NEET 2018 Solved Paper

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NEET - 2018
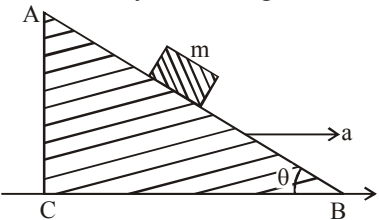## Solved Paper

**Time : 3 hours**   **MM : 720**

PHYSICS

1. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of –0.004 cm, the correct diameter of the ball is
   (a) 0.521 cm   (b) 0.525 cm
   (c) 0.529 cm   (d) 0.053 cm

2. The moment of the force, $\vec{F} = 4\hat{i} + 5\hat{j} - 6\hat{k}$ at (2, 0, –3), about the point (2, –2, –2), is given by
   (a) $-8\hat{i} - 4\hat{j} - 7\hat{k}$ (b) $-4\hat{i} - \hat{j} - 8\hat{k}$
   (c) $-7\hat{i} - 4\hat{j} - 8\hat{k}$ (d) $-7\hat{i} - 8\hat{j} - 4\hat{k}$

3. Which one of the following statements is incorrect?
   (a) Rolling friction is smaller than sliding friction.
   (b) Limiting value of static friction is directly proportional to normal reaction.
   (c) Coefficient of sliding friction has dimensions of length.
   (d) Frictional force opposes the relative motion.

4. A block of mass m is placed on a smooth inclined wedge ABC of inclination θ as shown in the figure. The wedge is given an acceleration 'a' towards the right. The relation between a and θ for the block to remain stationary on the wedge is

   (a) $a = \dfrac{g}{\cosec\,\theta}$ (b) $a = \dfrac{g}{\sin\theta}$
   (c) $a = g\tan\theta$ (d) $a = g\cos\theta$

5. A moving block having mass m, collides with another stationary block having mass 4m. The lighter block comes to rest after collision. When the initial velocity of the lighter block is v, then the value of coefficient of restitution (e) will be
   (a) 0.5   (b) 0.25
   (c) 0.4   (d) 0.8

6. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere?
   (a) Angular velocity
   (b) Moment of inertia
   (c) Angular momentum
   (d) Rotational kinetic energy

7. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy (K_t) as well as rotational kinetic energy (K_r) simultaneously. The ratio $K_t : (K_t + K_r)$ for the sphere is
   (a) 7 : 10   (b) 5 : 7
   (c) 2 : 5   (d) 10 : 7

8. Three objects, A : (a solid sphere), B : (a thin circular disk) and C : (a circular ring), each have the same mass M and radius R. They all spin with the same angular speed ω about their own symmetry axes. The amounts of work (W) required to bring them to rest, would satisfy the relation
   (a) $W_C > W_B > W_A$ (b) $W_A > W_B > W_C$
   (c) $W_A > W_C > W_B$ (d) $W_B > W_A > W_C$

9. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are K_A, K_B and K_C, respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then
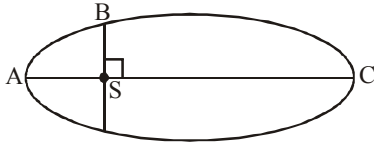
(a) $K_A < K_B < K_C$ (b) $K_A > K_B > K_C$
(c) $K_B > K_A > K_C$ (d) $K_B < K_A < K_C$

10. Two wires are made of the same material and have the same volume. The first wire has cross-sectional area A and the second wire has cross-sectional area 3A. If the length of the first wire is increased by $\Delta\ell$ on applying a force F, how much force is needed to stretch the second wire by the same amount?
(a) 9 F   (b) 6 F
(c) F   (d) 4 F

11. A small sphere of radius 'r' falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity, is proportional to
(a) r^3 (b) r^2
(c) r^4 (d) r^5

12. The power radiated by a black body is P and it radiates maximum energy at wavelength, λ_0. If the temperature of the black body is now changed so that it radiates maximum energy at wavelength $\frac{3}{4}\lambda_0$, the power radiated by it becomes nP. The value of n is
(a) $\frac{3}{4}$ (b) $\frac{4}{3}$

(c) $\frac{81}{256}$ (d) $\frac{256}{81}$

13. The volume (V) of a monatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state A to state B, is
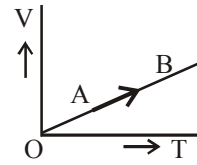
(a) $\frac{2}{5}$ (b) $\frac{2}{3}$

(c) $\frac{2}{7}$ (d) $\frac{1}{3}$

14. The efficiency of an ideal heat engine working between the freezing point and boiling point of water, is
(a) 26.8%   (b) 20%
(c) 12.5%   (d) 6.25%

15. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere?
(Given :
Mass of oxygen molecule (m) = 2.76×10^{-26} kg
Boltzmann's constant $k_B = 1.38 \times 10^{-23}$ JK^{-1})
(a) 2.508×10^4 K   (b) 8.360×10^4 K
(c) 1.254×10^4 K   (d) 5.016×10^4 K

16. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is 20 m/s^2 at a distance of 5 m from the mean position. The time period of oscillation is
(a) 2π s   (b) π s
(c) 1 s   (d) 2 s

17. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston. At room temperature of 27°C two successive resonances are produced at 20 cm and 73 cm of column length. If the frequency of the tuning fork is 320 Hz, the velocity of sound in air at 27°C is
(a) 330 m/s   (b) 339 m/s
(c) 300 m/s   (d) 350 m/s

18. The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe. If the length of the closed organ pipe is 20 cm, the length of the open organ pipe is
(a) 13.2 cm   (b) 8 cm
(c) 16 cm   (d) 12.5 cm

19. An electron falls from rest through a vertical distance h in a uniform and vertically upward directed electric field E. The direction of electric field is now reversed, keeping its magnitude the same. A proton is allowed to fall from rest in it through the same vertical distance h. The time of fall of the electron, in comparison to the time of fall of the proton is
    (a) smaller (b) 5 times greater
    (c) equal (d) 10 times greater

20. A toy car with charge q moves on a frictionless horizontal plane surface under the influence of a uniform electric field $\vec{E}$. Due to the force q $\vec{E}$, its velocity increases from 0 to 6 m/s in one second duration. At that instant the direction of the field is reversed. The car continues to move for two more seconds under the influence of this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively
    (a) 2 m/s, 4 m/s (b) 1 m/s, 3 m/s
    (c) 1.5 m/s, 3 m/s (d) 1 m/s, 3.5 m/s

21. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is
    (a) independent of the distance between the plates
    (b) linearly proportional to the distance between the plates
    (c) inversely proportional to the distance between the plates
    (d) proportional to the square root of the distance between the plates

22. A carbon resistor of (47 ± 4.7) kΩ is to be marked with rings of different colours for its identification. The colour code sequence will be
    (a) Violet – Yellow – Orange – Silver
    (b) Yellow – Violet – Orange – Silver
    (c) Green – Orange – Violet – Gold
    (d) Yellow – Green – Violet – Gold

23. A set of 'n' equal resistors, of value 'R' each, are connected in series to a battery of emf 'E' and internal resistance 'R'. The current drawn is I. Now, the 'n' resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10 I. The value of 'n' is
    (a) 10 (b) 11
    (c) 9 (d) 20

24. A metallic rod of mass per unit length 0.5 kg m^{-1} is lying horizontally on a smooth inclined plane which makes an angle of 30° with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction 0.25 T is acting on it in the vertical direction. The current flowing in the rod to keep it stationary is
    (a) 7.14 A (b) 5.98 A
    (c) 11.32 A (d) 14.76 A

25. Current sensitivity of a moving coil galvanometer is 5 div/mA and its voltage sensitivity (angular deflection per unit voltage applied) is 20 div/V. The resistance of the galvanometer is
    (a) 40 Ω (b) 25 Ω
    (c) 500 Ω (d) 250 Ω

26. A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the current in the electromagnet is switched on, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence the rod gains gravitational potential energy. The work required to do this comes from
    (a) the current source
    (b) the magnetic field
    (c) the induced electric field due to the changing magnetic field
    (d) the lattice structure of the material of the rod

27. The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor is of inductance
    (a) 0.138 H (b) 138.88 H
    (c) 13.89 H (d) 1.389 H

28. An inductor 20 mH, a capacitor 100 μF and a resistor 50Ω are connected in series across a source of emf, V = 10 sin 314 t. The power loss in the circuit is
    (a) 0.79 W (b) 0.43 W
    (c) 1.13 W (d) 2.74 W

29. An em wave is propagating in a medium with a velocity $\vec{V} = V\hat{i}$. The instantaneous oscillating electric field of this em wave is along +y axis. Then the direction of oscillating magnetic field of the em wave will be along
    (a) –z direction (b) +z direction
    (c) –x direction (d) –y direction

30. The refractive index of the material of a prism is $\sqrt{2}$ and the angle of the prism is 30°. One of the two refracting surfaces of the prism is made a mirror inwards, by silver coating. A beam of monochromatic light entering the prism from the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is
    (a) 60°   (b) 45°
    (c) Zero   (d) 30°

31. An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of
    (a) small focal length and large diameter
    (b) large focal length and small diameter
    (c) small focal length and small diameter
    (d) large focal length and large diameter

32. In Young's double slit experiment the separation d between the slits is 2 mm, the wavelength λ of the light used is 5896 Å and distance D between the screen and slits is 100 cm. It is found that the angular width of the fringes is 0.20°. To increase the fringe angular width to 0.21° (with same λ and D) the separation between the slits needs to be changed to
    (a) 1.8 mm   (b) 1.9 mm
    (c) 1.7 mm   (d) 2.1 mm

33. Unpolarised light is incident from air on a plane surface of a material of refractive index 'μ'. At a particular angle of incidence 'i', it is found that the reflected and refracted rays are perpendicular to each other. Which of the following options is correct for this situation?
    (a) Reflected light is polarised with its electric vector parallel to the plane of incidence
    (b) Reflected light is polarised with its electric vector perpendicular to the plane of incidence
    (c) $i = \tan^{-1}\left(\dfrac{1}{\mu}\right)$
    (d) $i = \sin^{-1}\left(\dfrac{1}{\mu}\right)$

34. An electron of mass m with an initial velocity $\vec{V} = V_0 \hat{i}$ $(V_0 > 0)$ enters an electric field $\vec{E} = -E_0 \hat{i}$ $(E_0 = \text{constant} > 0)$ at t = 0. If λ_0 is its de-Broglie wavelength initially, then its de-Broglie wavelength at time t is
   (a) $\dfrac{\lambda_0}{\left(1 + \dfrac{eE_0}{mV_0}t\right)}$
    (b) $\lambda_0\left(1 + \dfrac{eE_0}{mV_0}t\right)$
    (c) λ_0
    (d) $\lambda_0 t$

35. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is
    (a) 1 : 1   (b) 1 : –1
    (c) 1 : –2   (d) 2 : –1

36. For a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is
    (a) 20   (b) 10
    (c) 15   (d) 30

37. In a p-n junction diode, change in temperature due to heating
    (a) Affects only reverse resistance
    (b) Affects only forward resistance
    (c) Affects the overall V-I characteristics of p-n junction
    (d) Does not affect resistance of p-n junction

38. In the circuit shown in the figure, the input voltage V_i is 20 V, $V_{BE} = 0$ and $V_{CE} = 0$. The values of I_B, I_C and β are given by
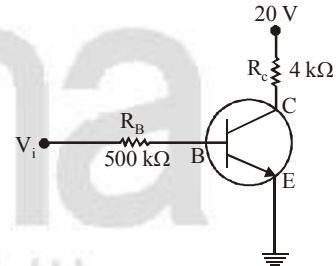

    (a) $I_B = 40\,\mu A$, $I_C = 10\,mA$, $\beta = 250$
    (b) $I_B = 25\,\mu A$, $I_C = 5\,mA$, $\beta = 200$
    (c) $I_B = 40\,\mu A$, $I_C = 5\,mA$, $\beta = 125$
    (d) $I_B = 20\,\mu A$, $I_C = 5\,mA$, $\beta = 250$

39. In the combination of the following gates the output Y can be written in terms of inputs A and B as
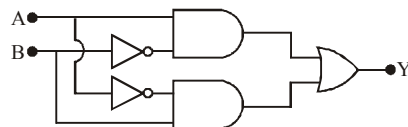
    (a) $\overline{A \cdot B}$
    (b) $A \cdot \overline{B} + \overline{A} \cdot B$
    (c) $\overline{A + B}$
    (d) $\overline{A \cdot B} + A \cdot B$

40. A battery consists of a variable number 'n' of identical cells (having internal resistance 'r' each) which are connected in series. The terminals of the battery are short-circuited and the current I is measured. Which of the graphs shows the correct relationship between I and n?

