the following type of mutation involves the reverse order of genes in a chromosome?
    (a) Deletion
    (b) Duplication
    (c) Inversion
    (d) Reciprocal translocation

40. Which one of the following can help in the diagnosis of a genetical disorder?
    (a) ELISA   (b) ABO blood group
    (c) PCR   (d) NMR

41. Initiation of polypeptide chain is through
    (a) methionine   (b) glycine
    (c) lysine   (d) leucine

42. Which one of the following is incorrect about the characteristics of protobionts (co-aservates) and microspheres as ensvisaged in the abiogenic origin of life?
    (a) They were able to reproduce
    (b) They could separate combinations of molecules from the surroundings
    (c) They are partially surrounded by the surroundings
    (d) They could maintain an internal environment

43. At which stage of HIV infection does one usually shows symptoms of AIDS?
    (a) When viral DNA is produced by reverse transcriptase
    (b) When HIV replicates rapidly in helper T-lymphocytes and damages large number of cells
    (c) Within these 15 days of sexual contact with an infected person

    (d) When the infecting retrovirus enters the host cells

44. When CO_2 concentration in blood increases, breathing becomes
    (a) shallower and slow
    (b) there is no effect on breathing
    (c) slow and deep
    (d) faster and deeper

45. A free living nitrogen fixing cyanobacterium which can also form symbiotic association with the water fern Azolla is
    (a) Tolypothrix   (b) Chlorella
    (c) Nostoc   (d) Anabaena

46. Which of the following hormones is not a secretion product of human placenta?
    (a) Human chorionic gonadotropin
    (b) Prolactin
    (c) Oestrogen
    (d) Progesterone

47. The international unit used in biology to measure size of objects is
    (a) μm (micrometer)   (b) nm (nanometer)
    (c) Å (angstrom)   (d) All are used

48. Out of 1.7 million species of living organisms known to us, insects contributes to about
    (a) 0.7 million   (b) 70000
    (c) 70 lakh   (d) one lakh

49. Primitive earth had
    (a) reducing atmosphere (without free oxygen)
    (b) oxidizing atmosphere (free oxygen)
    (c) Both (a) and (b)
    (d) None of the above

50. The white fibres are resistant to streaching and formed of a substance, the protein collagen, which on boiling with water yields
    (a) gelatin
    (b) elastin
    (c) ossein
    (d) chondrin

51. Which one of the following is not used in production of yoghurt?
    (a) Streptococcus lactis
    (b) S. thermophilus
    (c) Lactobacillus bulgaricus
    (d) Acetobacter aceti

52. Viagra is an anti impotent drug. Its chemical salt is
    (a) sildenafil citrate
    (b) nitrous oxide
    (c) nitroglycerene
    (d) digitoxyline

53. Two mating types of a variety of *Paramecium* are
    (a) morphologically different and physiologically similar
    (b) morphologically similar and physiologically different
    (c) physiologically similar
    (d) physiologically different

54. Correct sequence among the following is
    (a) Palaeozoic $\longrightarrow$ Mesozoic $\longrightarrow$ Coenozoic
    (b) Mesozoic $\longrightarrow$ Archaeozoic $\longrightarrow$ Proterozoic
    (c) Palaeozoic $\longrightarrow$ Archaeozoic $\longrightarrow$ Coenozoic
    (d) Archaeozoic $\longrightarrow$ Palaeozoic $\longrightarrow$ Proterozoic

55. The epithelial cells lining the stomach of vertebrates is protected from damage by HCl because
    (a) HCl is too dilute
    (b) the epithelial cells are resistant to the action of HCl
    (c) HCl is neutralized by alkaline gastric juice

(d) the epithelial cells are covered with a mucous secretion

56. *In situ* conservation of genetic diversity is done in the form of
    (a) national parks
    (b) biosphere reserves
    (c) wildlife sanctuaries
    (d) All of the above

57. Pyrenoids are centre of
    (a) fat storage
    (b) starch storage
    (c) protein formation
    (d) enzyme formation

58. 'Damping off a seedling' is due to
    (a) Nematode
    (b) *Albugo candida*
    (c) *Fusarium oxysporium*
    (d) *Pythium debaryanum*

59. Which one is not a vestigial organ of man?
    (a) Nictitating membrane
    (b) Epiglottis or ileum
    (c) Vermiform appendix
    (d) Muscles or ear pinnae

60. Reason, will, memory, intelligence and emotions are governed by
    (a) cerebellum
    (b) mid brain
    (c) medulla oblongata
    (d) cerebral hemispheres

General Aptitude and Current Issues

Directions *Select the related word/ letter/number from the given alternatives.*

1. Life : Death :: Beginning : ?
   (a) Era   (b) End
   (c) Time   (d) Commence

2. Arrange the following words according to English Dictionary.
   1. Advertise   2. Admit
   3. Addition   4. Adhesive
   (a) 1, 2, 3, 4   (b) 3, 4, 2, 1
   (c) 3, 2, 4, 1   (d) 4, 1, 2, 3

3. Which one set of letters when sequentially placed at the gaps in the given letter series shall complete it?
   KLM_, KL_N, K_MN, _LMN
   (a) NMLK
   (b) KLMN
   (c) LKNM
   (d) KLNM

4. Find the wrong number in the given series.
   6, 14, 31, 64, 137, 280
   (a) 31   (b) 64
   (c) 137   (d) 280

5. Pointing to a girl in a bus, a man tells his friend, "She is the daughter of the only son of my father's wife". How is the girl related to the man?
   - (a) Cousin
   - (b) Daughter
   - (c) Mother
   - (d) Sister

6. There are five friends Suresh, Kaushal, Madhur, Amit and Ramesh. Suresh is shorter than Kaushal but taller than Ramesh. Madhur is the tallest. Amit is a little shorter than Kaushal but little taller than Suresh. If they stand in the order of their heights, who will be the shortest?
   - (a) Amit
   - (b) Madhur
   - (c) Ramesh
   - (d) Kaushal

7. From the given alternatives, select the word which cannot be formed using the letters of the given word.
   HISTORICAL
   - (a) RICHES
   - (b) CHARIOT
   - (c) CHART
   - (d) CHAOS

   Directions (Q.Nos. 8-9) *Select the missing number from the given responses.*

8.

8	72	9
6	66	11

   - (a) 64
   - (b) 60
   - (c) 52
   - (d) 54

9.

14	25	42
2	4	6
3	3	?

   - (a) 3
   - (b) 4
   - (c) 6
   - (d) 7

10. X walks Southwards and then turns right, then left and then right. In which direction is he moving now?
    - (a) South
    - (b) North
    - (c) West
    - (d) South-West

11. Kalpana travelled from point B straight to C, a distance of 8 ft. She turned left and walked 5 ft away. Again, she turned left and walked 7 ft and finally turned left and walked 5 ft. How far is she from the starting point?
    - (a) 3 ft
    - (b) 4 ft
    - (c) 1 ft
    - (d) 5 ft

12. Two statements are given followed by two Conclusions I and II. You have to consider the statements to be true even if they seem to be at variance from commonly known facts. You are to decide which of the given conclusions, if any, follow from the given statements. Indicate your answer.
    Statements Teaching is an art.
    Drawing is also an art.
    Conclusions
    I. All artists are teachers.
    II. All artists know to draw pictures.
    - (a) Only Conclusion I follows
    - (b) Only Conclusion II follows
    - (c) Neither Conclusion I nor II follows
    - (d) Both Conclusions I and II follow

13. Which answer figure will complete the pattern in the question figure?
    Question Figure
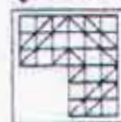
    Answer Figures
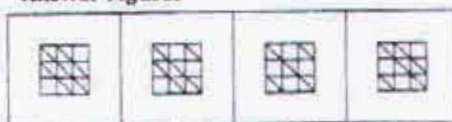
    (a)   (b)   (c)   (d)

14. A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened?
    Question Figures
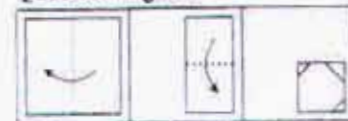
    Answer Figures
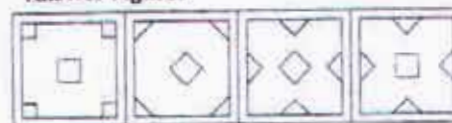
    (a)   (b)   (c)   (d)

15. Which of the answer figure is exactly the mirror image of the given figure, when the mirror is held on the line AB?

Question Figure

Answer Figures

(a)   (b)   (c)   (d)
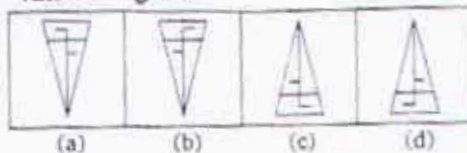
Directions (Q.Nos. 16-17) *Some parts of the sentence have errors and some are correct. Find out which part of a sentence has an error corresponding to the appropriate letter (a), (b) and (c). If a sentence is free from errors, mark the answer (d).*

16. Supposing if (a)/ it rains (b)/ what shall we do? (c)/ No error (d)

17. The captain along with his team (a)/ are practising very hard (b)/ for the forthcoming match. (c)/ No error (d)

Directions (Q.Nos. 18-20) *Out of the four alternatives, choose the one which best expresses the meaning of the given word and mark it in the answer sheet.*

18. Defer
    (a) Indifferent   (b) Defy
    (c) Differ   (d) Postpone

19. Cease
    (a) Begin   (b) Stop
    (c) Create   (d) Dull

20. Pious
    (a) Religious   (b) Sympathetic
    (c) Afraid   (d) Faithful

Directions (Q.Nos. 21-22) *Choose the word opposite in meaning to the given word and mark it in the answer sheet.*

21. Stingy
    (a) Clean   (b) Tight
    (c) Generous   (d) Cheap

22. Barren
    (a) Fertile   (b) Rich
    (c) Prosperous   (d) Positive

Directions (Q.Nos. 23-24) *Four alternatives are given for the idiom/phrase. Choose the alternative which best expresses the meaning of the idiom/phrase and mark it in the answer sheet.*

23. To look down one's nose
    (a) To show anger
    (b) To retaliate
    (c) To insult in the presence of others
    (d) To regard with contempt

24. To shed crocodile tears
    (a) To weep profusely
    (b) To pretend grief
    (c) To grieve seriously
    (d) To mock something

Directions (Q.Nos. 25-26) *A part of the sentence is underlined which may need improvement. Alternatives are given at (a), (b) and (c) below, which may be better option. In case no improvement is needed, your answer is (d).*

25. The cheapest electronic good are manufactured in China
    (a) electronical good   (b) electrical good
    (c) electronic goods   (d) No improvement

26. I have been living in Delhi from 1989.
    (a) eversince
    (b) since
    (c) in
    (d) No improvement

Directions (Q.Nos. 27-28) *Out of the four alternatives, choose the one which can be substituted for the given words/sentence.*

27. Murder of a man
    (a) Regicide   (b) Fratricide
    (c) Homicide   (d) Genocide

28. Use of force or threats to get someone to agree to something
    (a) Coercion
    (b) Conviction
    (c) Confession
    (d) Cajolement

Directions (Q.Nos. 29-30) *In the following questions, group of four words are given. In each group, one word is correctly spelt. Find the correctly spelt word and mark it in the answer sheet.*

29. (a) Livelihood   (b) Livelyhood
    (c) Livlihood   (d) Liveiyhud

30. (a) Foyere   (b) Foayer
    (c) Foyer   (d) Fouyer

31. If the sum of five consecutive integers is S, then the largest of those integers in terms of S is

    (a) $\dfrac{S-10}{5}$ (b) $\dfrac{S+4}{4}$

    (c) $\dfrac{S+5}{4}$ (d) $\dfrac{S+10}{5}$

32. The greatest among the numbers $3\sqrt{2}, 3\sqrt{7}, 6\sqrt{5}, 2\sqrt{20}$ is

    (a) $3\sqrt{2}$ (b) $3\sqrt{7}$
    (c) $6\sqrt{5}$ (d) $2\sqrt{20}$

33. The denominator of a fraction is 3 more than its numerator. If the numerator is increased by 7 and the denominator is decreased by 2, we obtain 2. The sum of numerator and denominator of the fraction is

    (a) 5   (b) 13
    (c) 17   (d) 19

34. 47 is added to the product of 71 and an unknown number. The new number is divisible by 7, giving the quotient 98. The unknown number is a multiple of

    (a) 2   (b) 5
    (c) 7   (d) 3

35. The least number which, when divided by 16, 18, 20 and 25 leaves 4 as remainder in each case but when divided by 7 leaves no remainder is

    (a) 17004   (b) 18000
    (c) 18002   (d) 18004

36. A can do a work in 5 days less than the time taken by B to do it. If both of them together take $11\dfrac{1}{9}$ days, then the time taken by B alone to do the same work (in days) is

(a) 15   (b) 20
(c) 25   (d) 30

37. The price of a certain television set is discounted by 10% and the reduced price is then discounted by 10%. This series of successive discounts is equivalent to a single discount of

    (a) 20%   (b) 19%
    (c) 18%   (d) 11%

38. Rahim bought a TV with 20% discount on list price. Had he bought it with 25% discount, he would have saved ₹ 500. At what price did he buy the TV?

    (a) ₹ 16000   (b) ₹ 12000
    (c) ₹ 10000   (d) ₹ 8000

39. If $\dfrac{a}{3} = \dfrac{b}{2}$, then value of $\dfrac{2a+3b}{3a-2b}$ is

    (a) $\dfrac{12}{5}$ (b) $\dfrac{5}{12}$

    (c) 1   (d) $\dfrac{12}{7}$

40. A shopkeeper bought pens at the rate of 7 for ₹10 and sold them at a profit of 40%. How many pens would a customer get for ₹ 10?

    (a) 6   (b) 4
    (c) 5   (d) 3

41. If the cost price of 10 articles is equal to the sales price of 16 articles, then the gain or loss per cent is

    (a) 28% profit   (b) $37\dfrac{1}{2}$% profit

    (c) 28% loss   (d) $37\dfrac{1}{2}$% loss

42. Three persons A, B and C whose salaries together amount to ₹ 72000, spend 80, 85 and 75 per cent of their salaries respectively. If their savings are in the ratio 8 : 9 : 20, then A's salary is

    (a) ₹ 20000   (b) ₹ 16000
    (c) ₹ 22000   (d) ₹ 18000

43. Two solutions of 90% and 97% purity are mixed, resulting in 21 L of mixture of 94% purity. The quantity of the second solution in the resulting mixture, in litres, is

    (a) 15   (b) 12
    (c) 9   (d) 6

44. A boat travels 24 km upstream in 6 h and 20 km downstream in 4 h. Then, the speed of boat in still water and the speed of water current are respectively
    (a) 4 km/h and 3 km/h
    (b) 4.5 km/h and 0.5 km/h
    (c) 4 km/h and 2 km/h
    (d) 5 km/h and 2 km/h

45. If the difference between simple interest and compound interest on a certain sum of money for 3 yr at 10% per annum is ₹ 31, the sum is
    (a) ₹ 500   (b) ₹ 750
    (c) ₹ 1000   (d) ₹ 1250

46. Which one of the following is not an objective of fiscal policy in India?
    (a) Full employment
    (b) Price stability
    (c) Equitable distribution of wealth and incomes
    (d) Regulation of international trade

47. Which one of the following is not a quantitative credit control measure of a Central Bank?
    (a) Bank Rate Policy
    (b) Open Market Operations
    (c) Cash Reserve Ratio
    (d) Moral Suasion

48. In which market structure is the demand curve of the market represented by the demand curve of the firm?
    (a) Monopoly
    (b) Oligopoly
    (c) Duopoly
    (d) Perfect competition

49. 'Mixed Farming' means
    (a) sowing of both cash and food crops
    (b) sowing of two or more crops in the same field
    (c) sowing of two or more plants in alternate years
    (d) rearing of cattle and agriculture

50. Which of the following is deducted from NNP to arrive at NI?
    (a) Indirect tax
    (b) Capital consumption allowance
    (c) Subsidy
    (d) Interest

51. Whom did Bal Gangadhar Tilak refer to as his Political Guru?
    (a) Swami Vivekanand (b) Ram Mohan Roy
    (c) Sisir Kumar Ghosh (d) Dadabhai Naoroji

52. Who introduced 'doctrine of lapse'?
    (a) Lord Wellesley   (b) Lord Curzon
    (c) Lord Dalhousie   (d) Lord Lytton

53. Tides are caused by the gravitational pull of the
    (a) Earth on the Moon
    (b) Earth on the Sun
    (c) Sun and Moon on the Earth
    (d) Moon on the Earth

54. Dry farming in India is extensively practised in
    (a) Canara Plains   (b) Deccan Plateau
    (c) Coromandal Plains (d) Ganga Plains

55. The Kullu Valley is situated between
    (a) Ladakh and Pirpanjal
    (b) Ranjoti and Nag Tibba
    (c) Lesser Himalayas and Siwalik
    (d) Dhauladhar and Pirpanjal

56. Terrace farming is done
    (a) on the slope of hills
    (b) in dry regions
    (c) on roof tops
    (d) on mountain tops

57. The colour change in the Chameleon is due to the presence of
    (a) haemoglobin
    (b) chromatophore
    (c) chlorophyll
    (d) pneumatophore

58. The deficiency of iodine leads to
    (a) hyperthyroidism   (b) goitre
    (c) midgut   (d) diabetes

59. Two richest known sources of edible protein are
    (a) meat and eggs
    (b) some algae and other microorganisms
    (c) soyabean and groundnut
    (d) milk and leafy vegetables

60. The saliva helps in the digestion of
    (a) proteins   (b) starch
    (c) fibres   (d) fats

61. Which of the following correctly explains the phenomenon of 'Test Tube Baby'?
    (a) When every process of embryo formation is in the test tube
    (b) When the embryo develops in a test tube
    (c) When the fertilization is external and development is internal
    (d) When the fertilization is internal and development is external

62. Heart attack occurs due to
    (a) bacterial attack on the heart
    (b) stopping of heart beat
    (c) lack of supply of blood to the heart itself
    (d) impairment of heart's working due to unknown reasons

63. Direct conversion of solar energy with the use of a photovoltaic cell results in the production of
    (a) optical energy
    (b) electrical energy
    (c) thermal energy
    (d) mechanical energy

64. A man inside an artificial satellite feels weightlessness because the force of attraction due to earth is
    (a) zero at that place
    (b) is balanced by the force of attraction due to moon
    (c) equal to the centripetal force
    (d) non-effective due to particular design of the satellite

65. When a detergent is added to pure water, its surface tension
    (a) increases   (b) decreases
    (c) remains constant   (d) becomes infinite

66. 'Supernova' is
    (a) a comet   (b) an asteroid
    (c) an exploding star (d) a black hole

67. The device that converts computer output for transmission over telephone lines is called
    (a) interface   (b) interpreter
    (c) modem   (d) I/O port

68. A 'bug' in a programme is a
    (a) statement   (b) error
    (c) signature   (d) Both (b) and (c)

69. Wood spirit is
    (a) methyl alcohol   (b) ethyl alcohol
    (c) butyl alcohol   (d) propyl alcohol

70. Which of the following processes is used for the production of Biodiesel?
    (a) Transamination   (b) Transcription
    (c) Transesterification (d) Translation

71. One property of ammonia is
    (a) it is insoluble in water
    (b) it is a odourless gas
    (c) it is a yellowish gas
    (d) its aqueous solution turns red litmus to blue

72. Of the following, which one pollutes the air of a big city?
    (a) Copper   (b) Chromium
    (c) Lead   (d) Calcium

73. Ultraviolet light of Sun's radiation is prevented from reaching the Earth's atmosphere by the layer of
    (a) Oxygen   (b) Hydrogen
    (c) Ozone   (d) Helium

74. Greater population can be supported on the Earth only if we eat more
    (a) mutton   (b) eggs
    (c) plant products   (d) beef

75. Varahamihira is
    (a) an astronaut
    (b) a space shuttle
    (c) a power station
    (d) an ancient astronomer

76. "Fire fighting clothes" are made from
    (a) mica   (b) asbestos
    (c) talc   (d) steatite

77. Tummalapalli in Andhra Pradesh has recently come on the world map for its largest
    (a) uranium deposits
    (b) tungsten deposits
    (c) coal deposits
    (d) bauxite ore deposits

78. As per the provisional result of the 2011 Census, the density of population in India is
    (a) 325   (b) 352
    (c) 372   (d) 382

79. 'Rath Yatra' at Puri is celebrated in honour of
    (a) Lord Rama   (b) Lord Shiva
    (c) Lord Jagannath   (d) Lord Vishnu

80. Gagan Narang, whose name has been recommended for 'Rajiv Gandhi Khel Ratna Award' is a famous
    (a) motor car racer   (b) cricketer
    (c) air rifle shooter (d) footballer

81. The five permanent members of the United Nations Security Council are
    (a) Canada, China, France, USA, UK
    (b) China, France, Russia, USA, UK
    (c) Japan, Germany, Russia, USA, UK
    (d) Germany, China, Russia, USA, UK

82. Which city has the headquarters of two railway zones in India?
    (a) Hubli   (b) New Delhi
    (c) Mumbai   (d) Jabalpur

83. Who acts as the Chairman of the State Planning Board?
    (a) Governor
    (b) Chief Minister
    (c) Leader of the opposition
    (d) Speaker

84. Air bladder in fish acts as
    (a) accessory respiratory organ
    (b) hydrostatic organ
    (c) both accessory respiratory organ and hydrostatic organ
    (d) primary respiratory organ