(a)

(b)

(c)

(d)
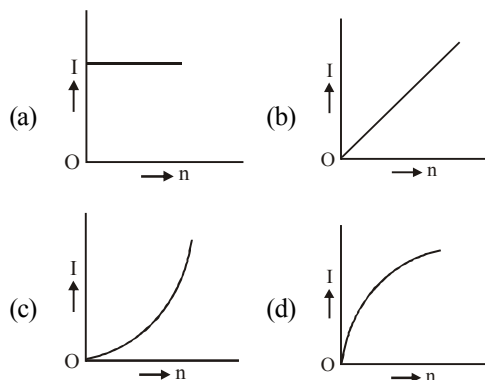
41. An object is placed at a distance of 40 cm from a concave mirror of focal length 15 cm. If the object is displaced through a distance of 20 cm towards the mirror, the displacement of the image will be
    (a) 30 cm away from the mirror
    (b) 36 cm away from the mirror
    (c) 36 cm towards the mirror
    (d) 30 cm towards the mirror

42. When the light of frequency $2\nu_0$ (where ν_0 is threshold frequency), is incident on a metalplate, the maximum velocity of electrons emitted is v_1. When the frequency of the incident radiation is increased to $5\nu_0$, the maximum velocity of electrons emitted from the same plate is v_2. The ratio of v_1 to v_2 is

(a) $1:2$ (b) $1:4$
(c) $2:1$ (d) $4:1$

43. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct?
    (a) Raindrops will fall faster
    (b) Walking on the ground would become more difficult
    (c) 'g' on the Earth will not change
    (d) Time period of a simple pendulum on the Earth would decrease

44. A sample of 0.1 g of water at 100°C and normal pressure (1.013×10^5 Nm^{-2}) requires 54 cal of heat energy to convert to steam at 100°C. If the volume of the steam produced is 167.1 cc, the change in internal energy of the sample, is
    (a) 104.3 J (b) 208.7 J
    (c) 84.5 J   (d) 42.2 J

45. A body initially at rest and sliding along a frictionless track from a height h (as shown in the figure) just completes a vertical circle of diameter AB = D. The height h is equal to
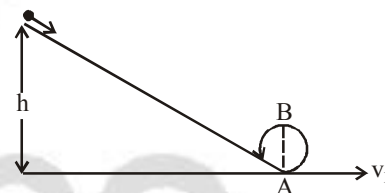

(a) $\dfrac{3}{2}D$ (b) D

(c) $\dfrac{5}{4}D$ (d) $\dfrac{7}{5}D$

CHEMISTRY

46. In which case is number of molecules of water maximum?
    (a) 18 mL of water
    (b) 0.18 g of water
    (c) 10^{-3} mol of water
    (d) 0.00224 L of water vapours at 1 atm and 273 K

47. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be
    (a) 1.4 (b) 3.0 (c) 4.4 (d) 2.8

48. Which one is a wrong statement?
    (a) Total orbital angular momentum of electron in 's' orbital is equal to zero
    (b) An orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers
    (c) The value of m for d_z^2 is zero
   (d) The electronic configuration of N atom is
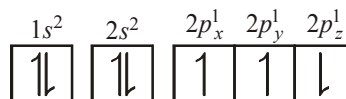
49. The correct order of atomic radii in group 13 elements is
    (a) $B < Al < In < Ga < Tl$
    (b) $B < Al < Ga < In < Tl$
    (c) $B < Ga < Al < In < Tl$
    (d) $B < Ga < Al < Tl < In$

50. In the structure of ClF_3, the number of lone pair of electrons on central atom 'Cl' is
    (a) One   (b) Two
    (c) Three   (d) Four

51. Which of the following molecules represents the order of hybridisation sp^2, sp^2, sp, sp from left to right atoms?
    (a) $HC \equiv C - C \equiv CH$
    (b) $CH_2 = CH - C \equiv CH$
    (c) $CH_3 - CH = CH - CH_3$
    (d) $CH_2 = CH - CH = CH_2$

52. Consider the following species :
    CN^+, CN^-, NO and CN
    Which one of these will have the highest bond order?
    (a) NO   (b) CN^- (c) CN   (d) CN^+

53. The correction factor 'a' to the ideal gas equation corresponds to
    (a) Density of the gas molecules
    (b) Volume of the gas molecules
    (c) Forces of attraction between the gas molecules
    (d) Electric field present between the gas molecules

54. Given van der Waals constants for NH_3, H_2, O_2 and CO_2 are respectively 4.17, 0.244, 1.36 and 3.59, which one of the following gases is most easily liquefied?
    (a) NH_3 (b) H_2 (c) CO_2 (d) O_2

55. The bond dissociation energies of X_2, Y_2 and XY are in the ratio of $1 : 0.5 : 1$. ΔH for the formation of XY is -200 kJ mol^{-1}. The bond dissociation energy of X_2 will be
    (a) 200 kJ mol^{-1} (b) 100 kJ mol^{-1}
    (c) 400 kJ mol^{-1} (d) 800 kJ mol^{-1}

56. Which one of the following conditions will favour maximum formation of the product in the reaction,
    $A_2(g) + B_2(g) \rightleftharpoons X_2(g) \ \Delta_r H \quad -X$ kJ :

(a) Low temperature and high pressure
(b) Low temperature and low pressure
(c) High temperature and low pressure
(d) High temperature and high pressure

57. Following solutions were prepared by mixing different volumes of NaOH and HCl of different concentrations :
    a. $60 \, mL \ \dfrac{M}{10} \ HCl + 40 \, mL \ \dfrac{M}{10} \ NaOH$

    b. $55 \, mL \ \dfrac{M}{10} \ HCl + 45 \, mL \ \dfrac{M}{10} \ NaOH$

    c. $75 \, mL \ \dfrac{M}{5} \ HCl + 25 \, mL \ \dfrac{M}{5} \ NaOH$

    d. $100 \, mL \ \dfrac{M}{10} \ HCl + 100 \, mL \ \dfrac{M}{10} \ NaOH$

    pH of which one of them will be equal to 1?
    (a) b   (b) a   (c) c   (d) d

58. The solubility of $BaSO_4$ in water is 2.42×10^{-3} gL^{-1} at 298 K. The value of its solubility product (K_{sp}) will be
    (Given molar mass of $BaSO_4 = 233$ g mol^{-1})
    (a) 1.08×10^{-10} mol^{2}L^{-2}
    (b) 1.08×10^{-12} mol^{2}L^{-2}
    (c) 1.08×10^{-8} mol^{2}L^{-2}
    (d) 1.08×10^{-14} mol^{2}L^{-2}

59. For the redox reaction
    $MnO_4^- \quad C_2O_4^{2-} \quad H \rightarrow Mn^{2+} + CO_2 + H_2O$
    The correct coefficients of the reactants for the balanced equation are

	MnO_4^-	$C_2O_4^{2-}$	H^+
(a)	16	5	2
(b)	2	5	16
(c)	5	16	2
(d)	2	16	5

60. Consider the change in oxidation state of bromine corresponding to different emf values as shown in the diagram below :

    $BrO_4^- \xrightarrow{\ 1.82 \, V\ } BrO_3^- \xrightarrow{\ 1.5 \, V\ } HBrO$

    $Br^- \xleftarrow{\ 1.0652 \, V\ } Br_2 \xleftarrow{\ 1.595 \, V\ }$

Then the species undergoing disproportionation is

(a) BrO_3^- (b) BrO_4^- (c) $HBrO$ (d) Br_2

61. Which of the following oxides is most acidic in nature?
(a) MgO (b) BeO (c) CaO (d) BaO

62. Among CaH_2, BeH_2, BaH_2, the order of ionic character is
(a) $BeH_2 < CaH_2 < BaH_2$
(b) $CaH_2 < BeH_2 < BaH_2$
(d) $BaH_2 < BeH_2 < CaH_2$
(d) $BeH_2 < BaH_2 < CaH_2$

63. Which one of the following elements is unable to form MF_6^{3-} ion?
(a) Ga (b) Al (c) In (d) B

64. Which of the following carbocations is expected to be most stable?
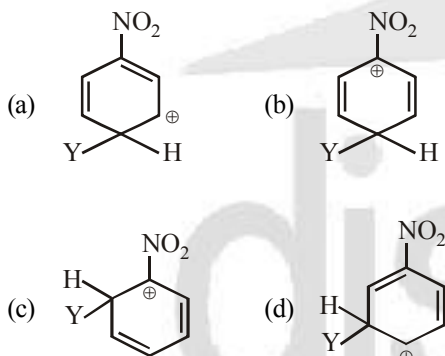
65. Which of the following is correct with respect to – I effect of the substituents? (R = alkyl)
(a) $-NH_2 < -OR < -F$
(b) $-NR_2 < -OR < -F$
(c) $-NR_2 > -OR > -F$
(d) $-NH_2 > -OR > -F$

66. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is
(a) $CH \equiv CH$ (b) $CH_2 = CH_2$
(c) CH_4 (d) $CH_3 - CH_3$

67. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?
(a) N_2O_5 (b) NO_2 (c) NO (d) N_2O

68. Iron exhibits *bcc* structure at room temperature. Above 900°C, it transforms to *fcc* structure. The ratio of density of iron at room temperature to that at 900°C (assuming molar mass and atomic radii of iron remains constant with temperature) is

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

69. The correct difference between first and second order reactions is that
(a) The rate of a first-order reaction does not depend on reactant concentrations, the rate of a second-order reaction does depend on reactant concentrations
(b) The half-life of a first-order reaction does not depend on $[A]_0$, the half-life of a second-order reaction does depend on $[A]_0$
(c) The rate of a first-order reaction does depend on reactant concentrations, the rate of a second-order reaction does not depend on reactant concentrations
(d) A first-order reaction can be catalyzed, a second-order reaction cannot be catalyzed

70. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction
(a) is halved (b) is doubled
(c) remains unchanged (d) is tripled

71. On which of the following properties does the coagulating power of an ion depend?
(a) The magnitude of the charge on the ion alone
(b) Size of the ion alone
(c) The sign of charge on the ion alone
(d) Both magnitude and sign of the charge on the ion

72. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?
(a) Fe (c) Zn (c) Cu (d) Mg

73. The correct order of N-compounds in its decreasing order of oxidation states is
    (a) HNO_3, NO, N_2, NH_4Cl
    (b) HNO_3, NO, NH_4Cl, N_2
    (c) NH_4Cl, N_2, NO, HNO_3
    (d) HNO_3, NH_4Cl, NO, N_2