85. Which of the following is called 'Blue Planet'?
    (a) Saturn   (b) Earth
    (c) Jupiter   (d) Mars

86. In cauliflower plant, the useful part is
    (a) underground stem
    (b) root
    (c) young inflorescence
    (d) leaves

87. Aurobindo Ghosh was arrested in connection with
    (a) Alipore Bomb Case
    (b) Kolhapur Bomb Case
    (c) Lahore Conspiracy Case
    (d) Kakori Case

88. 'Manchester' of South India is
    (a) Coimbatore   (b) Madurai
    (c) Bengaluru   (d) Chennai

89. The acid stored in batteries is
    (a) sulphuric acid   (b) nitric acid
    (c) hydrochloric acid (d) acetic acid

90. Heavy metal pollution of water is caused by
    (a) paints   (b) wood burning
    (c) acid plants   (d) domestic sewage

91. Which of the following 'Public Undertakings' has not been conferred with 'Maharatna' Status?
    (a) SAIL   (b) BHEL
    (c) ONGC   (d) Coal India Limited

92. Who is known as the 'Indian Bismarck'?
    (a) Vallabhbhai Patel
    (b) Subhash Chandra Bose
    (c) Bhagat Singh
    (d) Bal Gangadhar Tilak

93. Which one of the four regions above the Earth has smallest height (km)?
    (a) Stratosphere
    (b) Mesosphere
    (c) Thermosphere
    (d) Troposphere

94. Which State of India shows the lowest population as per Census 2011?
    (a) Manipur   (b) Tripura
    (c) Puducherry   (d) Sikkim

95. 'Rail Bandhu' is
    (a) Website of each railway division
    (b) the onboard medical officer in every train to attend to medical emergencies
    (c) security guard in every AC coach of Rajdhani/ Shatabdi and AC Duronto Express
    (d) an onboard magazine of Indian Railways to be available in Rajdhani/Shatabdi/AC Duronto Express

96. Which one of the following ceased to be a Fundamental Right under the Constitution?
    (a) Right to Education
    (b) Right to Work
    (c) Right to Property
    (d) Right to Equality before Law

97. Coffee Research Institute of India is located at
   (a) Yercaud   (b) Wayanad
   (c) Coorg   (d) Coimbatore

98. How many major seaports are there in India?
   (a) 6   (b) 9
   (c) 10   (d) 12

99. The members of the Rajya Sabha are elected for a term of
   (a) two years   (b) four years
   (c) five years   (d) six years

100. When was National Emergency imposed by the President of India on the grounds of internal disorder?
   (a) 1962   (b) 1965
   (c) 1971   (d) 1975

101. Which one of the following is an example for Monopoly?
   (a) SPIC
   (b) Indian Railways
   (c) HMT
   (d) Hindustan Unilever Limited

102. A black body can absorb radiations of
   (a) lower wavelengths only
   (b) intermediate wavelengths only
   (c) higher wavelengths only
   (d) all wavelengths

103. The only Hindu courtier of Akbar who accepted Deen-e-Illahi was
   (a) Todermal   (b) Birbal
   (c) Tansen   (d) Man Singh

104. The chemical which is used in art and craft and can cause anemia and leukaemia is
   (a) benzene   (b) dioxine
   (c) phthalate   (d) aldrin

105. Which Party was established by Subhash Chandra Bose after he came out of Indian National Congress?
   (a) Indian National Army
   (b) Republican Party
   (c) Forward Block
   (d) Socialist Party

106. The Rama Krishna Mission was established by
   (a) Vivekananda
   (b) Rama Krishna
   (c) MG Ranade
   (d) Keshab Chandra Sen

107. The year of accession of Kanishka to throne was
   (a) AD 108   (b) AD 78
   (c) AD 58   (d) AD 128

108. Total number of muscles present in our body is
   (a) 565   (b) 656
   (c) 665   (d) 556

109. Which of the following Mughal Emperors is credited with composition of Hindi songs?
   (a) Babar   (b) Akbar
   (c) Jahangir   (d) Shahjahan

110. WTO came into existence in the year
   (a) 1977   (b) 1985
   (c) 1995   (d) 1950

111. Hydraulic machines work under the Principle of
   (a) Newton's Law   (b) Joules Law
   (c) Pascal's Law   (d) Floatation Law

112. Who invented aeroplane?
   (a) Orville Wright and Wilbur Wright
   (b) Sir Frank Whittle
   (c) Michael Faraday
   (d) Christian Huygens

113. World Bank helps countries with loans for the purpose of
   (a) reconstruction and development
   (b) stimulating private investment
   (c) tailing foreign exchange crises
   (d) meeting deficits in government budget

114. Which is not a Central Service?
   (a) Indian Police Service ((IPS)
   (b) Indian Foreign Service (IFS)
   (c) Indian Audit and Accounts Service (IAAS)
   (d) Indian Revenue Service (IRS)

115. The first Indian State which was created on a linguistic basis following along drawn agitation is
   (a) Andhra Pradesh
   (b) Asom
   (c) Tamil Nadu
   (d) Karnataka

116. The Great Barrier reef is
    (a) conglomeration of Corals in Australian waters
    (b) mountains range in Utah, USA
    (c) salt hills of Afghanistan
    (d) sub-oceanic mountain in South China Sea

117. The Panama Canal links
    (a) Mediterranean Sea with Red Sea
    (b) Atlantic Ocean with Indian Ocean
    (c) Indian Ocean with Mediterranean
    (d) Atlantic Ocean with Pacific Ocean

118. C, BASIC, COBOL, and Java are examples of .... language.
    (a) low level
    (b) computer
    (c) system programing
    (d) high - level

119. .... is approximately one billion bytes.
    (a) Kilobyte   (b) Bit
    (c) Gigabyte   (d) Megabyte

120. The wildlife week is celebrated from
    (a) 2-8 October   (b) 1-7 June
    (c) 16-22 April   (d) 14 -20 January

Answers

Physics

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

Chemistry

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

Biology

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

General Aptitude and Current Issues

1. (b)	2. (b)	3. (a)	4. (b)	5. (b)	6. (c)	7. (a)	8. (d)	9. (b)	10. (c)
11. (c)	12. (c)	13. (b)	14. (c)	15. (a)	16. (a)	17. (b)	18. (a)	19. (b)	20. (a)
21. (c)	22. (a)	23. (b)	24. (b)	25. (c)	26. (c)	27. (c)	28. (a)	29. (a)	30. (c)
31. (d)	32. (c)	33. (b)	34. (d)	35. (d)	36. (c)	37. (b)	38. (d)	39. (a)	40. (c)
41. (d)	42. (b)	43. (b)	44. (b)	45. (c)	46. (d)	47. (d)	48. (a)	49. (b)	50. (a)
51. (c)	52. (c)	53. (c)	54. (b)	55. (a)	56. (a)	57. (b)	58. (b)	59. (c)	60. (b)
61. (c)	62. (c)	63. (b)	64. (c)	65. (b)	66. (c)	67. (c)	68. (b)	69. (a)	70. (c)
71. (d)	72. (c)	73. (a)	74. (c)	75. (d)	76. (b)	77. (a)	78. (d)	79. (c)	80. (c)
81. (b)	82. (c)	83. (b)	84. (c)	85. (c)	86. (d)	87. (a)	88. (a)	89. (a)	90. (c)
91. (a)	92. (a)	93. (d)	94. (d)	95. (c)	96. (c)	97. (d)	98. (a)	99. (d)	100. (d)
101. (b)	102. (d)	103. (b)	104. (d)	105. (c)	106. (a)	107. (d)	108. (b)	109. (b)	110. (c)
111. (c)	112. (a)	113. (a)	114. (a)	115. (a)	116. (a)	117. (d)	118. (d)	119. (c)	120. (a)

Hints & Solutions

Physics

1. As the rise of liquid column, $h \approx \dfrac{1}{r}$

   Then, by reducing the radius of capillary to half, the rise of liquid will be two times.

2. Let ΔW is the energy used for expansion

   $$= p dV = R dT$$

   $\Delta Q =$ heat supplied to diatomic gas at constant pressure

   $$= C_p \, dT$$
   $$= \frac{7}{2} R dT \qquad \left(\because C_p = \frac{7}{2} R \right)$$

   $$\therefore \qquad \frac{\Delta W}{\Delta Q} = \frac{R dT}{\frac{7}{2} R dT} = \frac{2}{7}$$

3. We know that, pressure $= \dfrac{\text{Force}}{\text{Area}} = \dfrac{\text{Energy}}{\text{Volume}}$

   $$= [ML^{-1}T^{-2}]$$

4. For μ moles of a real gas, Van der Waal's equation is given

   $$p + \frac{\mu^2 a}{V^2}(V - \mu b) = \mu R T$$

   $$\Rightarrow \quad p = \frac{\mu R T}{V - \mu b} - \frac{\mu^2 a}{V^2}$$

   On comparing this equation with given equation.

   $$\mu = \frac{1}{2}$$

   But $\qquad \mu = \dfrac{m}{M}$

   Mass of gas, $m = \mu M = \dfrac{1}{2} \times 44 = 22\,g$

5. Velocity gradient, $\dfrac{dv}{dx} = \dfrac{8}{0.1} = 80\,s^{-1}$

6. The range of a projectile, $R = \dfrac{u^2 \sin 2\theta}{g}$

   $$\Rightarrow \qquad R = u^2$$

   So, if the velocity is doubled then range will becomes 4 times.

7. For a series LR, AC circuit,

   $$\tan \phi = \frac{X_L}{R}$$

   $$\Rightarrow \qquad \tan \frac{\pi}{4} = \frac{X_L}{R}$$

   $$\Rightarrow \qquad 1 = \frac{X_L}{R} \text{ or } X_L = R$$

8. Resultant intensity, $I = 4I_0 \cos^2(\phi / 2)$

   $\therefore$ Ratio of intensity for two waves

   $$\frac{I_1}{I_2} = \frac{\cos^2(\phi_1 / 2)}{\cos^2(\phi_2 / 2)}$$

   $$= \frac{\cos^2 0°}{\cos^2(90°/2)} = \frac{2}{1}$$

9. If forward bias is made large, the majority charge carriers would move from the emitter to the collector through the base with high velocity. This would give rise to excessive heat, causing damage to transistor.

10. Power, $P = \dfrac{V_0 I_0}{2} \cos \phi$

    $$\Rightarrow 1000 = \frac{1}{2} \times 200 \times I_0 \times \cos 60°$$

    $$\Rightarrow \qquad I_0 = 20\,A$$

    or $\quad I_{rms} = \dfrac{I_0}{\sqrt{2}} = \dfrac{20}{\sqrt{2}} = 10\sqrt{2}\,A$

11. Acceleration of the particle is given as

    $$A = - a\omega^2 \sin \omega t$$

    So, the velocity of the particle, $v = \int A \, dt$

    $$= \int (-a\omega^2 \sin \omega t) \, dt$$

    $$= a\omega \cos \omega t$$

    $\therefore$ Displacement of the particle, $x = \int v \, dt$

    $$= \int (a\omega \cos \omega t) \, dt$$

    $$= a \sin \omega t$$

12. In uniform circular motion only centripetal acceleration works.

13. The given equation is dimensionally correct only because both the sides are dimension less but it is numerically wrong because the correct equation is

$$\tan \theta = \frac{v^2}{rg}$$

14. Gravitational potential, $V = -\dfrac{GM}{r}$

and intensity of gravitational field,

$$I = \frac{GM}{r^2}$$

If $V = 0$ and $I = 0$,

Then, $r = \infty$ (infinity)

So, the point at which the value of both gravitational potential and gravitational field is zero is at infinity.