74. Which of the following statements is not true for halogens?
    (a) All form monobasic oxyacids
    (b) All are oxidizing agents
    (c) Chlorine has the highest electron-gain enthalpy
    (d) All but fluorine shows positive oxidation states

75. Which one of the following ions exhibits *d-d* transition and paramagnetism as well?
    (a) CrO_4^{2-}
    (b) $Cr_2O_7^{2-}$
    (c) MnO_4^{2-}
    (d) MnO_4^-

76. The type of isomerism shown by the complex $[CoCl_2(en)_2]$ is
    (a) Geometrical isomerism
    (b) Coordination isomerism
    (c) Linkage isomerism
    (d) Ionization isomerism

77. The geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ are
    (a) Square planar geometry and diamagnetic
    (b) Tetrahedral geometry and diamagnetic
    (c) Tetrahedral geometry and paramagnetic
    (d) Square planar geometry and paramagnetic

78. Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code :

	Column I		Column II
a.	Co^{3+}	i.	$\sqrt{8}$ BM
b.	Cr^{3+}	ii.	$\sqrt{35}$ BM
c.	Fe^{3+}	iii.	$\sqrt{3}$ BM
d.	Ni^{2+}	iv.	$\sqrt{24}$ BM
		v.	$\sqrt{15}$ BM

	a	b	c	d
(a)	iv	v	ii	i
(b)	i	ii	iii	iv
(c)	iii	v	i	ii
(d)	iv	i	ii	iii

79. Iron carbonyl, $[Fe(CO)_5]$ is
    (a) Tetranuclear
    (b) Mononuclear
    (c) Dinuclear
    (d) Trinuclear

80. The compound C_7H_8 undergoes the following reactions:

    $$C_7H_8 \xrightarrow{3Cl_2/\Delta} A \xrightarrow{Br_2/Fe} B \xrightarrow{Zn/HCl} C$$
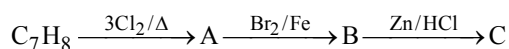
    The product 'C' is
    (a) *m*-bromotoluene
    (b) *o*-bromotoluene
    (c) *p*-bromotoluene
    (d) 3-bromo-2,4,6-trichlorotoluene

81. The compound A on treatment with Na gives B, and with PCl_5 gives C. B and C react together to give diethyl ether. A, B and C are in the order
    (a) C_2H_5OH, C_2H_6, C_2H_5Cl
    (b) C_2H_5OH, C_2H_5Cl, C_2H_5ONa
    (c) C_2H_5OH, C_2H_5ONa, C_2H_5Cl
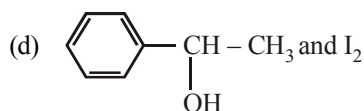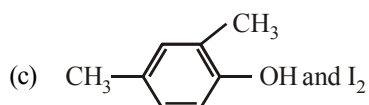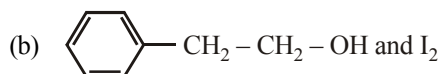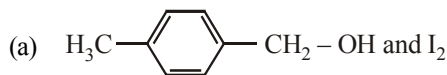   (d) C_2H_5Cl, C_2H_6, C_2H_5OH

82. In the reaction

     + $CHCl_3$ + NaOH $\longrightarrow$
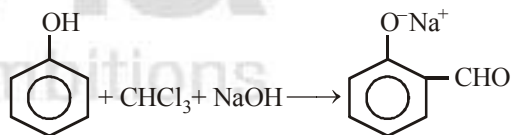
    The electrophile involved is
    (a) Dichloromethyl cation $\left(\overset{\oplus}{C}HCl_2\right)$
    (b) Formyl cation $\left(\overset{\oplus}{C}HO\right)$
    (c) Dichlorocarbene $(:CCl_2)$
    (d) Dichloromethyl anion $\left(\overset{\ominus}{C}HCl_2\right)$

83. Compound A, $C_8H_{10}O$, is found to react with NaOI (produced by reacting Y with NaOH) and yields a yellow precipitate with characteristic smell.

    A and Y are respectively

    (a) H$_3$C—⟨benzene⟩—CH$_2$ – OH and I$_2$

    (b) ⟨benzene⟩—CH$_2$ – CH$_2$ – OH and I$_2$

    (c) CH$_3$—⟨benzene with CH$_3$⟩—OH and I$_2$

    (d) ⟨benzene⟩—CH – CH$_3$ and I$_2$
         |
         OH

84. Identify the major products P, Q and R in the following sequence of reactions:

    ⟨benzene⟩ + CH$_3$CH$_2$CH$_2$Cl $\xrightarrow[\text{AlCl}_3]{\text{Anhydrous}}$

    $P \xrightarrow[\text{(ii) H}_3\text{O}^+/\Delta]{\text{(i) O}_2} Q + R$

	P	**Q**	**R**

    (a) ⟨benzene⟩CH$_2$CH$_2$CH$_3$, ⟨benzene⟩CHO , CH$_3$CH$_2$–OH

    (b) ⟨benzene⟩CH$_2$CH$_2$CH$_3$, ⟨benzene⟩CHO , ⟨benzene⟩COOH

    (c) ⟨benzene⟩CH(CH$_3$)$_2$, ⟨benzene⟩OH , CH$_3$ – CO – CH$_3$
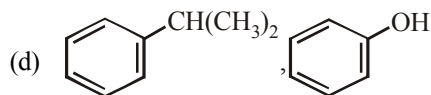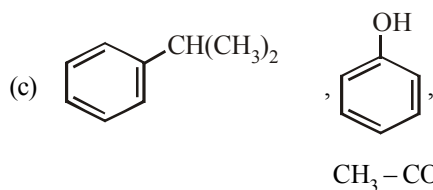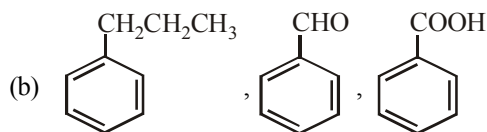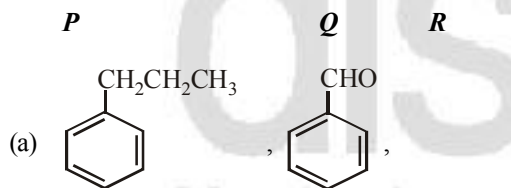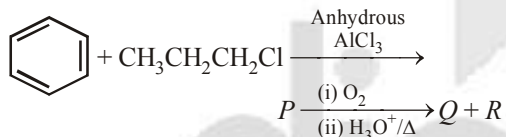
85. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their
    (a) Formation of intramolecular H-bonding
    (b) Formation of carboxylate ion
    (c) Formation of intermolecular H-bonding
    (d) More extensive association of carboxylic acid via van der Waals force of attraction

86. Nitration of aniline in strong acidic medium also gives m-nitroaniline because
    (a) Inspite of substituents nitro group always goes to only m-position.
    (b) In electrophilic substitution reactions, amino group is meta directive.
    (c) In acidic (strong) medium aniline is present as anilinium ion.
    (d) In absence of substituents, nitro group always goes to m-position.

87. Which of the following compounds can form a zwitterion?
    (a) Aniline   (b) Acetanilide
    (c) Glycine   (d) Benzoic acid

88. Regarding cross-linked or network polymers, which of the following statements is incorrect?
    (a) They contain covalent bonds between various linear polymer chains.
    (b) They are formed from bi- and tri-functional monomers.
    (c) They contain strong covalents bonds in their polymer chains.
    (d) Examples are bakelite and melamine.

89. The difference between amylose and amylopectin is
    (a) Amylopectin has $1 \to 4$ α-linkage and $1 \to 6$ α-linkage
    (b) Amylose has $1 \to 4$ α-linkage and $1 \to 6$ β-linkage
    (c) Amylose is made up of glucose and galactose
    (d) Amylopectin has $1 \to 4$ α-linkage and $1 \to 6$ β-linkage

90. Which of the following oxides is most acidic in nature?
    (a) MgO (b) BeO (c) CaO (d) BaO

(d) ⟨benzene⟩CH(CH$_3$)$_2$, ⟨benzene⟩OH , CH$_3$CH(OH)CH$_3$

BIOLOGY

91. Which of the following has proved helpful in preserving pollen as fossils?
    (a) Pollenkitt
    (b) Cellulosic intine
    (c) Sporopollenin
    (d) Oil content

92. Which among the following is not a prokaryote?
    (a) *Saccharomyces*
    (b) *Mycobacterium*
    (c) *Oscillatoria*
    (d) *Nostoc*

93. Which of the following organisms are known as chief producers in the oceans?
    (a) Dinoflagellates
    (b) Diatoms
    (c) Euglenoids
    (d) Cyanobacteria

94. Ciliates differ from all other protozoans in
    (a) using flagella for locomotion
    (b) having a contractile vacuole for removing excess water
    (c) having two types of nuclei
    (d) using pseudopodia for capturing prey

95. Which one is wrongly matched?
    (a) Uniflagellate gametes – *Polysiphonia*
    (b) Biflagellate zoospores – Brown algae
    (c) Unicellular organism – *Chlorella*
    (d) Gemma cups – *Marchantia*

96. After karyogamy followed by meiosis, spores are produced exogenously in
    (a) *Neurospora*
    (b) *Alternaria*
    (c) *Saccharomyces*
    (d) *Agaricus*

97. Select the wrong statement :
    (a) Cell wall is present in members of Fungi and Plantae
    (b) Mushrooms belong to Basidiomycetes
    (c) Mitochondria are the powerhouse of the cell in all kingdoms except Monera
    (d) Pseudopodia are locomotory and feeding structures in Sporozoans

98. Which of the following animals does not undergo metamorphosis?
    (a) Earthworm
    (b) Tunicate
    (c) Starfish
    (d) Moth

99. Pneumatophores occur in
    (a) Halophytes
    (b) Free-floating hydrophytes
    (c) Submerged hydrophytes
    (d) Carnivorous plants

100. Winged pollen grains are present in
    (a) Mustard
    (b) *Cycas*
    (c) *Pinus*
    (d) Mango

101. Casparian strips occur in
    (a) Epidermis
    (b) Pericycle
    (c) Endodermis
    (d) Cortex

102. Secondary xylem and phloem in dicot stem are produced by
    (a) Apical meristems
    (b) Vascular cambium
    (c) Axillary meristems
    (d) Phellogen

103. Plants having little or no secondary growth are
    (a) Grasses
    (b) Deciduous angiosperms
    (c) Cycads
    (d) Conifers

104. The two functional groups characteristic of sugars are
    (a) Hydroxyl and methyl
    (b) Carbonyl and methyl
    (c) Carbonyl and hydroxyl
    (d) Carbonyl and phosphate

105. The stage during which separation of the paired homologous chromosomes begins is
    (a) Pachytene
    (b) Diplotene
    (c) Zygotene
    (d) Diakinesis

106. Stomatal movement is not affected by
    (a) Temperature
    (b) Light
    (c) CO_2 concentration
    (d) O_2 concentration

107. Stomata in grass leaf are
    (a) Dumb-bell shaped
    (b) Kidney shaped
    (c) Barrel shaped
    (d) Rectangular

108. In which of the following forms is iron absorbed by plants?
    (a) Ferric
    (b) Ferrous
    (c) Both ferric and ferrous
    (d) Free element

109. Which of the following elements is responsible for maintaining turgor in cells?
    (a) Magnesium   (b) Sodium
    (c) Calcium   (d) Potassium

110. Oxygen is not produced during photosynthesis by
    (a) Green sulphur bacteria
    (b) *Nostoc*
    (c) *Chara*
    (d) *Cycas*

111. Which of the following is not a product of light reaction of photosynthesis?
    (a) ATP   (b) NADH
    (c) Oxygen   (d) NADPH

112. Which of these statements is incorrect?
    (a) Enzymes of TCA cycle are present in mitochondrial matrix
    (b) Glycolysis occurs in cytosol
    (c) Oxidative phosphorylation takes place in outer mitochondrial membrane
    (d) Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms

113. What is the role of NAD^+ in cellular respiration?
    (a) It functions as an enzyme.
    (b) It functions as an electron carrier.
    (c) It is the final electron acceptor for anaerobic respiration.
    (d) It is a nucleotide source for ATP synthesis.

114. Which of the following terms describe human dentition?
    (a) Thecodont, Diphyodont, Homodont
    (b) Thecodont, Diphyodont, Heterodont
    (c) Pleurodont, Diphyodont, Heterodont
    (d) Pleurodont, Monophyodont, Homodont

115. Match the items given in Column I with those in Column II and select the correct option given below:

	Column I		Column II
A.	Tidal volume	i.	2500 – 3000 mL
B.	Inspiratory Reserve volume	ii.	1100 – 1200 mL
C.	Expiratory Reserve volume	iii.	500 – 550 mL
D.	Residual volume	iv.	1000 – 1100 mL

	A	B	C	D
(a)	iii	ii	i	iv
(b)	iii	i	iv	ii
(c)	iv	iii	ii	i
(d)	i	iv	ii	iii

116. Which part of poppy plant is used to obtain the drug "Smack"?
    (a) Flowers   (b) Latex
    (c) Leaves   (d) Roots

117. Which of the following is an occupational respiratory disorder?
    (a) Anthracis   (b) Silicosis
    (c) Emphysema   (d) Botulism

118. Match the items given in Column I with those in Column II and select the correct option given below:

	Column I		Column II
A.	Fibrinogen	(i)	Osmotic balance
B.	Globulin	(ii)	Blood clotting
C.	Albumin	(iii)	Defence mechanism

	A	B	C
(a)	(iii)	(ii)	(i)
(b)	(i)	(ii)	(iii)
(c)	(ii)	(iii)	(i)
(d)	(i)	(iii)	(ii)

119. Match the items given in Column I with those in Column II and select the correct option given below:

	Column I		Column II
A.	Tricuspid valve	i.	Between left atrium and left ventricle
B.	Bicuspid valve	ii.	Between right ventricle and pulmonary artery
C.	Semilunar valve	iii.	Between right atrium and right ventricle

	A	B	C
(a)	iii	i	ii
(b)	i	iii	ii
(c)	ii	i	iii
(d)	i	ii	iii

120. Match the items given in Column I with those in Column II and select the correct option given below:

	Column I		Column II
A.	Glycosuria	i.	Accumulation of uric acid in joints
B.	Gout	ii.	Mass of crystallised salts within the kidney
C.	Renal calculi	iii.	Inflammation in glomeruli
D.	Glomerular nephritis	iv.	Presence of in glucose urine

	A	B	C	D
(a)	iii	ii	iv	i
(b)	i	ii	iii	iv
(c)	iv	i	ii	iii
(d)	ii	iii	i	iv

121. Calcium is important in skeletal muscle contraction because it
    (a) Binds to troponin to remove the masking of active sites on actin for myosin.
    (b) Activates the myosin ATPase by binding to it.
    (c) Prevents the formation of bonds between the myosin cross bridges and the actin filament.
    (d) Detaches the myosin head from the actin filament.

122. Which of the following is not an autoimmune disease?
    (a) Psoriasis   (b) Rheumatoid arthritis
    (c) Vitiligo   (d) Alzheimer's disease

123. Which of the following hormones can play a significant role in osteoporosis?
    (a) Aldosterone and Prolactin
    (b) Progesterone and Aldosterone
    (c) Parathyroid hormone and Prolactin
    (d) Estrogen and Parathyroid hormone

124. Which of the following structures or regions is incorrectly paired with its functions?
    (a) Medulla oblongata : controls respiration and cardiovascular reflexes.
    (b) Limbic system : consists of fibre tracts that interconnect different regions of brain; controls movement.
    (c) Corpus callosum : band of fibers connecting left and right cerebral hemispheres.
    (d) Hypothalamus : production of releasing hormones and regulation of temperature, hunger and thirst.

125. Nissl bodies are mainly composed of
    (a) Proteins and lipids
    (b) DNA and RNA
    (c) Free ribosomes and RER
    (d) Nucleic acids and SER

126. The transparent lens in the human eye is held in its place by
    (a) ligaments attached to the ciliary body
    (b) ligaments attached to the iris
    (c) smooth muscles attached to the ciliary body
    (d) smooth muscles attached to the iris

127. Which of the following is an amino acid derived hormone?
    (a) Epinephrine   (b) Ecdysone
    (c) Estriol   (d) Estradiol

128. Offsets are produced by
    (a) Meiotic divisions (b) Mitotic divisions
    (c) Parthenogenesis   (d) Parthenocarpy

129. Which of the following flowers blooms only once in its life-time?
    (a) Bamboo species   (b) Jackfruit
    (c) Papaya   (d) Mango

130. Pollen grains can be stored for several years in liquid nitrogen having a temperature of
    (a) $-120°C$ (b) $-80°C$
    (c) $-160°C$ (d) $-196°C$

131. Double fertilization is
    (a) Fusion of two male gametes of a pollen tube with two different eggs
    (b) Fusion of one male gamete with two polar nuclei
    (c) Syngamy and triple fusion
    (d) Fusion of two male gametes with one egg

132. The difference between spermiogenesis and spermiation is
    (a) In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.
    (b) In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
    (c) In spermiogenesis spermatozoa are formed, while in spermiation spermatozoa are released from sertoli cells into the cavity of seminiferous tubules.
    (d) In spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.

133. Match the items given in Column I with those in Column II and select the correct option given below:

Column I	Column II
A. Proliferative Phase	i. Breakdown of endometrial lining
B. Secretory Phase	ii. Follicular Phase
C. Menstruation	iii. Luteal Phase

	A	B	C
(a)	iii	ii	i
(b)	i	iii	ii
(c)	iii	i	ii
(d)	ii	iii	i

134. The amnion of mammalian embryo is derived from
    (a) ectoderm and mesoderm
    (b) endoderm and mesoderm
    (c) ectoderm and endoderm
    (d) mesoderm and trophoblast

135. Hormones secreted by the placenta to maintain pregnancy are
    (a) hCG, hPL, progestogens, prolactin
    (b) hCG, hPL, estrogens, relaxin, oxytocin
    (c) hCG, progestogens, estrogens, glucocorticoids
    (d) hCG, hPL, progestogens, estrogens

136. The contraceptive 'SAHELI'
    (a) blocks estrogen receptors in the uterus, preventing eggs from getting implanted.
    (b) increases the concentration of estrogen and prevents ovulation in females.
    (c) is a post-coital contraceptive.
    (d) is an IUD.

137. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by
    (a) Only daughters
    (b) Only sons
    (c) Both sons and daughters
    (d) Only grandchildren

138. Which of the following characteristics represent 'Inheritance of blood groups' in humans?
    A. Dominance
    B. Co-dominance
    C. Multiple allele
    D. Incomplete dominance
    E. Polygenic inheritance
    (a) B, C and E   (b) A, B and C
    (c) A, C and E   (d) B, D and E

139. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA?
    (a) AGGUAUCGCAU   (b) UGGTUTCGCAT
    (c) UCCAUAGCGUA   (d) ACCUAUGCGAU

140. Select the correct match
    (a) Alec Jeffreys - *Streptococcus pneumoniae*
    (b) Alfred Hershey and - TMV Martha Chase
    (c) Francois Jacob and - Lac operon Jacques Monod
    (d) Matthew Meselson - *Pisum sativum* and F. Stahl

141. The experimental proof for semiconservative replication of DNA was first shown in a
    (a) Fungus   (b) Bacterium
    (c) Virus   (d) Plant

142. All of the following are part of an operon except
    (a) an operator   (b) structural genes
    (c) a promoter   (d) an enhancer

143. According to Hugo de Vries, the mechanism of evolution is
    (a) Multiple step mutations
    (b) Saltation
    (c) Minor mutations
    (d) Phenotypic variations

144. Among the following sets of examples for divergent evolution, select the incorrect option :
    (a) Forelimbs of man, bat and cheetah
    (b) Heart of bat, man and cheetah
    (c) Eye of octopus, bat and man
    (d) Brain of bat, man and cheetah

145. The similarity of bone structure in the forelimbs of many vertebrates is an example of
    (a) Homology
    (b) Analogy
    (c) Adaptive radiation
    (d) Convergent evolution

146. In which disease does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels?
    (a) Elephantiasis (b) Ascariasis
    (c) Amoebiasis   (d) Ringworm disease

147. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes?
    (a) Retrovirus   (b) Ti plasmid
    (c) pBR 322   (d) □ phage

148. The correct order of steps in Polymerase Chain Reaction (PCR) is
    (a) Extension, Denaturation, Annealing
    (b) Annealing, Extension, Denaturation
    (c) Denaturation, Annealing, Extension
    (d) Denaturation, Extension, Annealing

149. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called
    (a) Bio-infringement (b) Biopiracy
    (c) Bioexploitation   (d) Biodegradation

150. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is
    (a) Indian Council of Medical Research (ICMR)
    (b) Council for Scientific and Industrial Research (CSIR)
    (c) Genetic Engineering Appraisal Committee (GEAC)
    (d) Research Committee on Genetic Manipulation (RCGM)

151. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to
    (a) Co-667
    (b) Sharbati Sonora
    (c) Basmati
    (d) Lerma Rojo

152. Which one of these animals is not a homeotherm?
    (a) *Macropus*
    (b) *Chelone*
    (c) *Psittacula*
    (d) *Camelus*

153. Match Column-I with Column-II.

Column-I		Column-II
(A) Saprophyte	(i)	Symbiotic association of fungi with plant roots
(B) Parasite	(ii)	Decomposition of dead organic materials
(C) Lichens	(iii)	Living on living plants or animals
(D) Mycorrhiza	(iv)	Symbiotic association of algae and fungi

Choose the correct answer from the options given below:

	(A)	(B)	(C)	(D)
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(ii)	(i)	(iii)	(iv)
(d)	(ii)	(iii)	(iv)	(i)

154. In a growing population of a country,
    (a) pre-reproductive individuals are more than the reproductive individuals.
    (b) reproductive individuals are less than the post-reproductive individuals.
    (c) pre-reproductive individuals are less than the reproductive individuals.
    (d) reproductive and pre-reproductive individuals are equal in number.