15. The breaking force $\propto$ Area of cross-section (πr^2)

When the thickness (radius) of wire is doubled, then the breaking force will becomes four times.

16. We know that, $Y = 2\eta (1 + \sigma)$

$$\therefore \quad 3\eta = 2\eta (1 + \sigma)$$

$$\Rightarrow \quad \sigma = \frac{3}{2} - 1 = \frac{1}{2}$$

Substituting the value of σ in the expression,

$$Y = 3K (1 - 2\sigma)$$

$$K = \frac{Y}{3(1 - 2\sigma)} = \infty$$

17. The given situation can be shown as

Length of the arc,

$$l = r\theta = r\frac{\pi}{3}$$

$\therefore$ Charge of the arc $= \dfrac{r\pi}{3} \times \lambda$

So, the potential at the centre $= \dfrac{kq}{r}$

$$= \frac{1}{4\pi\varepsilon_0} \times \frac{r\pi}{3} \times \frac{\lambda}{r}$$

$$= \frac{\lambda}{12\varepsilon_0}$$

18. For small difference of temperature, Newton's law of cooling is the special case of Stefan's law.

19. We know that, $v_{rms} = \sqrt{\dfrac{3RT}{M}}$

$$\therefore \quad v_{rms} = \frac{1}{\sqrt{M}} \quad \text{(As } T \text{ is constant)}$$

$$\Rightarrow \quad \frac{(v_{rms})_{O_2}}{(v_{rms})_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$\Rightarrow \quad \frac{400}{(v_{rms})_{H_2}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

$$\Rightarrow \quad (v_{rms})_{H_2} = 4 \times 400 = 1600 \text{ m/s}$$

20. The moment of inertia $I = \dfrac{1}{4} mr^2$

$$\therefore \quad I = \frac{1 \times (0.1)^2}{4} = \frac{1 \times 1 \times 10^{-2}}{4}$$

$$= 2.5 \times 10^{-3} \text{ kg-m}^2$$

21. The momentum and kinetic energy is related by

$$p = \sqrt{2mE}$$

$$\therefore \quad p \propto \sqrt{E}$$

According to question, kinetic energy becomes 64% of the original

$$\therefore \quad \frac{p_2}{p_1} = \sqrt{\frac{E_2}{E_1}}$$

$$= \sqrt{\frac{64E}{100E}}$$

$$= \frac{8}{10} = 0.8$$

$\Rightarrow p_2 = 0.8 \, p \therefore p_2 = 80\%$ of original value i.e., decrease in momentum is 20%.
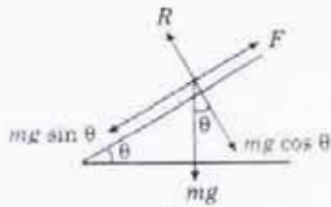
22. Given, $v = 7.2 \text{ kmh}^{-1}$

$$= 7.2 \times \frac{5}{18} = 2 \text{ m/s}$$

Slope is given 1 in 20

$i.e.,$ $\sin\theta = \dfrac{1}{20}$

For the upward motion to the cyclist.

$$F = mg\sin\theta$$

$\therefore$ Power of the man, $P = F \times v = mg\,\sin\theta \times v$

$$= 100 \times 9.8 \times \dfrac{1}{20} \times 2 = 98\,W$$

23. The moment of inertia of the ring,
$$I = mr^2 = 10 \times (0.2)^2 = 0.4\,\text{kg-m}^2$$

Angular frequency of the ring,
$$\omega = 2\pi n = 2\pi \times \dfrac{2100}{60}\ \text{rad/s}$$

$\therefore$ Angular momentum of the ring,
$$L = I\omega = \dfrac{0.4 \times 2\pi \times 2100}{60}$$

$$= 88\ \text{kg m}^2/s$$

24. We know that, $P = \dfrac{V^2}{R}$

$\Rightarrow$ $R = \dfrac{V^2}{P}$

$\therefore$ $R_1 = \dfrac{V_1^2}{P_1}$

$$= \dfrac{(200)^2}{40} = 1000\,\Omega$$

and $R_2 = \dfrac{V_2^2}{P_2} = \dfrac{(200)^2}{100} = 400\,\Omega$

So, the resistance of filament of bulb of 40 W is greater than that of 100W.

25. We know that, $i = \dfrac{q}{t}$

or $i = qv$

$\therefore$ The magnetic field at the centre of the orbit

$$B = \dfrac{\mu_0 i}{2r} = \dfrac{\mu_0}{2r}\,qv$$

$$= \dfrac{4\pi \times 10^{-7} \times 1.6 \times 10^{-19} \times 6.6 \times 10^{15}}{2 \times 0.53 \times 10^{-10}}$$

$$= \dfrac{2\pi \times 1.6 \times 6.6}{5.3} = 12.5\,T$$

26. $(\overline{A \cdot B})\ A = (\overline{\overline{A} + \overline{B}})\ A$
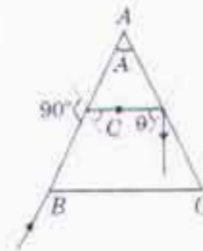
$$= (A + B) \cdot A$$

$$= A \cdot A + AB$$

$$= A + AB$$

$$= A(1 + B) = A$$

27. The mobility of free electrons is greater because they require low energy to continue their motion.

28. From figure,

$$A = C + \theta$$

For total internal reflection at AC

$$\theta > C$$

So, $A > 2C$

29. For improving near point, a convex lens is required and for this convex lens.

$u = -25$ cm and $v = -75$ cm

$\therefore \dfrac{1}{f} = \dfrac{1}{-75} - \dfrac{1}{-25} \Rightarrow f = \dfrac{75}{2}$ cm

$\therefore$ Power, $P = \dfrac{100}{f} = \dfrac{100}{75/2} = +\dfrac{8}{3}\,D$

30. As $\mu_2 > \mu_1$, the upper half of the lens become diverging and as $\mu_2 > \mu_3$, the lower half of the lens become converging.
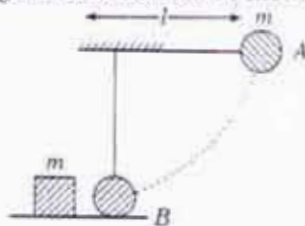
31. Maximum number of nuclei will be present when rate of decay = rate of formation.

$i.e.,$ $\lambda N = \alpha$

or $N = \dfrac{\alpha}{\lambda}$

32. The given condition can be shown as

Potential energy of bob at point $A = mgl$

The total energy is converted into kinetic energy.

$\therefore$ Kinetic energy of bob at point B

$$= mgl$$

As collision between bob and block is elastic so after collision bob will come to rest and total kinetic energy will be transferred to block.

So, kinetic energy of the block $= mgl$

33. For providing path to charge induced on the surface of the carriers which take inflammable material.

34. During charging the terminal potential difference of a cell is greater than its emf.

35. Let the real dip be ϕ, then

$$\tan \phi = \frac{B_V}{B_H}$$

For apparent dip,

$$\tan \phi' = \frac{B_V}{B_H \cos\beta} = \frac{B_V}{B_H \cos 30°}$$

$$= \frac{2B_V}{\sqrt{3} B_H}$$

or $\quad \tan 45° = \frac{2}{\sqrt{3}} \tan \phi$

$$\phi = \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$$

36. The induced emf between centre and rim of the rotating disc

$$E = \frac{1}{2} B\omega R^2$$

$$= \frac{1}{2} \times 0.1 \times 2\pi \times 10 \times (0.1)^2$$

$$= 10\pi \times 10^{-3} \text{ V}$$

$$= 10\pi \text{ mV}$$

37. We know that,

$$L = \mu n i$$

$\therefore \quad \dfrac{L_2}{L_1} = \dfrac{\mu}{\mu_0} \quad$ (as n and i are same)

$\Rightarrow \quad L_2 = \dfrac{\mu}{\mu_0} \times L_1 = \mu_r L_1$

$$= 900 \times 0.18 = 162 \text{ mH}$$

38. The frequency of electrical oscillation.

$$v = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10^{-6} \times 10^{-4}}}$$

$$= \frac{10^5}{2\pi} \text{Hz}$$

39. Wavelength of light, $\lambda = 4000$ Å
Frequency of light

$$v = \frac{c}{\lambda} = \frac{3 \times 10^8}{4000 \times 10^{-10}} = 0.75 \times 10^{15} \text{ Hz}$$

Which is less than the given threshold frequency.

Hence, no photoelectric emission takes place.

40. Given, $\quad n_e = 8 \times 10^{18} \text{m}^{-3}$

and $\quad n_h = 5 \times 10^{19} \text{ m}^{-3}$

also $\quad \mu_e = 2.3 \text{ m}^2/\text{V-s}$

and $\quad \mu_h = 0.01 \text{ m}^2 m^2/\text{V-s}$

$\because n_e > n_h$, so semiconductor is n-type.