155. Which one of the following population interactions is widely used in medical science for the production of antibiotics?
    (a) Commensalism
    (b) Mutualism
    (c) Amensalism
    (d) Parasitism

156. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other?
    (a) *Hydrilla*
    (b) *Yucca*
    (c) *Viola*
    (d) Banana

157. World Ozone Day is celebrated on
    (a) 5th June
    (b) 21st April
    (c) 22nd April
    (d) 16th September

158. Niche is
    (a) all the biological factors in the organism's environment
    (b) the physical space where an organism lives
    (c) the functional role played by the organism where it lives
    (d) the range of temperature that the organism needs to live

159. What type of ecological pyramid would be obtained with the following data?
    Secondary consumer : 120 g
    Primary consumer : 60 g
    Primary producer : 10 g
    (a) Inverted pyramid of biomass
    (b) Pyramid of energy
    (c) Upright pyramid of biomass
    (d) Upright pyramid of numbers

160. All of the following are included in 'ex-situ conservation' except
    (a) Wildlife safari parks
    (b) Sacred groves
    (c) Seed banks
    (d) Botanical gardens

161. Which of the following is a secondary pollutant?
    (a) CO
    (b) CO_2
    (c) O_2
    (d) SO_2

162. Match the items given in Column I with those in Column II and select the correct option given below :

Column-I		Column-II
A. Eutrophication	i.	UV-B radiation
B. Sanitary landfill	ii.	Deforestation
C. Snow blindness	iii.	Nutrient enrichment
D. Jhum cultivation	iv.	Waste disposal

	A	B	C	D
(a)	ii	i	iii	iv
(b)	i	iii	iv	ii
(c)	i	ii	iv	iii
(d)	iii	iv	i	ii

163. In stratosphere, which of the following elements acts as a catalyst in degradation of ozone and release of molecular oxygen?   *[2018[*
    (a) Carbon
    (b) Cl
    (c) Oxygen
    (d) Fe

164. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively?
    (a) Inflammation of bronchioles; Decreased respiratory surface
    (b) Increased number of bronchioles; Increased respiratory surface
    (c) Decreased respiratory surface; Inflammation of bronchioles
    (d) Increased respiratory surface; Inflammation of bronchioles

165. Select the incorrect match :
    (a) Lampbrush chromosomes – Diplotene bivalents
    (b) Allosomes – Sex chromosomes
    (c) Polytene chromosomes – Oocytes of amphibians
    (d) Submetacentric chromosomes – L-shaped chromosomes

166. Which of the following events does not occur in rough endoplasmic reticulum?
    (a) Protein folding
    (b) Protein glycosylation
    (c) Phospholipid synthesis
    (d) Cleavage of signal peptide

167. Many ribosomes may associate with a single mRNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as
    (a) Polysome   (b) Polyhedral bodies
    (c) Nucleosome   (d) Plastidome

168. Identify the vertebrate group of animals characterized by crop and gizzard in its digestive system
    (a) Amphibia   (b) Reptilia
    (c) Osteichthyes (d) Aves

169. Which of the following features is used to identify a male cockroach from a female cockroach?
    (a) Presence of a boat shaped sternum on the 9th abdominal segment
    (b) Presence of caudal styles
    (c) Presence of anal cerci
    (d) Forewings with darker tegmina

170. Match the items given in Column I with those in Column II and select the correct option given below:

	Column I (Function)		Column II (Part of Excretory system)
A.	Ultrafiltration	i.	Henle's loop
B.	Concentration of urine	ii.	Ureter
C.	Transport of urine	iii.	Urinary bladder
D.	Storage of urine	iv.	Malpighian corpuscle
		v.	Proximal convoluted tubule

	A	B	C	D
(a)	iv	v	ii	iii
(b)	iv	i	ii	iii
(c)	v	iv	i	iii
(d)	v	iv	i	ii

171. The Golgi complex participates in
    (a) Fatty acid breakdown
    (b) Formation of secretory vesicles
    (c) Activation of amino acid
    (d) Respiration in bacteria

172. Which of the following is true for nucleolus?
    (a) Larger nucleoli are present in dividing cells
    (b) It is a membrane-bound structure
    (c) It is a site for active ribosomal RNA synthesis
    (d) It takes part in spindle formation

173. Select the correct match
    (a) Ribozyme - Nucleic acid
    (b) F_2 × Recessive parent - Dihybrid cross
    (c) G. Mendel - Transformation
    (d) T.H. Morgan - Transduction

174. Which of the following pairs is wrongly matched?
    (a) Starch synthesis in pea : Multiple alleles
    (b) ABO blood grouping : Co-dominance
    (c) T.H. Morgan : Linkage
    (d) XO type sex determination : Grasshopper

175. Natality refers to
    (a) Death rate
    (b) Birth rate
    (c) Number of individuals entering a habitat
    (d) Number of individuals leaving the habitat

176. Match the items given in Column I with those in Column II and select the correct option given below:

Column I		Column II
A. Herbarium	(i)	It is a place having a collection of preserved plants and animals
B. Key	(ii)	A list that enumerates methodically all the species found in an area with brief description aiding identification
C. Museum	(iii)	Is a place where dried and pressed plant specimens mounted on sheets are kept
D. Catalogue	(iv)	A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.

	A	B	C	D
(a)	(i)	(iv)	(iii)	(ii)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(ii)	(iv)	(iii)	(i)

177. Which of the following statements is correct?
    (a) Ovules are not enclosed by ovary wall in gymnosperms
    (b) Selaginella is heterosporous, while Salvinia is homosporous
    (c) Stems are usually unbranched in both Cycas and Cedrus
    (d) Horsetails are gymnosperms

178. Sweet potato is a modified
    (a) Stem
    (b) Adventitious root
    (c) Rhizome
    (d) Tap root

179. Conversion of milk to curd improves its nutritional value by increasing the amount of
    (a) Vitamin D
    (b) Vitamin A
    (c) Vitamin E
    (d) Vitamin B12

180. Which of the following gastric cells indirectly help in erythropoiesis?
    (a) Chief cells
    (b) Mucous cells
    (c) Parietal cells
    (d) Goblet cells

HINTS & SOLUTIONS

PHYSICS

1. (c) Diameter of the ball
= MSR + CSR × (ℓeast count) – zero error
= 0.5 cm + 25 × 0.001 – (–0.004)
= 0.5 + 0.025 + 0.004 = 0.529 cm

2. (c) Moment of force, $\vec{\tau} = \vec{r} \times \vec{F}$
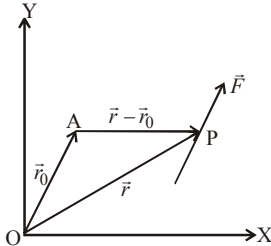
$\vec{\tau} = (\vec{r} - \vec{r}_0) \times \vec{F}$

$\vec{r} - \vec{r}_0 = (2\hat{i} + 0\hat{j} - 3\hat{k}) - (2\hat{i} - 2\hat{j} - 2\hat{k})$
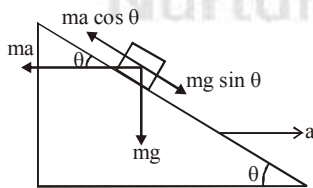$= 0\hat{i} + 2\hat{j} - \hat{k}$

$\vec{\tau} = (0\hat{i} + 2\hat{j} - \hat{k})(4\hat{i} + 5\hat{j} - 6\hat{k})$

$\vec{\tau} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 2 & -1 \\ 4 & 5 & -6 \end{vmatrix} = -7\hat{i} - 4\hat{j} - 8\hat{k}$

3. (c) Coefficient of friction or sliding friction has no dimension.

$f = \mu_s N \Rightarrow \mu_s = \dfrac{f}{N} = [M^0 L^0 T^0]$

4. (c) Let the mass of block is m. It will remains stationary if forces acting on it are in equilibrium.
i.e., ma cos θ = mg sin θ ⇒ a = g tan θ

Here ma = Pseudo force on block, mg = weight.

5. (b)

According to law of conservation of linear momentum,

$mv + 4m \times 0 = 4 mv' + 0 \Rightarrow v' = \dfrac{v}{4}$

Coefficient of restitution,

$e = \dfrac{\text{Relative velocity of separation}}{\text{Relative velocity of approach}}$

$= \dfrac{\dfrac{v}{4}}{v}$

or, $e = \dfrac{1}{4} = 0.25$

6. (c) Angular momentum, remains conserved until the torque acting on sphere remains zero.
$\tau_{ex} = 0$

So, $\dfrac{dL}{dt} = 0$

i.e., angular momentum L = constant.

> **NOTES** Angular momentum plays the same role in rotatory motion as the linear momentum does in translatory motion.

7. (b) In rolling motion, rotational kinetic energy.

$K_t = \dfrac{1}{2} mv^2$

And, $K_t + K_r = \dfrac{1}{2} mv^2 + \dfrac{1}{2} I\omega^2$

$= \dfrac{1}{2} mv^2 + \dfrac{1}{2}\left(\dfrac{2}{5} mr^2\right)\left(\dfrac{v}{r}\right)^2 = \dfrac{7}{10} mv^2$

$\therefore \dfrac{K_t}{K_t + K_r} = \dfrac{\dfrac{1}{2} mv^2}{\dfrac{7}{10} mv^2} = \dfrac{5}{7}$

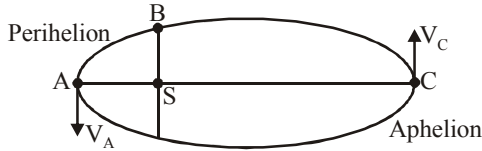8. (a) Work done required to bring them rest
ΔW = ΔKE (work-energy theorem)

$\Delta W = \dfrac{1}{2} I\omega^2 \left(\Delta kE_{rot} = \dfrac{1}{2} I\omega^2\right)$

or, $\Delta W \propto I$ (for same ω)

$I_{\text{solid sphere}} = \dfrac{2}{5} MR^2$, $I_{\text{Disk}} = \dfrac{1}{2} MR^2$

$I_{\text{Ring}} = MR^2 \quad \therefore W_C > W_B > W_A$

9. (b) Speed of the planet will be maximum when its distance from the sun is minimum as $mvr =$ constant.

Point A is perihelion and C is aphelion.

Clearly, $V_A > V_B > V_C$

So, $K_A > K_B > K_C$

10. (a) Wire 1:

$$\Delta\ell = \left(\frac{F}{AY}\right)3\ell \qquad ...(i)$$

Wire 2:

$$\Delta\ell = \left(\frac{F'}{3AY}\right)\ell \qquad ...(ii)$$

From equation (i) & (ii),

$$\Delta\ell = \left(\frac{F}{AY}\right)3\ell = \left(\frac{F'}{3AY}\right)\ell \text{ or, } F' = 9\,F$$

11. (d) Power = rate of production of heat = F.V

$= 6\pi\eta r V_T \cdot V_T = 6\pi\eta r V_T{}^2$

$(\because F = 6\pi\eta V_T\, r \text{ stoke's formula})$

$V_T \propto r^2$

$\because \quad V_T = \frac{2}{9}\frac{r^2(\rho-\sigma)}{\eta}g$

$\therefore \quad$ Power $\propto r^5$

12. (d) From Wien's law

$\lambda_{max}\, T = $ constant

i.e., $\lambda_{max_1}\, T_1 = \lambda_{max_2}\, T_2$

$\Rightarrow \quad \lambda_0\, T = \frac{3\lambda_0}{4}T'$

$\Rightarrow \quad T' = \frac{4}{3}T$

Power radiated $P \propto T^4$

So, $\dfrac{P_2}{P_1} = n = \left(\dfrac{T'}{T}\right)^4 = \left(\dfrac{4}{3}\right)^4 = \dfrac{256}{81}$

13. (a) Gas is monatomic, so $C_p = \dfrac{5}{2}R$

Given process is isobaric

$\therefore \quad dQ = n\, C_p\, dT$

$\Rightarrow \quad dQ = n\left(\dfrac{5}{2}R\right)dT$

$dW = P\, dV = n\, RdT$

$\therefore \quad$ Required ratio $= \dfrac{dW}{dQ} = \dfrac{nRdT}{n\left(\dfrac{5}{2}R\right)dT} = \dfrac{2}{5}$

14. (a) Efficiency of ideal heat engine, $\eta = \left(1 - \dfrac{T_2}{T_1}\right)$

Sink temperature, $T_2 = 100°C = 100 + 273 = 373\,K$

Source temperature, $T_1 = 0°C = 0 + 273 = 273\,K$

Percentage efficiency, $\%\eta = \left(1 - \dfrac{T_2}{T_1}\right) \times 100$

$= \left(1 - \dfrac{273}{373}\right) \times 100 = \left(\dfrac{100}{373}\right) \times 100 = 26.8\%$

15. (b) Let at temperature T rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere

$V_{escape} = 11200\,m/s$

Also, $V_{rms} = V_{escape} = \sqrt{\dfrac{3k_B T}{m_{O_2}}} = 11200\,m/s$

Putting value of K_B and m_{O_2} we get,

$T = 8.360 \times 10^4\,K$

16. (b) From question, acceleration, $a = 20\,m/s^2$, and displacement, $y = 5m$

$|a| = \omega^2 y$

$\Rightarrow 20 = \omega^2(5)$

$\Rightarrow \omega = 2\,rad/s$

Time period of pendulum,

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{2} = \pi\,s$$

17. (b) Two successive resonance are produced at 20 cm and 73 cm of column length

$\therefore \quad \dfrac{\lambda}{2} = (73 - 20) \times 10^{-2}\,m$

$\Rightarrow \lambda = 2 \times (73 - 20) \times 10^{-2}$

Velocity of sound, $v = n\lambda$

$= 2 \times 320\,[73 - 20] \times 10^{-2}$

$= 339.2\,ms^{-1}$

18. (a) For closed organ pipe, third harmonic

$$n = \frac{(2N-1)V}{4\ell} = \frac{3V}{4\ell} \;(\because N = 2)$$

For open organ pipe, fundamental frequenty

$$n = \frac{NV}{2\ell} = \frac{V}{2\ell'} \;(\because N = 1)$$

According to question, $\dfrac{3V}{4\ell} = \dfrac{V}{2\ell'}$

$$\Rightarrow \quad \ell' = \frac{4\ell}{3 \times 2} = \frac{2\ell}{3} = \frac{2 \times 20}{3} = 13.33 \text{ cm}$$
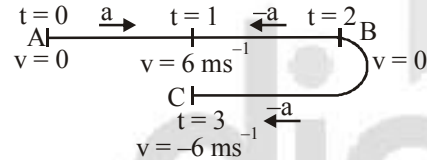
19. (a) As we know, $F = qE = ma$

$$\Rightarrow \quad a = \frac{qE}{m}$$

$$h = \frac{1}{2}\frac{qE}{m}t^2$$

$$\therefore \quad t = \sqrt{\frac{2hm}{qE}}$$

i.e., time $t \propto \sqrt{m}$ as 'q' is same for electron and proton.

Since, electron has smaller mass so it will take smaller time.

20. (b)

Acceleration, $a = \dfrac{v-u}{t} = \dfrac{6-0}{1}$

$\qquad = 6\ \text{ms}^{-2}$

For $t = 0$ to $t = 1$ s,

$S_1 = \dfrac{1}{2} \times 6(1)^2 = 3\ \text{m} \qquad ...(i)$

For $t = 1$ s = to $t = 2$ s,

$S_2 = 6.1 - \dfrac{1}{2} \times 6(1)^2 = 3\text{m} \quad ...(ii)$

For $t = 2$ s to $t = 3$ s,

$S_3 = 0 - \dfrac{1}{2} \times 6(1)^2 = -3\ \text{m} \quad (iii)$

Total displacement $S = S_1 + S_2 + S_3 = 3$ m

Average velocity $= \dfrac{3}{3} = 1\ \text{ms}^{-1}$

Total distance travelled $= 9$ m

Average speed $= \dfrac{9}{3} = 3\ \text{ms}^{-1}$

21. (a) Electrostatic force between the metal plates

$$F_{\text{plate}} = \frac{Q^2}{2A\varepsilon_0}$$

For isolated capacitor Q = constant
Clearly, F is independent of the distance between plates.

22. (b) Colour code for carbon resistor

0	Black		
1	Brown	Tolerance :	± 5% Gold
2	Red		± 10% Silver
3	Orange		± 20% No colour
4	Yellow		
5	Green		
6	Blue		
7	Violet		
8	Grey		
9	White		

$(47 \pm 4.7)\ \text{k}\Omega = 47 \times 10^3 \pm 10\%$

$\therefore$ Yellow - Violet - Orange - Silver

23. (a) In series grouping equivalent resistance

$R_{\text{series}} = nR$

In parallel grouping equivalent resistance

$$R_{\text{parallel}} = \frac{R}{n}$$

$$I = \frac{E}{nR + R} \qquad ...(i)$$

$$10\ I = \frac{E}{\dfrac{R}{n} + R} \qquad ...(ii)$$

Dividing eq. (ii) by (i),
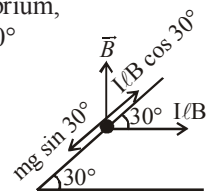
$$10 = \frac{(n+1)R}{\left(\dfrac{1}{n}+1\right)R}$$

Solving we get, n = 10

24. (c) From figure, for equilibrium,
$mg \sin 30° = I\ell B \cos 30°$

$$\Rightarrow \quad I = \frac{mg}{\ell B} \tan 30°$$

$$= \frac{0.5 \times 9.8}{0.25 \times \sqrt{3}} = 11.32\ \text{A}$$

25. (d) Current sensitivity of moving coil galvanometer

$$I_s = \frac{NBA}{C} \qquad ...(i)$$

Voltage sensitivity of moving coil galvanometer,

$$V_s = \frac{NBA}{CR_G} \qquad ...(ii)$$

Dividing eqn. (i) by (ii)
Resistance of galvanometer

$$R_G = \frac{I_s}{V_s} = \frac{5 \times 1}{20 \times 10^{-3}} = \frac{5000}{20} = 250\,\Omega$$

26. (a) Rod gains gravitational potential energy which comes from energy of current source.

27. (c) From question energy stored in inductor,
$U = 25 \times 10^{-3}$ J
Current, $I = 60$ mA

Energy stored in inductor $U = \frac{1}{2}LI^2$

$$25 \times 10^{-3} = \frac{1}{2} \times L \times (60 \times 10^{-3})^2$$

$$L = \frac{25 \times 2 \times 10^6 \times 10^{-3}}{3600} = 13.89\,Hm$$

28. (a) Power dissipated in an LCR series circuit connected to an a.c. source of emf E

$$P = E_{rms}\,i_{rms}\cos\phi = \frac{E_{rms}^2 R}{Z^2} = \frac{E_{rms}^2 R}{R^2 + \left(\omega L - \dfrac{1}{C\omega}\right)^2}$$

$$= \frac{\left(\dfrac{10}{\sqrt{2}}\right)^2 \times 50}{(50)^2 + \left(314 \times 20 \times 10^{-3} - \dfrac{1}{314 \times 100 \times 10^{-6}}\right)^2}$$

Solving we get, $P = 0.79$ W

29. (b) As we know,

$$\vec{E} \times \vec{B} = \vec{V}$$

$$(E\hat{j}) \times (\vec{B}) = V\hat{i}$$

($\because$ Electric field vector is along +y axis)

So, $\vec{B} = B\hat{k}$

i.e., direction of magnetic field vector is along +z direction.

30. (b) For retracing the path, light ray should be normally incident on silvered face.
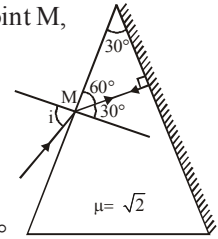$A = r + O \Rightarrow r = 30°$

Applying Snell's law at point M,

$$\frac{\sin i}{\sin 30°} = \frac{\sqrt{2}}{1}$$

$$\Rightarrow \quad \sin i = \sqrt{2} \times \frac{1}{2}$$

or, $\sin i = \dfrac{1}{\sqrt{2}}$ i.e., $i = 45°$

31. (d) For telescope, angular magnification

$$= \frac{f_0}{f_E}$$

So, focal length of objective lens should be large.

Angular resolution $= \dfrac{D}{1.22\lambda}$ So, D should be large.

So, objective lens of refracting telescope should have large focal length (f_0) and large diameter D for larger angular magnification.

32. (b) Angular width $= \dfrac{\lambda}{d}$

So, $0.20° = \dfrac{\lambda}{2\,mm}$

$\Rightarrow \quad \lambda = 0.20° \times 2$

Again, $0.21° = \dfrac{\lambda}{d}$
Now putting the value of λ

$$d = \frac{0.20° \times 2\,mm}{0.21°}$$
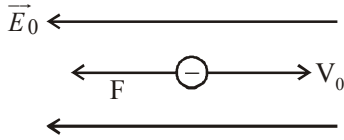
$\therefore \quad d = 1.9\,mm$

33. (b) When reflected light rays and refracted rays are perpendicular, reflected light is polarised with electric field vector perpendicular to the plane of incidence.
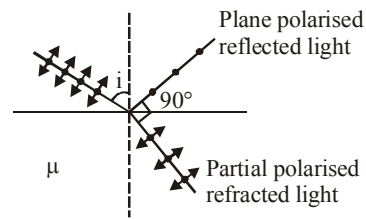
Also, $\tan i = \mu$ (i = Brewester angle)

34. (a) Initial de-Brogile wavelength

$$\lambda_0 = \frac{h}{mV_0} \qquad \ldots(i)$$

$$\overrightarrow{E}_0 \longleftarrow$$

$$\longleftarrow \underset{F}{\bigcirc} \longrightarrow V_0$$

$$\longleftarrow$$

Acceleration of electron

$$a = \frac{eE_0}{m} \qquad (\because F = ma = eE_0)$$

Velocity after time 't'

$$V = \left(V_0 + \frac{eE_0}{m}t\right)$$

So, $\lambda = \dfrac{h}{mV} = \dfrac{h}{m\left(V_0 + \dfrac{eE_0}{m}t\right)}$

$$= \frac{h}{mV_0\left[1 + \dfrac{eE_0}{mV_0}t\right]} = \frac{\lambda_0}{\left[1 + \dfrac{eE_0}{mV_0}t\right]} \quad \ldots(ii)$$

Dividing eqs. (ii) by (i),

de-Broglie wavelength $\lambda = \dfrac{\lambda_0}{\left[1 + \dfrac{eE_0}{mV_0}t\right]}$

35. (b) In a Bohr orbit of the hydrogen atom
    Kinetic energy,

$$k = \frac{kze^2}{2r_n}$$

Total energy, $E = \dfrac{-kze^2}{2r_n}$

So, Kinetic energy : total energy $= 1 : -1$

36. (a) Number of nuclei remaining, $N = 600 - 450$
    $= 150$ after time 't'

$$\frac{N}{N_0} = \frac{150}{600} = \frac{1}{4}$$

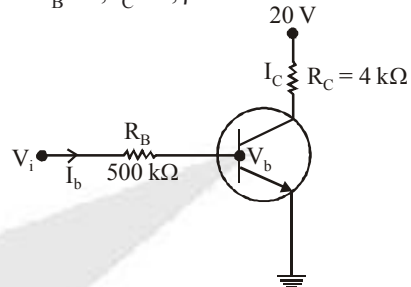$$N = N_0 e^{-\lambda t} \implies \ell n\frac{N_0}{N} = \lambda t$$

$$\implies t = \frac{1}{\lambda} \ell n \frac{N_0}{N}$$

$$\implies t = \frac{2.303 \times T_{\frac{1}{2}}}{0.693} \log_{10} \frac{N_0}{N}$$

$$= \frac{2.303 \times 10}{0.693} \log_{10} 4$$

37. (c) On heating, number of electron-hole pairs increases, so overall resistance of diode will change.
    Hence forward biasing and reversed biasing both are changed.