Now, conductivity $\sigma = \dfrac{1}{\text{Resistivity } (\rho)}$

$$= e\,(n_e \mu_e + n_h \mu_h)$$

$\Rightarrow \dfrac{1}{\rho} = 1.6 \times 10^{-19}[8 \times 10^{18} \times 2.3 + 5$

$$\times 10^{18} \times 0.01]$$

$\Rightarrow \quad \rho = 0.34 \,\Omega\cdot\text{m}$

41. $\qquad y = A \sin\left(\dfrac{2\pi}{T}\right) t$

$\Rightarrow \qquad \dfrac{A}{2} = A \sin\left(\dfrac{2\pi}{4}\right) t$

$\Rightarrow \qquad \dfrac{\pi t}{2} = \dfrac{\pi}{6} \Rightarrow t = \dfrac{1}{3} \text{ s}$

42. When 700 g mass is removed, the remaining masses (500 + 400)g oscillate a period of 3 s

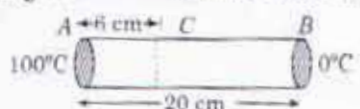$$3 = 2\pi \sqrt{\left(\frac{500 + 400}{k}\right)} \qquad ...(i)$$

If 500g mass is also removed, the remaining mass is 400 g, its time period

$$t' = 2\pi \sqrt{\frac{400}{k}} \qquad ...(ii)$$

Dividing Eq. (i) by Eq. (ii)

$$\frac{3}{t'} = \sqrt{\frac{900}{400}} = \frac{3}{2} \Rightarrow t' = 2s$$

43. The given condition can be shown as
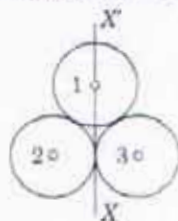

In steady state, the temperature gradient is constant

$$\therefore \quad \frac{(\theta_A - \theta_C)}{6} = \frac{(\theta_A - \theta_B)}{20}$$

$$\Rightarrow \quad (100 - \theta_C) = \frac{6}{20}(100 - 0)$$

$$\Rightarrow \quad 100 - \theta_C = 30$$

$$\text{or} \quad \theta_C = 100 - 30 = 70^\circ C$$

44. Moment of inertia of the system about XX'

$$I = I_1 + I_2 + I_3$$
$$= \frac{1}{2}mr^2 + \frac{3}{2}mr^2 + \frac{3}{2}mr^2$$
$$= \frac{7}{2}mr^2$$

45. Since, the body is moving in the direction of force, therefore work done by gravitational force will be positive.

Work done, $W = F.s = mgh$

$$= 10 \times 9.8 \times 5 = 480 \text{ J}$$

46. Let F force is acting at an angle 30° with horizontal.

For condition of motion,

$$F = \mu R$$

$$F \cos 30° = \mu(mg - F \sin 30°)$$

$$\Rightarrow \quad F\frac{\sqrt{3}}{2} = \frac{1}{\sqrt{3}}\left(100 - F \times \frac{1}{2}\right)$$

$$\Rightarrow \quad \frac{3F}{2} = 100 - \frac{F}{2}$$

$$\Rightarrow \quad 2F = 100$$

$$\text{or} \quad F = 50 \text{ N}$$

47. Average acceleration

$$= \frac{\text{Change in velocity}}{\text{Time taken}}$$

$$= \frac{v_2 - v_1}{t_2 - t_1}$$

Velocity at 2s, $v_1 = [10 + 2(2)^2] = 18 \text{ m/s}$

Velocity at 5s, $v_2 = [10 + 2(5)^2] = 60 \text{ m/s}$

$$\therefore \quad a_{av} = \frac{60 - 18}{5 - 2} = \frac{42}{3}$$

$$= 14 \text{ m/s}^2$$

48. At the highest point of the path of a projectile, potential energy is maximum so the kinetic energy is minimum.

49. Change in momentum $= 2mv \sin\theta$

$$= 2mv \sin\frac{\pi}{4}$$

$$= \sqrt{2} \, mv$$

50. When body moves under action of constant force then kinetic energy acquired by the body

$$KE = F \times x$$

$$\therefore \quad KE \propto x \qquad (\text{As, } F \text{ is constant})$$

So, the graph between kinetic energy and x is a straight line.

51. We know that,

$$U = \frac{-GMm}{r}$$

As r increases, U also increases.

52. The value of g on the surface of the earth

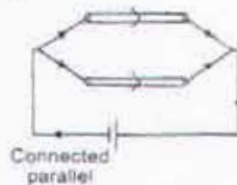$$g \propto \frac{1}{R^2}$$

At a height h from the surface of earth

$$g' \propto \frac{1}{(R+h)^2}$$

$$\therefore g' = g \frac{R^2}{(R+h)^2} = \frac{9.8 \times (6400)^2}{(6400+480)^2}$$

$$= 8.4 \, m/s^2$$

53. When connected in parallel the current will be in the same direction, hence the force is attractive.

Connected parallel

When connected in series the current will be in the opposite direction hence the force is repulsive.

54. Magnetism of a magnet falls with rise of temperature and becomes practically zero above curie temperature.

55. Given, efficiency $\eta = 50\%$

$$\therefore \quad e = \frac{E}{2}$$

and $\quad i = \frac{E - e}{2}$

$$\Rightarrow \quad i = \frac{E - E/2}{R} = \frac{E}{2R}$$

$$\therefore \quad R = \frac{E}{2i} = \frac{60}{2 \times 10} = 3\Omega$$

56. Current will be maximum in the condition of resonance,

So, $\quad I_{max} = \frac{V}{R} = \frac{V}{10} A$

So, energy stored in the coil,

$$E_1 = \frac{1}{2} L (I_{max})^2 = \frac{1}{2} L \left(\frac{E}{10}\right)^2$$

$$= \frac{1}{2} \times 10^{-3} \left(\frac{E^2}{100}\right) = \frac{1}{2} \times 10^{-5} E^2 J$$

Also, energy stored in the capacitor,

$$E_c = \frac{1}{2} CE^2 = \frac{1}{2} \times 2 \times 10^{-6} E^2 J$$

$$= 10^{-6} E^2 J$$

$$\therefore \quad \frac{E_c}{E_1} = \frac{10^{-6} E^2}{1/2 \times 10^{-5} E^2} = \frac{1}{5}$$

57. From the given reaction

$$_{12}Mg^{24} + {}_2He^4 \longrightarrow {}_{14}Si^x + {}_0n^1$$

$$1 + x = 24 + 4$$

or $\quad x = 28 - 1 = 27$

58. In a diode, before saturation region linear region comes. In linear region

$$i_p = V_p$$

$$\Rightarrow \quad \frac{i_1}{i_2} = \frac{V_{p_1}}{V_{p_2}} = \frac{400}{200} = \frac{2}{1}$$

59. The output of the given combinations can be given as

$$D = \overline{(A + B) \cdot C}$$

$$= (\overline{A + B}) + \overline{C}$$

If $\quad A = B = C = 0$

Then, $D = (\overline{0 + 0}) + \overline{0} = (\overline{0} + \overline{0}) = 1 + 1 = 1$

and If $A = B = 1, C = 0$

Then $D = (\overline{1 + 1}) + \overline{0} = (\overline{1} + \overline{0}) = 0 + 1 = 1$

60. Number of beats per second $= n_1 - n_2$

Here, $\quad \omega_1 = 2000\pi$

$$2\pi n_1 = 2000\pi$$

$$n_1 = 1000$$

$$\omega_2 = 2008\pi$$

$$\Rightarrow \quad 2\pi n_2 = 2008\pi$$

or $\quad n_2 = 1004$

$\therefore$ Number of beats heard per second

$$= 1004 - 1000 = 4$$

Chemistry

1. From second law of Faraday

$$\frac{m_{Al}}{m_H} = \frac{E_{Al}}{E_H}$$

$$\therefore \quad \frac{4.5}{m_H} = \frac{27/3}{1}$$

or $\quad m_H = 0.5\,g$

∵ The volume of $2\,g\,H_2$ at STP = 22.4 L

∴ The volume of $0.5\,g\,H_2$ at STP

$$= \frac{22.4 \times 0.5}{2}\,L = 5.6\,L$$

2. For the first order reaction

$$Rate\left(\frac{dx}{dt}\right) = k[A]$$

$[A] \rightarrow$ concentration of reactant

$k \rightarrow$ rate constant

Given that

$$\frac{dx}{dt} = 1.5 \times 10^{-2}\,mol\,L^{-1}\,min^{-1}$$

$$k = ? \text{ and } [A] = 0.5\,M$$

$$\therefore \quad 1.5 \times 10^{-2} = k \times 0.5$$

$$\therefore \quad k = \frac{1.5 \times 10^{-2}}{0.5} = 3 \times 10^{-2}\,min^{-1}$$

For first order reaction,

Half-life period, $t_{1/2} = \dfrac{0.693}{k} = \dfrac{0.693}{3 \times 10^{-2}}$

$$= 23.1\,min$$
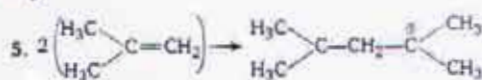
3. Number of atoms of A per unit cell

$$= 8 \times \frac{1}{8} = 1$$

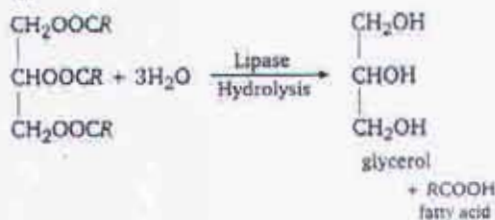Number of atoms of B per unit cell

$$= 6 \times \frac{1}{2} = 3$$

Hence, the composition of $A_x B_y = AB_3$

4. The helical structure of protein is stabilised by hydrogen bonds between amide group of the same peptide chain. These bonds are formed by —NH— group of one unit and oxygen of carbonyl group of the third unit. This H-bonding is responsible for holding helix in a fixed position.

5. $2\begin{pmatrix}H_3C\\H_3C\end{pmatrix}C{=}CH_2 \longrightarrow \begin{matrix}H_3C\\H_3C\end{matrix}C{-}CH_2{-}C\begin{matrix}CH_3\\CH_3\end{matrix}$

6.

$$\begin{matrix}CH_2OOCR\\|\\CHOOCR\\|\\CH_2OOCR\end{matrix} + 3H_2O \xrightarrow[\text{Hydrolysis}]{\text{Lipase}} \begin{matrix}CH_2OH\\|\\CHOH\\|\\CH_2OH\end{matrix}$$

glycerol

$+\ RCOOH$
fatty acid

7. The decreasing order of bond angle is as

Species	NO_2^+	NO_2	NO_2^-
Bond angle	180°	135°	115°

**8.** The reducing power of halide ions decreases in the order

$$I^- > Br^- > Cl^- > F^-$$

Hence, I^- is the strongest reducing agent.

9. Diethyl ether is resistant to nucleophilic attack by hydroxyl ion.

10. Cis-platin is the cis-isomer of $[Pt(NH_3)_2Cl_2]$ which is used as an anticancer drug for treating several types of malignant tumours.

(cis-platin)
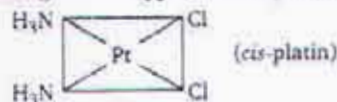
11. CN^- is a strong field ligand because it is an example of pseudohalide. Pseudohalide ions are stronger coordinating ligands and they have the ability to form σ bond and π bond.

12. The solubility of sulphates of alkaline earth metals decreases regularly on moving down in the group due to decrease in hydration energy and almost constant lattice energy. Thus, the correct order is

$$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$$
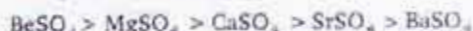
13. In blast furnace, iron oxide is reduced to iron by carbon monoxide.

$$3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2$$
$$FeO + CO \longrightarrow Fe + CO_2$$

$$Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$$
$$Fe_3O_4 + 4CO \longrightarrow 3Fe + 4CO_2$$
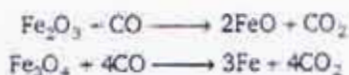
14. Aniline on diazotisation in cold (at 0° to 5°C) gives benzene diazonium chloride.

benzene diazonium chloride

This benzene diazonium chloride on coupling reaction with dimethyl aniline gives a coloured product i.e., p-(N, N-dimethyl) amino azobenzene (azo dye).