38. (c) From question, $V_{BE} = = 0$, $V_i = 20\,V$
    $V_{CE} = 0$
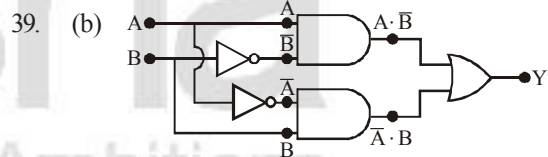 $V_b = 0$ (earthed)
    $I_B = ?$, $I_C = ?$, $\beta = ?$

$$I_C = \frac{(20-0)}{4 \times 10^3} = 5 \times 10^{-3} = 5\,mA$$

$$V_i = V_{BE} + I_B R_B \quad \text{or,} \quad V_i = 0 + I_B R_B$$

$$\implies 20 = I_B \times 500 \times 10^3$$

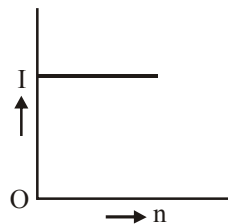$$\implies I_B = \frac{20}{500 \times 10^3} = 40\,\mu A$$

$$\beta = \frac{I_C}{I_b} = \frac{25 \times 10^{-3}}{40 \times 10^{-6}} = 125$$
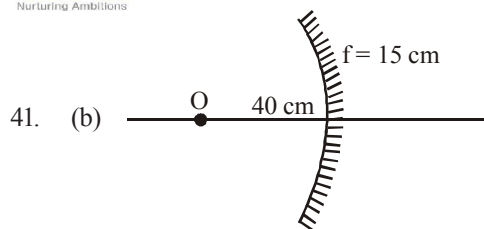
39. (b)

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

40. (a) Short circuited current,

$$I = \frac{n\varepsilon}{nr} = \frac{\varepsilon}{r}$$

So, I is independent of n and I is constant.

41. (b)

using mirror formula, $\dfrac{1}{f} = \dfrac{1}{v_1} + \dfrac{1}{u}$

$-\dfrac{1}{15} = \dfrac{1}{v_1} + \dfrac{1}{u}$ $\Rightarrow$ $\dfrac{1}{v_1} = \dfrac{1}{-15} + \dfrac{1}{40}$

$\therefore$ $v_1 = -24$ cm

When object is displaced by 20 cm towards mirror

Now, $u_2 = -20$

So, $\dfrac{1}{f} = \dfrac{1}{v_2} + \dfrac{1}{u_2}$

$\dfrac{1}{-15} = \dfrac{1}{v_2} - \dfrac{1}{20}$ $\Rightarrow$ $\dfrac{1}{v_2} = \dfrac{1}{20} - \dfrac{1}{15}$

$\therefore$ $v_2 = -60$ cm

Therefore image shifts away from mirror by
= 60 – 24 = 36 cm

42. (a) Using Einstein's photoelectric equation,
$E = W_0 + k_{max}$
When light of frequency, $2\nu_0$ is incident on a metal plate,

$h(2\nu_0) = h\nu_0 + \dfrac{1}{2}mv_1^2$

$h\nu_0 = \dfrac{1}{2}mv_1^2$ ...(i)

when light of frequency, $5\nu_0$ is incident on a metal plate

$h(5\nu_0) = h\nu_0 + \dfrac{1}{2}mv_2^2$

$4h\nu_0 = \dfrac{1}{2}mv_2^2$ ...(ii)

Dividing eqn. (i) by (ii),

$\dfrac{1}{4} = \dfrac{v_1^2}{v_2^2}$

$\therefore$ $\dfrac{v_1}{v_2} = \dfrac{1}{2}$

43. (c) If universal gravitational constant becomes ten times, then $G' = 10\,G$

Acceleration due to gravity, $g = \dfrac{GM}{R^2}$

So, acceleration due to gravity increases.

44. (b) Using first law of thermodynamics equation,
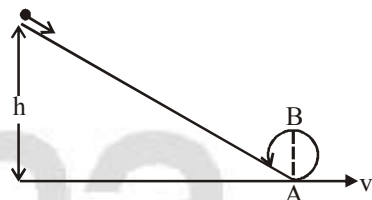
$\Delta Q = \Delta U + \Delta W$

$\Rightarrow$ 54×4.18

$= \Delta U + 1.013 \times 10^5 (167.1 \times 10^{-6} - 0)$

$(\because \Delta W = P\Delta V)$

$\Rightarrow$ $\Delta U = 208.7$ J

45. (c) As track is frictionless, so total mechanical energy will remain constant

i.e., $0 + mgh = \dfrac{1}{2}mv_L^2 + 0$

Using $v^2 - u^2 = 2gh$, $h = \dfrac{v_L^2}{2g}$ $(\because u = 0)$

For completing the vertical circle, $v_L \geq \sqrt{5gR}$

or, $h = \dfrac{5gR}{2g} = \dfrac{5}{2}R = \dfrac{5}{4}D$

CHEMISTRY

46. (a)
(a) Mass of water = $18 \times 1 = 18$ g
Molecules of water = mole $\times N_A$

$= \dfrac{18}{18}N_A = N_A$

(b) Molecules of water = mole $\times N_A$

$= \dfrac{0.18}{18}N_A = 10^{-2}N_A$
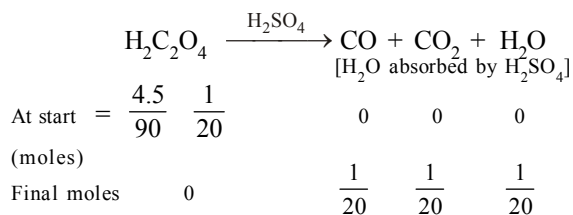
(c) Molecules of water = mole $\times N_A = 10^{-3}N_A$

(d) Moles of water = $\dfrac{0.00224}{22.4} = 10^{-4}$

Molecules of water = mole $\times N_A = 10^{-4}N_A$

47. (d) $HCOOH \xrightarrow[\substack{\text{Dehydrating} \\ \text{agent}}]{H_2SO_4} CO + H_2O$

$$[H_2O \text{ absorbed by } H_2SO_4]$$
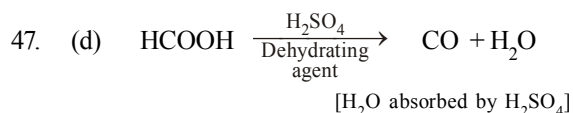
At start $= \dfrac{2.3}{46} \quad \dfrac{1}{20} \qquad\qquad 0 \qquad 0$

(moles)

Final moles $\quad 0 \qquad\qquad \dfrac{1}{20} \quad \dfrac{1}{20}$

$$H_2C_2O_4 \xrightarrow{H_2SO_4} CO + CO_2 + H_2O$$
$$[H_2O \text{ absorbed by } H_2SO_4]$$

At start $= \dfrac{4.5}{90} \quad \dfrac{1}{20} \qquad 0 \qquad 0 \qquad 0$

(moles)

Final moles $\quad 0 \qquad\qquad \dfrac{1}{20} \quad \dfrac{1}{20} \quad \dfrac{1}{20}$
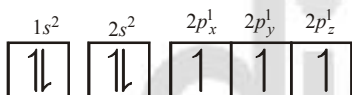
CO_2 is absorbed by KOH.

So, the remaning product is only CO.

Moles of CO formed from both reactions

$$\dfrac{1}{20} \quad \dfrac{1}{20} \quad \dfrac{1}{10}$$
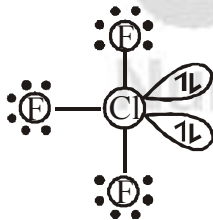
Left mass of CO = moles × molar mass

$$= \dfrac{1}{10} \times 28 \quad 2.8 \text{ g}$$

48. (d) The correct configuration of 'N' is

$1s^2 \qquad 2s^2 \qquad 2p_x^1 \quad 2p_y^1 \quad 2p_z^1$

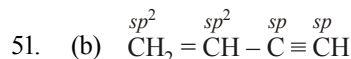$$[\,\uparrow\downarrow\,] \quad [\,\uparrow\downarrow\,] \quad [\,\uparrow\,][\,\uparrow\,][\,\uparrow\,]$$

49. (c) Due to poor shielding effect of 3d electrons in Ga, the atomic radii of Ga < Al. Thus, the correct order of atomic radii is B < Ga < Al < In < Tl.

50. (b) The structure of ClF_3 is

The number of lone pair of electrons on central Cl is 2.

51. (b) $\overset{sp^2}{CH_2} = \overset{sp^2}{CH} - \overset{sp}{C} \equiv \overset{sp}{CH}$

52. (b) $NO : (\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2, (\sigma 2p_z)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2, (\pi^*2p_x)^1 = (\pi^*2p_y)^0$

$B.O. = \dfrac{10-5}{2} = 2.5$

$CN^- : (\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2, (\sigma 2p_z)^2$

$B.O. = \dfrac{10-4}{2} = 3$

$CN : (\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2, (\sigma 2p_z)^1$

$B.O. = \dfrac{9-4}{2} = 2.5$

$CN^+ : (\sigma 1s)^2, (\sigma^*1s)^2, (\sigma 2s)^2, (\sigma^*2s)^2, (\pi 2p_x)^2 = (\pi 2p_y)^2$

$B.O. = \dfrac{8-4}{2} = 2$

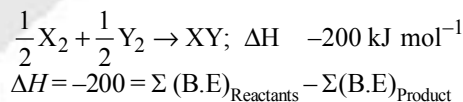Hence, option (b) should be the right answer.

53. (c) In real gas equation,
van der Wall constant $(a) \propto$ forces of attraction.

54. (a) van der Waal constant 'a', signifies intermolecular forces of attraction.
Higher is the value of 'a', easier will be the liquefaction of gas.

55. (d) Let B.E of X_2, Y_2 and XY are x kJ mol^{-1}, $0.5\,x$ kJ mol^{-1} and x kJ mol^{-1} respectively

$$\dfrac{1}{2}X_2 + \dfrac{1}{2}Y_2 \rightarrow XY; \ \Delta H \quad -200 \text{ kJ mol}^{-1}$$

$\Delta H = -200 = \Sigma (B.E)_{Reactants} - \Sigma(B.E)_{Product}$

$$= \left[\dfrac{1}{2} \times (x) + \dfrac{1}{2} \times (0.5x)\right] - [1 \times (x)]$$

On solving, $x = 800$ kJ mol^{-1}

56. (a) $A_2(g) + B_2(g) \rightleftharpoons X_2(g); \Delta H = -X$ kJ
On increasing pressure equilibrium shifts in a direction where number of moles decreases i.e. forward direction.
On decreasing temperature, equilibrium shifts in exothermic direction i.e., forward direction.
So, high pressure and low temperature favours maximum formation of product.