15. Normality of the mixed solution
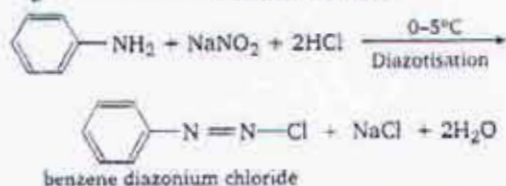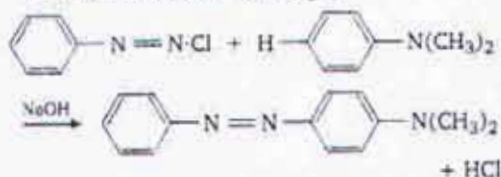
$$= \frac{N_1V_1 + N_2V_2}{V_1 + V_2}$$

$$= \frac{0.6 \times \dfrac{100}{1000} + 0.3 \times \dfrac{200}{1000}}{\dfrac{100 + 200}{1000}}$$

$$= \frac{0.6 \times 0.1 + 0.3 \times 0.2}{0.3}$$

$$= \frac{0.06 + 0.06}{0.3} = \frac{0.12}{0.3} = 0.4\,N$$

16. Heat of neutralisation of strong acid and strong base is −57.33 kJ. MgO is a weak base while HCl is a strong acid, so the heat of neutralisation of MgO and HCl is lower than −57.33 kJ because MgO requires some heat in ionisation, then net released amount of heat is decreased.

17. 0.1 M $FeCl_3$ will give the maximum number of particle (i.e., ions) in the solution. Hence, its elevation of boiling point is maximum and therefore, it has the highest boiling point.

$$FeCl_3 \longrightarrow Fe^{3+} + 3Cl^-$$

18. Chlorine of vinyl chloride (CH_2=CHCl) is non-reactive (less reactive) towards nucleophile in nucleophilic substitution reaction because it shows the following resonating structure due to +M effect of —Cl atom.
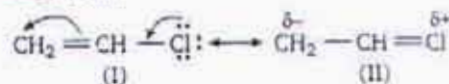
In structure II, Cl-atom have positive charge and partial double bond character with C of vinyl group, so it is more tightly attracted towards the nucleus and it does not get replaced by nucleophile in S_N reaction.

19. Stability of alkene

$$\propto \frac{1}{\text{Heat of hydrogenation of alkene}}$$

Greater the number of alkyl groups attached to the doubly bonded carbon atoms, more stable is the alkene. Hence, given alkenes follow the following order of stability,
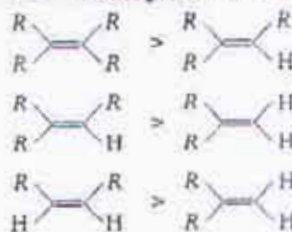
Hence, faster hydrogenation occur in

20.

21.

R, R configuration
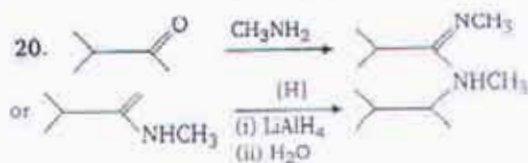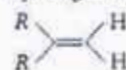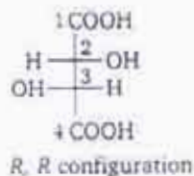
22. Phenols are much more acidic than alcohols due to the stabilisation of phenoxide ion by resonance.

phenol   phenoxide ion

Phenoxide ion is stabilised due to following resonating structures

I   II   III

IV   V

While in alcohols

$$R—\overset{..}{O}—H \longrightarrow R—\overset{..}{O}^- + H^-$$
alcohol   not stabilised due to absence of resonance
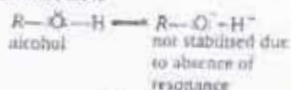
ortho-nitrophenol is most acidic because in it —NO_2 i.e., electron attracting group is attached on ortho position which helps in stabilising negative charge on the oxygen of phenoxide ion. Hence, due to this reason acidic character of phenol is increased, while on attachment of —CH_3 group (electron donating group) acidic strength of phenol is decreased in cresol due to destabilisation of phenoxide ion.
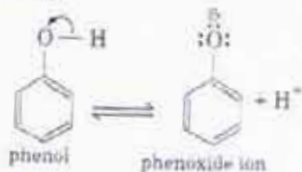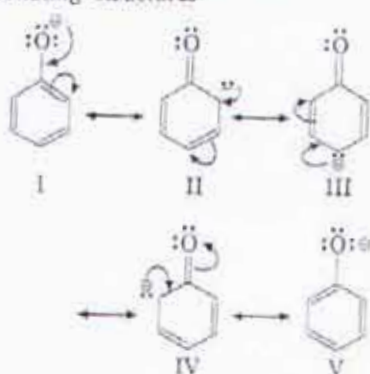
23. Molecular mass of

$Na_2CO_3 = 2 \times 23 + 12 + 3 \times 16 = 106$

∵ 106 g Na_2CO_3 contains

$= 3 \times 6.023 \times 10^{23}$ oxygen atoms

∴ 10.6 g of Na_2CO_3 will contain

$= \dfrac{3 \times 6.023 \times 10^{23}}{106} \times 10.6$

$= 18.069 \times 10^{24}$

$= 1.806 \times 10^{23}$ oxygen atoms

24. Surface tension of H_2O is maximum due to maximum hydrogen bonding in comparison to C_6H_6, CH_3OH, C_2H_5OH. The order of H-bonding is

$H_2O > CH_3OH > C_2H_5OH$
(Benzene does not form H-Bond.)
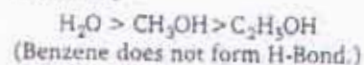
25. PTFE is resistant towards heat, action of chemicals such as acids and bases. It is a bad conductor of electricity hence, it can be used as an insulator and for lubrication.

26.

27. Correct order of acid strength

$\underset{+1}{HClO} < \underset{+3}{HClO_2} < \underset{+5}{HClO_3} < \underset{+7}{HClO_4}$
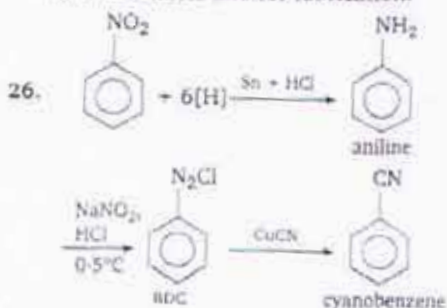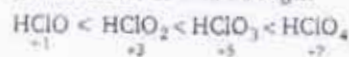
∵ Acid strength ∝ oxidation number.

28. $4Ag + 8CN^- + 2H_2O + O_2$

$\longrightarrow 4[Ag(CN)_2]^- + 4OH^-$

This process is called cyanide process. It is used in the extraction of silver from argentite (Ag_2S).

29. Cis-$[Co(en)_2Cl_2]$ is able to exhibit the phenomena of optical isomerism because it can form non-superimposable mirror images.
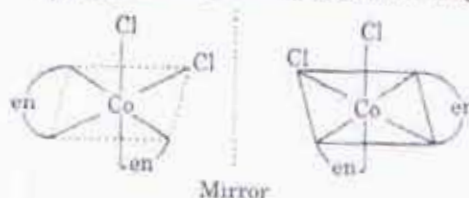
Mirror

30. The best method for the separation of naphthalene and benzoic acid from their

mixture is sublimation because it is applicable for those organic compounds which pass directly from solid to vapour state on heating and vice-versa on cooling. In these compounds naphthalene is volatile and benzoic acid is non-volatile due to the formation of dimer via hydrogen bonding (intermolecular).

31. By Nernst equation,

$$E_{cell} = E^{\circ}_{cell} - \frac{2.303RT}{nF} \log_{10} K$$

At equilibrium $E_{cell} = 0$

Given that

∴ $R = 8.314\,JK^{-1}\,mol^{-1}$

$T = 25^{\circ}C + 273 = 298\,K$

$F = 96500\,C$ and $n = 2$

∴ $E^{\circ}_{cell} = \frac{2.303 \times 8.314 \times 298}{2 \times 96500} \log_{10} K$

$= \frac{0.0591}{2} \log_{10} K$

∵ Given that $E^{\circ}_{cell} = 0.295\,V$

∴ $0.295 = \frac{0.0591}{2} \log_{10} K$

or $\log_{10} K = \frac{0.295 \times 2}{0.0591} = 10$

or $K = $ antilog 10

$K = 1 \times 10^{10}$

32. Milk is an emulsion in which the particles (or globules) of liquid fats are dispersed in water.

33. Cu^{2+} : $[Ar]\,3d^9$

Hence, Cu^{2+} has one unpaired electron.

$\mu = \sqrt{n(n+2)}$

$= \sqrt{1(1+2)}$

$= \sqrt{3}$

$= 1.73\,BM$

34. $H^+ + e \longrightarrow \frac{1}{2} H_2$

$E = E^{\circ} - \frac{0.059}{n} \log \frac{1}{[H^+]}$

$= 0 - \frac{0.059}{1} pH$

$E = -0.059 \times 3 = -0.177\,V$

35. For the reaction,

$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$ $\Delta H^{\circ} = ?$

On the basis of bond energies of H_2, Br_2 and HBr, ΔH of above is calculated as follows

$\Delta H = -[2 \times$ bond energy of HBr $-$ (bond energy of H_2 + bond energy of Cl_2)]

$\Delta H = -[2 \times (364) - (433) + 192\,kJ]$

$= -[728 - (625)]\,kJ = -103\,kJ$

36. IF_3 has bent-T shaped geometry.

PCl_3 has pyramidal geometry.

NH_3 has pyramidal geometry.
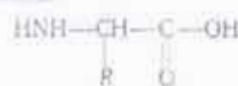

BF_3 has trigonal planar geometry.
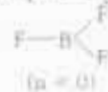
$(\mu = 0)$

37. When formaldehyde reacts with ammonia it gives urotropine or hexamethylene tetramine. It is used as medicine to treat urinary infections.

$6HCHO + 4NH_3 \longrightarrow (CH_2)_6 N_4 + 6H_2O$
                                    urotropine

38. The peptide linkage (—NH—CO—) is formed by the condensation of amino acids molecules.

$+ H-NH-CH-C-OH \longrightarrow$

$-HN-CH-C-NH-CH-C-$

Hence, following structure represents the peptide chain.

$-N-C-C-N-C-C-N-C-C-$

39. Freons or chlorofluoro carbons are responsible for depletion of the ozone layer in the upper strata of the atmosphere. They are used as propellants, aerosol spray caps, refrigerants, fire fighting reagents etc. They are stable and chemically inert compounds. They absorb UV-radiation and break down liberating free atomic chlorine which causes decomposition of ozone through free radical reaction. This results in the depletion of the ozone layer.

Freons are mainly freon-1 ($CFCl_3$) and Freon-12 (CF_2Cl_2). They form free radical of chlorine in the presence of UV-radiation. Such free radical decomposes O_3 as follows

$Cl^\bullet + O_3 \longrightarrow ClO^\bullet + O_2$

$ClO^\bullet + O_3 \longrightarrow \underset{\substack{\text{chlorine} \\ \text{free radical}}}{Cl^\bullet} + 2O_2$

40. $_{28}Ni^{60} + {}_0n^1 \longrightarrow {}_{27}Co^{60} + {}_1H^1$

(n, p means that neutron attacks and proton liberates).

41. Reaction of HBr with propene in the presence of peroxide gives n-propyl bromide. This addition reaction is an example of anti-Markownikoff addition reaction (i.e., it is completed in form of free radical addition).

$CH_3-CH=CH_2 + HBr \xrightarrow{\text{Peroxide}}$

$\underset{\text{n-propyl bromide}}{CH_3-CH_2-CH_2Br}$

42. For first order reaction,

$A \longrightarrow B$

Given, that rate $= k \times [A]$

Rate $= 2.0 \times 10^{-5}$ mol $L^{-1}s^{-1}$

$[A]$ = concentration of $A = 0.01$ M

So $2.0 \times 10^{-5} = k \times 0.01$ $K = \dfrac{2.0 \times 10^{-5}}{0.01} s^{-1}$

$= 2.0 \times 10^{-3} s^{-1}$

For first order reaction,

$T_{1/2} = \dfrac{0.693}{k} = \dfrac{0.693}{2.0 \times 10^{-3}}$

$= 346.5 = 347$ s

43. In pure water

$[H^+] = [OH^-]$

$K_w = [H^+][OH^-]$

$K_w = 10^{-6} \times 10^{-6} = 10^{-12}$

44. 50 mL of 0.1 M HCl $= \dfrac{0.1 \times 50}{1000} = 5 \times 10^{-3}$

50 mL of 0.2 M NaOH $= \dfrac{0.2 \times 50}{1000} = 10 \times 10^{-3}$

Hence, after neutralisation NaOH left

$= 10 \times 10^{-3} - 5 \times 10^{-3}$

$= 5 \times 10^{-3}$

Total volume $= 100$ cc

The concentration of NaOH

$= \dfrac{5 \times 10^{-3} \times 1000}{100} = 0.05$ M

$[OH^-] = 0.05 M = 5 \times 10^{-2}$ M

$pOH = -\log[OH^-]$

$= -\log[5 \times 10^{-2}]$

$= 1.3010$

$pH + pOH = 14$

$pH = 14 - 1.3010$

$= 12.699 = 12.70$

45. By the reaction of benzene with ethylene in the presence of anhydrous $AlCl_3$, ethylbenzene is produced.

46. Vitamin-B_{12} contains cobalt (Co). Its chemical name is cyanocobalamin.

47.

48. Alizarin is an anthraquinone dye.

alizarin dye

49.

Correct IUPAC name is 4-ethyl-3-methyl heptane because substituents are written in alphabetical order.

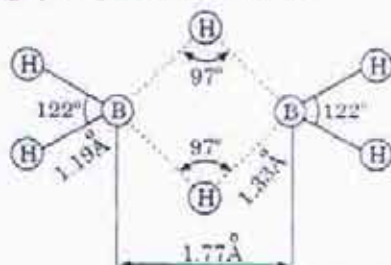**50.** B_2H_6 is an electron deficient molecule because boron atom has three half-filled orbitals in excited state. The structure of B_2H_6 is represented as follows

In it two electrons of a B—H bond are involved in the formation of three centre bond, these bonds are represented as dotted lines.

51. Base, BOH is dissociated as follows

$$BOH \rightleftharpoons B^+ + OH^-$$

So, the dissociation constant of BOH,

$$K_b = \frac{[B^+][OH^-]}{[BOH]}$$

At equilibrium, $[B^+] = [OH^-]$

$$\therefore \qquad K_b = \frac{[OH^-]^2}{[BOH]}$$

Given that $\quad K_b = 1.0 \times 10^{-12}$

and $\qquad [BOH] = 0.01\,M$

Thus, $1.0 \times 10^{-12} = \dfrac{[OH^-]^2}{0.01}$

$$[OH^-]^2 = 1 \times 10^{-14}$$

$$[OH^-] = 1.0 \times 10^{-7}\,mol\,L^{-1}$$

52. According to Huckel's rule an aromatic compound has $(4n + 2)\pi$ electrons, where $n = 0, 1, 2, 3, \ldots\ldots$ etc.

 ; $4n + 2 = 2$; $n = 0$; aromatic

 ; $4n + 2 = 6$; $n = 1$; aromatic

 ; $4n + 2 = 4$; $n = 0.5$; non-aromatic

 ; $4n + 2 = 6$; $n = 1$; aromatic

53. In $\pi\ 2p_x$ two nodal planes are present.

54. β-hydroxy aldehydes or β-hydroxyketones (i.e., aldol) readily dehydrated under acidic condition to give α, β-unsaturated aldeyhde or ketone.

55. Compound X is $CaCO_3$.

$$CaCO_3 \underset{X}{} \xrightarrow{\Delta} \underset{residue}{CaO} + CO_2 \uparrow$$

$$\underset{residue}{CaO} + H_2O \longrightarrow \underset{Y}{Ca(OH)_2}$$

$$\underset{Y}{Ca(OH)_2} + \underset{excess}{CO_2} + H_2O \longrightarrow \underset{Z}{Ca(HCO_3)_2}$$
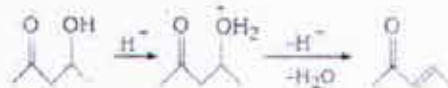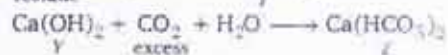
$$Ca(HCO_3)_2 \xrightarrow{\Delta} \underset{X}{CaCO_3} + H_2O + CO_2 \uparrow$$

56. In $_{23}V = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3, 4s^2$ third electron which is removed in third ionisation enthalpy belongs to $3d^3$ sub-shell.

$_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2 3p^6 3d^5, 4s^1$

Third electron which is removed in third ionisation potential belongs to $3d^5$ sub-shell.

$_{26}Fe = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2$

Third electron which is removed in third ionisation enthalpy belongs to $3d^6$ sub-shell.

$_{25}Mn = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^5, 4s^2$
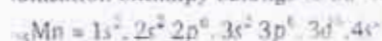
Third electron which is removed in third ionisation potential belongs to $3d^5$ sub-shell. In all elements shell and sub-shells are same. Required amount of energy (enthalpy) is based upon the stability of d-subshell.

The $3d^5$ sub-shell has highest stability in all because it is half-filled sub-shell (while other are incomplete). So, Mn shows highest third ionisation potential.

57. Let the oxidation state of P is x in Ca_3P_2

$\Rightarrow \quad 3(+2) + 2x = 0$

$2x = -6$

$x = -3$

58. The energy of second Bohr orbit of hydrogen atom (E_2) is -328 kJ mol^{-1} because

$E_n = -\dfrac{1312}{(2)^2}$ kJ mol^{-1}

$E_n = -\dfrac{1312}{n^2}$ kJ mol^{-1}

If $n = 4$

$\therefore \qquad E_4 = -\dfrac{1312}{(4)^2}$ kJ mol^{-1}

$= -82$ kJ mol^{-1}

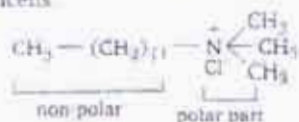**59.** Angular momentum $= \sqrt{l(l+1)}\,\dfrac{h}{2\pi}$

For d-orbital, $l = 2$

Angular momentum $= \sqrt{2(2+1)}\,\dfrac{h}{2\pi}$

$= \sqrt{6}\,\dfrac{h}{2\pi}$

60. Surfactants detergents form micelles in solution above their CMC (critical micelle concentration). Dodecyl trimethyl ammonium chloride is an example of surfactant (cationic surfactant), so it exists as micells

$$CH_3 - (CH_2)_{11} - \overset{+}{\underset{Cl^-}{N}}\overset{CH_3}{\underset{CH_3}{\longleftarrow}} CH_3$$

non polar   polar part

Biology

1. *Adiantum* is also called walking fern. In *Adiantum*, the tips of the leaves, on coming in contact with the soil, gives out adventitious roots which in turn, produce new leaves and develop into new plants.

Marchantia may reproduce vegetatively (by-death and decay of the older parts of thallus, adventitious branches, formation of gemmae) and sexually. Moss (*Funaria*) reproduces mainly sexually.

2. Since, large populations of *Escherichia coli* are found in human colon, the presence of *E. coli* in water indicates that, it has been contaminated with faecal matter. Thus, *E. coli* is commonly known as indicator of water pollution.

Lemna and *Eichhornia* are free-floating hydrophytes, which remain in contact with water and air but not soil.

E. histolytica is a parasitic and pathogenic protozoan protist, which resides in the upper part of large intestine in human beings. it causes amoebic dysentery or amoebiasis

3. According to Oparin, the atmosphere of primitive earth was reducing because H atoms were most numerous and most reactive. Large quantities of H_2, N_2, water vapour, CO_2, CH_4 and NH_3 were present but free oxygen was not present in significant amount.

4. At telophase stage, nuclear membrane vesicles associate with the surface of individual chromosomes and fuse to reform the nuclear membranes, which partially

enclose clusters of chromosomes before coalescing to reform the complete nuclear envelope. During this process the nuclear pores reassemble and reassociate to form the nuclear lamina. One of the lamina proteins (lamina-B) remains with the nuclear membrane fragments throughout mitosis and may help nucleate reassembly. After the nucleus reforms, the pores pump in nuclear proteins, the chromosome decondense and RNA synthesis resumes, causing the nucleolus to reappear.

5. Reporter genes are used to determine whether a particular DNA construct has been successfully introduced into a cell, organ or tissue.

6. **Restriction endonuclease** is a type of enzyme that can cleave molecules of DNA at a particular site called restriction site having palindromic sequence. These enzymes are produced by many bacteria and protect the cell by cleaving and destroying the DNA of invading viruses. Now a days, restriction enzymes are widely used in the techniques of genetic engineering.

7. Class–Oligochaeta includes terrestrial earthworms and some other species that live in freshwater. Aquatic oligochaetes excrete ammonia while terrestrial oligochaetes excrete **urea** but *Lumbricus* produces both ammonia and urea.

8. In open circulatory system, the blood flows in open spaces like lacunae and sinuses and it bathes the cells directly, e.g., arthropods (cockroach or *Periplaneta*).

   Octopus and *Sepia* are the cephalopods in which the circulatory system is of completely closed type.

   Pheretima and *Hirudinaria* are the annelids. Annelids possess the closed circulatory system in which the blood circulates inside the blood vessels without coming in direct contact of body cells.

9. *Ctenoplana* and *Beroe* lack cnidoblasts and have biradial symmetry. These belong to phylum–Ctenophora.

   Hydra, sea anemone, *Aurelia* are coelenterates which have cnidoblasts.

Although sea anemone has biradial symmetry.

10. In meristem culture, the shoot apical meristem alongwith some surrounding tissue is grown *in vitro*. It is used for clonal propagation and recovery of virus free plants. It is also potentially useful in germplasm exchange and long term storage of germplasm through freeze preservation.

   Protoplast culture involves the culture of protoplasts (plant cell without cell wall) on suitable medium.

   Embryo rescue is the culture of incised immature embryo to raise new plants.

   Anther culture involves the culture of anthers on artificial culture medium. It is helpful in obtaining haploid plants.

11. Both sickle cell anaemia and Huntington's chorea are congenital genetic disorders. Sickle cell anaemia was first reported by James Herrick (1904). In this disease, the patient's haemoglobin level reduced to half of the normal and the RBCs becomes sickle-shaped. A single mutation in a gene can cause sickle cell anaemia.

   Huntington's chorea is caused by autosomal mutation, which is dominant. The gene is present on chromosome numbers.

12. Pellagra is caused due to deficiency of vitamin-B_3 (niacin or nicotinic acid). Deficiency of vitamin-B_{12} (cyanocobalamine) causes pernicious anaemia.

   Deficiency of vitamin-B_1 (thiamine) causes beri-beri.

13. Vagus nerve is a mixed cranial nerve, controlling much of the gut, ventilatory system and heart. It does not affect tongue movements. Tongue movement is controlled by glossopharyngeal nerve.

14. Living object of the environment are called biotic factor and non-living objects are called abiotic factor. The functional interrelation of biotic and abiotic factor is called ecosystem.

15. The pollen grains are the male reproductive part of the angiospermic plants life cycle. The study of morphology of pollen grains is called Palynology.

16. The vehicular exhaust is a source of CO_2, CO, nitrogen oxides, unburnt hydrocarbons and lead oxides. CO comprise for as much as 80% of all automobile emissions.

17. Variations are the dissimilarities in the chromosome, DNA or nucleotides. Mutation is the sudden and permanent change in the nucleotide of DNA which leads to variation.

18. The term xylem was introduced by Nageli (1858). The vessels and wood parenchyma are living while others are dead. The main function of vessels is water conduction.

19. The two communities not separated sharply but a zone of transition present between the communities called ecotone. Biome is the climax community having the species at different succession stage.

20. Centi Morgan is also called map unit. It is a unit of measuring distance between genes on a chromosome according to the frequency of recombination due to crossing over.

21. Due to continued secondary growth, the xylem cylidner year after year goes on increasing in diameter, with age the inner central portion of the wood (xylem) becomes non-functional and thus annual rings are formed. The annual rings are used to calculate the age of tree.

22. Such ecosystems are less dependent on direct solar energy. Such type of food chain operate in the decomposing accumulated litter in temperate forest. A good example is based on mangrove leaves.

23. Transmission of a gene from male parent to female child to male grandchild is called criss-cross inheritance, e.g., X-linked inheritance.

24. Dixon and Jolly (1894) propounded cohesion tension theory. According to this theory a strong cohesive force between the water molecules is responsible for the tensile strength of water column in the xylem vessels.

25. Totipotency is the ability of plant cell to regenerate complete plant. The totipotency was discovered by Hadberland.

26. The organisms which have not changed much during the post several million years.

Whereas other relative members of their group have changed are called living fossils. e.g., Cycas, Ginkgo, Limulus, etc.

27. The ultimate source of energy on earth is sun, i.e., all the energy coming from sun. The solar energy transformed to chemical energy by the green plants (the usable form of energy for organisms).

28. Photosynthesis is a reductive, endergenic and anabolic process.
It reduces CO_2 and H_2O to form glucose utilizing solar energy.

29. The correct sequence code transfer involved in the formation of polypeptide DNA → mRNA → tRNA → amino acid. Process of coding of DNA into mRNA is called transcription.
Process involved in coding of mRNA into amino acid is known as translation.

30. Benign tumour could be regarded as non cancerous since they are confined to one particular place. These could be cured easily.

31. Cri-du-chat syndrome (Cat-cry syndrome) was discovered by Lejeune in 1963 and is due to the deletion of a large part of the small arm of one of the 5th autosomes. Deletion is a type of mutation in which genetic material is removed from chromosomes or other DNA molecules.

Duplication is a type of chromosomal mutation in which part of a chromosome is replicated, so producing extra copies of those genes contained in the duplicated segment. e.g., mutation in Drosophila.

In inversion, a segment of chromosome becomes reversed and although there is not loss or gain of genetic material, there may be a positive or negative position effect on the phenotype.

In translocation, non-homologous chromosomes break and exchange pieces.

32. Synapsis is the pairing of homologous chromosomes during the zygotene stage of meiosis. Each pair is called bivalent. One of the pair comes from the male parent and one from the female parent. Each member of the pair is of the same length, their centromeres are in the same positions and they usually have the same number of genes arranged in

the same order. After zygotene stage cell entered in **pachytene** stage in which the bivalents become spiralled, shortened and thickened.

In diplotene stage, chiasma is formed, which indicates the completion of crossing over and beginning of separation of chromosomes.

In diakinesis, chromosomes become more condensed, bivalents more evenly distributed in nucleus and migrate towards periphery.

The nucleolus disappear and nuclear membrane is broken completely.

33. Pruning helps in making the hedge dense as it frees the axillary buds from apical dominance. In fact, the apices of the plant axis (e.g., shoot apex) has the highest concentration of auxin, which suppresses the axillary buds while promotes the growth of apical bud. When the shoot apex is cut down through pruning, the axillary buds grow and the hedge becomes dense.

34. The autonomous nervous system regulates the secretion of glands, whereas the glands do not regulate the nervous system.

35. Phylogeny (Gr. *phylon* = tribe or race; *genea* origin) is the origin and diversification of any taxon or the evolutionary history of its origin and diversification. It is usually represented as a diagrammatic phylogenetic tree (that traces putative evolutionary relationships), i.e., dendrogram.

    palaeontology is the study of fossils. Ontogeny is the whole course of an individual's development and life history.

36. Sertoli cells are the cells that line the seminiferous tubules in the testis. These cells protect the spermatids and convey nutrients to both the developing and mature spermatozoa. Sertoli cells are regulated by FSH (Follicle Stimulating Hormone) as the FSH receptors are confined to the Sertoli cells. FSH stimulates sertoli cells to produce androgen-binding protein and inhibin; and together with testosterone, promotes the proliferation of sertoli cells.

    Growth Hormone (GH) or Somatotropin (STH) is secreted from adenohypophysis of pituitary gland. It stimulates cellular growth and proliferation, growth and repair of bones, muscles and connective tissue. In the liver cells it promotes, glycogenesis, deamination and glycogenesis. Prolactin (PRL), Lactogenic, Luteotropic (LTH).

37. Pulmonary artery pumps deoxygenated blood to lungs, it has thick muscular wall in comparison to the pulmonary vein.

38. Cerebellum is the portion of hind brain. Its primary function is to maintain posture, orientation and equilibrium of body by coordinating and regulating bone and contraction of voluntary muscles mainly according to the commands of cerebrum.

39. Inversion involves a reverse order of genes in a part of chromosome.

40. PCR is a technique in which small fragment of DNA is rapidly cloned or duplicated to produce multiple DNA copies. It helps in the diagnosis of genetical disorder. This technique has concieved by American biochemist Kary B. Mullis.

41. AUG is the initiation codon which codes for methionine. During protein synthesis initiation of polypeptide chain occurs through methionine.

42. According to abiogenesis or theory of spontaneous generation, life originated from non-living matter.

    Francisco Redi gave the theory of biogenesis (life comes only from pre-existing life and first disproved the theory of abiogeneis by covering and uncovering boiled rotten meat.

43. HIV enter into T-lymphocytes, replicates and producers progeny viruses. The progeny viruses released in the blood and damages other helper T-lymphocytes. This is repeated leading to the progressive decrease in the number of T-lymphocytes in the body of infected person. During this period the person suffers from bounts of fever, diarrhoea and weight loss. The person start suffering from infections.

44. When CO_2 concentration in blood increases, breathing becomes faster and deeper. The effect of increased CO_2 is to decrease the affinity of haemoglobin for O_2. Thus, due to

Bohr's effect the CO_2 released in respiring tissue accelerates the delivery of oxygen by faster and deeper breathing.

45. *Anabaena* is a free-living nitrogen fixing cyanobacterium which can form symbiotic association with water ferm *Azolla*.
The alga *Tolypothrix* belongs to class–Cyanophyceae. Some forms of *Chlorella* form symbiotic association in lichens and in certain invertebrates such as *Hydra*, *Paramecium* and sponges. Some species of *Nostoc* have been reported to fix atmospheric nitrogen and tend to maintain fertility of paddy fields.

46. Prolactin is secreted by anterior pituitary glands, which stimulates mammary gland development during pregnancy and lactation after child birth. Placenta is a connection between the uterine wall of mother and their foetus. It helps in exchange of material between these two. Placenta secretes human chorionic gonadotropin, estrogen and progesterone.

47. International unit is nm. But when the object is seen under transmission electron microscope, Å is the smallest unit.

48. Currently 1.7 million living organisms are known to science. Out of these 1.2 million are animals and 0.5 million are plants. However, the single group of insects have 0.7 million species.

49. First hydrogen atoms combined with all oxygen atoms to form water and leaving no free oxygen. Thus, primitive atmosphere was reducing.

50. The white fibres are generally collected in bundles bound by a mucoprotein. These fibres are inelastic inextensible and colourless. On boiling the collagen fibres swellup and form gelatin (tropocollagen).

51. Yoghurt consists of pasteurised homogenised milk. In yoghurt production *Streptococcus thermophillus*, *S. lactis* and *Lactobacillus bulgricus* are inoculated. The *Acetobacter aceti* used in production of acetic acid.

52. Viagra enhances the effect of nitric oxide produced during sexual stimulation and allow flow of blood in penis.

53. The mating of two individuals of *Paramecium* is called conjugation. The mating types are morphologically similar but physiologically different and in conjugation there is exchange of micronuclear material.

54. The age of earth is about 4.6 billion years. The history of earth has been divided into a number of eras. The eras are sub-divided into periods. The modern periods are sub-divided into epochs.

55. The stomach and intestine are lining by columnar epithelium. The cells of columnar epithelium are tall broad at outer end and narrower at inner end. The mucus is secreted by this epithelia and protect it from HCl (the cardiac glands secretes mucus).

56. *In situ* conservation of genetic diversity is the conservation at their natural home. It is best conservation method but their is a danger of destruction/fragmentation of natural habitat.

57. Pyrenoids are starch storing structure in algal chloroplasts. The pyrenoid has a protein core around which starch is deposited in layers.

58. *Pythium debaryanum* kills seed lings of a number of plants through collapse of stem just above the ground level. *e.g.*, tomato, castor, mustard.

59. The organs which are present in reduced form and do not perform any function in the body but corresponds to fully developed organs of related animals are called vestigial organs.

60. The frontal lobe of cerebral hemispheres governed the reasoning, will, memory, intelligence and emotions. The creative ideas also occur in the frontal lobe of cerebral hemispheres.