57. (c) Meq. of HCl $= 75 \times \dfrac{1}{5} \times 1 = 15$

Meq. of NaOH $= 25 \times \dfrac{1}{5} \times 1 = 5$

Meq. of HCl in resulting solution = 10

Molarity of $[H^+]$ in resulting mixture $= \dfrac{10}{100} = \dfrac{1}{10}$
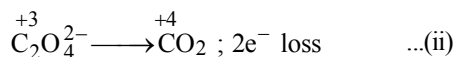
$pH = -\log[H^+] = -\log\left[\dfrac{1}{10}\right] = 1.0$

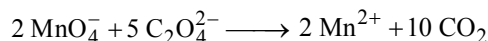58. (a) Solubility of $BaSO_4 = 2.42 \times 10^{-3}$ gL^{-1}

$\therefore \quad s = \dfrac{2.42 \times 10^{-3}}{233} = 1.038 \times 10^{-5}$ mol L^{-1}

$K_{sp} = s^2 = (1.038 \times 10^{-5})^2 = 1.08 \times 10^{-10}$ mol^2 L^{-2}

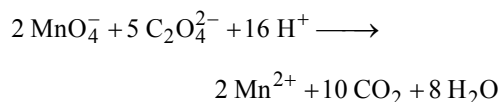59. (b) $\overset{7}{Mn}O_4^- \longrightarrow \overset{+2}{Mn}^2$; $5e^-$ gain   ...(i)

$\overset{+3}{C_2}O_4^{2-} \longrightarrow \overset{+4}{C}O_2$; $2e^-$ loss   ...(ii)

Multiplying (i) by 2 and (ii) by 5 to balance e^-

$2\,MnO_4^- + 5\,C_2O_4^{2-} \longrightarrow 2\,Mn^{2+} + 10\,CO_2$

On balancing charge;

$2\,MnO_4^- + 5\,C_2O_4^{2-} + 16\,H^+ \longrightarrow$

$\qquad\qquad\qquad 2\,Mn^{2+} + 10\,CO_2 + 8\,H_2O$

60. (c) Calculate E°_{cell} corresponding to each compound undergoing disproportionation reaction. The reaction for which E°_{cell} comes out + ve is spontaneous.

$HBrO \longrightarrow Br_2$ $E^\circ = 1.595$ V, SRP (cathode)

$HBrO \longrightarrow BrO_3^-$ $E^\circ = -1.5$ V, SOP (anode)

$2HBrO \longrightarrow Br_2 + BrO_3^-$
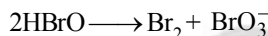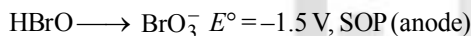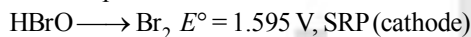
$E^\circ_{cell} = $ SRP (cathode) – SRP (anode)

$\qquad = 1.595 - 1.5$

$\qquad = 0.095$ V

$E^\circ_{cell} > 0 \Rightarrow \Delta G^\circ < 0$ [spontaneous]

NOTES
Reaction in (d) involves comproportionation or synproportionation. When two reactants, each containing the same element but with a different oxidation number, form a product in which the element involved reach the same oxidation number.

Oxidation

$2\overset{+7}{Mn}O_4^- + 3\overset{2+}{Mn} + 2H_2O \longrightarrow 5\overset{+4}{Mn}O_2 + 4H^+$

Reduction
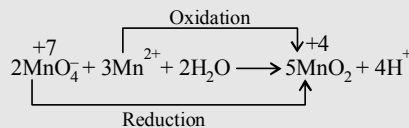
It is opposite to disproportionation.

61. (b) In metals, moving down the group, metallic character increases, so basic nature increases hence most acidic will be BeO.

$\xrightarrow[\text{increasing basic character}]{BeO < MgO < CaO < BaO}$

62. (a) $BeH_2 < CaH_2 < BaH_2$
Smaller the size of cation, more will be its polarising power. Hence, BeH_2 will be least ionic.

63. (d) Boron belongs to 2nd period and it does not have vacant d-orbital.
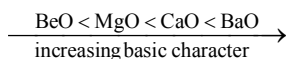
64. (d) $-NO_2$ group is meta-directing group
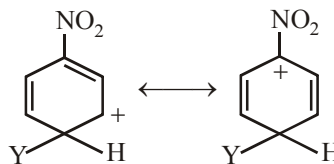
(Less stable due to more e^- withdrawing effect of $-NO_2$)
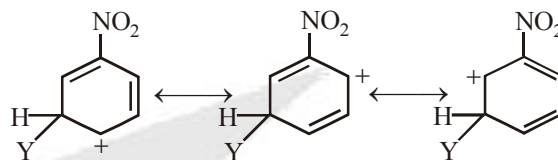
(More stable due to less e^- withdrawing effect of $-NO_2$) greater no. of resonating structures.

65. (a) $-I$ effect increases on increasing electronegativity of atom. So, correct order of $-I$ effect is $-NH_2 < -OR < -F$.

66. (c) $CH_4 \xrightarrow[h\nu]{Br_2} CH_3 - Br \xrightarrow[\text{ether}]{Na}$
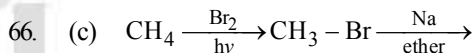
$\qquad\qquad\qquad\qquad CH_3 - CH_3$
$\qquad\qquad\qquad\qquad$ (less than four 'C')

67. (a) Nitrous oxide (N_2O) occurs naturally in environment.
In automobile engine, when fuel is burnt dinitrogen and dioxygen combine to yield NO and NO_2.
Thus, N_2O_5 is the answer.

68. (d) For bcc lattice : $Z = 2$, $a = \dfrac{4r}{\sqrt{3}}$

For fcc lattice : $Z = 4$, $a = 2\sqrt{2}r$

$\therefore \quad \dfrac{d_{25\ C}}{d_{900\ C}} \qquad \dfrac{\left(\dfrac{ZM}{N_A a^3}\right)_{bcc}}{\left(\dfrac{ZM}{N_A a^3}\right)_{fcc}}$

$\dfrac{2}{4}\left(\dfrac{2\sqrt{2}r}{\dfrac{4r}{\sqrt{3}}}\right)^3 \qquad \dfrac{3\sqrt{3}}{4\sqrt{2}}$

69. (b) $(t_{1/2})1^{st}$ order = Independent of concentration

$(t_{1/2})2^{nd}$ order $\propto \dfrac{1}{[A]_o}$

> **NOTES**
> Half life for the second order reaction is
> $t_{1/2} = \dfrac{1}{k \times [A]_0}$

70. (b) $(t_{1/2})_{zero} \quad \dfrac{[A]_o}{2k}$

$\therefore$ If $[A]_o$ = doubled, $t_{1/2}$ = doubled

71. (d) According to Hardy Schulze rule, coagulating power of an ion depends on both magnitude and sign of the charge on the ion.

> **NOTES**
> Greater the valence of the flocculating ion added, greater is the coagulating power.

72. (d) Mg has more $-\Delta G$ value than alumina. So it will be in the lower part of Ellingham diagram. Metals which have more $-\Delta G$ value can reduce those metal oxides which have less $-\Delta G$ value.

73. (a) $\overset{+5}{H}NO_3, \overset{+2}{N}O, \overset{0}{N_2}, \overset{-3}{N}H_4Cl$

> **NOTES**
> Nitrogen in its elemental form has zero oxidation state.

74. (d) Due to high electronegativity and small size, F forms only one oxoacid, HOF known as fluoric (I) acid.

> **NOTES**
> Flourine has –1 oxidation state in most of its compound. Oxidation number of F is +1 in HOF.

75. (c) CrO_4^{2-} Cr^{6+} diamagnetic

$Cr_2O_7^{2-}$ Cr^{6+} diamagnetic

MnO_4^{-} Mn^{7+} diamagnetic

MnO_4^{2-} Mn^{6+} paramagnetic
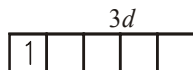
Thus, unpaired electron is present, so d–d transition is possible.
For tetrahedral geometry:

76. (b) $\left[Co(NH_3)_6\right]Cl_3 \xrightarrow{AgNO_3}$

3 mol of AgCl

$\left[Co(NH_3)_5 Cl\right]Cl_2 \xrightarrow{AgNO_3}$
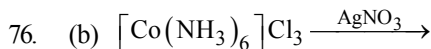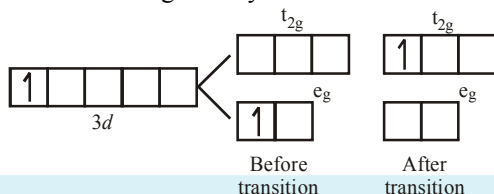
2 mol of AgCl
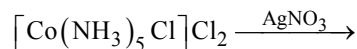
$\left[Co(NH_3)_4 Cl_2\right]Cl \xrightarrow{AgNO_3} 1$ mol of AgCl
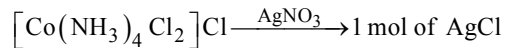
Complexes are respectively $[Co(NH_3)_6]$ Cl_3, $[Co(NH_3)_5Cl]Cl_2$ and $[Co(NH_3)_4Cl_2]Cl$

77. (b) Ni(28) : $[Ar]3d^8 4s^2$

$\because$ CO is a strong field ligand, so unpaired electrons get paired. Hence, configuration would be:
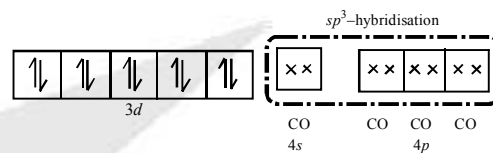
For, four 'CO' ligands hybridisation would be sp^3 and thus the complex would be diamagnetic and of tetrahedral geometry.

78. (a) $Co^{3+} = [Ar] 3d^6$, unpaired $e^-(n) = 4$
Spin magnetic moment

$= \sqrt{4(4\ 2)} = \sqrt{24}$ B.M.

$Cr^{3+} = [Ar] 3d^3$, unpaired $e^-(n) = 3$
Spin magnetic moment

$= \sqrt{3(3\ 2)} = \sqrt{15}$ B.M.

$Fe^{3+} = [Ar] 3d^5$, unpaired $e^-(n) = 5$
Spin magnetic moment

$= \sqrt{5(5\ 2)} = \sqrt{35}$ B.M.

$Ni^{2+} = [Ar] 3d^8$, unpaired $e^-(n) = 2$
Spin magnetic moment

$= \sqrt{2(2\ 2)} = \sqrt{8}$ B.M.

79. (b) $[Fe(CO)_5]$
EAN = Z – O.N. + 2(C.N.)
$\quad = 26 - 0 + 2(5)$
$\quad = 26 + 10$
$\quad = 36$

Only one central metal atom/ion is present and it follows EAN rule, so it is mononuclear.

80. (a)

$$\underset{\text{CH}_3}{\bigcirc} \xrightarrow[\Delta]{3Cl_2} \underset{\text{CCl}_3}{\bigcirc} \xrightarrow[\text{Fe}]{Br_2}$$

$$\underset{\text{CCl}_3, \text{Br}}{\bigcirc} \xrightarrow[\text{HCl}]{Zn} \underset{\text{CH}_3, \text{Br}}{\bigcirc}$$

m-Bromotoluene

81. (c) $C_2H_5OH \xrightarrow{\text{Na}} C_2H_5O^-Na^+$
$\quad\quad$ (A) $\quad\quad\quad\quad\quad\quad$ (B)

$\quad\quad\quad \downarrow PCl_5$

$\quad\quad\quad C_2H_5Cl$
$\quad\quad\quad\quad$ (C)

$C_2H_5O^-Na^+ + C_2H_5Cl \xrightarrow{S_N2} C_2H_5OC_2H_5$
$\quad$ (B) $\quad\quad\quad$ (C)

So, the correct option is (c)

82. (c) $CHCl_3 + NaOH \longrightarrow \bar{C}Cl_3 + H_2O$

$\quad\quad\quad\quad\quad\quad \downarrow \text{– Cl (}\alpha\text{-elimination)}$

$\quad\quad\quad : \underset{\text{dichlorocarbene}}{CCl_2} \text{ (electrophile)}$

83. (d) Haloform reaction is shown by compound having

$$CH_3 - \overset{\parallel}{\underset{O}{C}} - \quad\text{or}\quad CH_3 - \overset{|}{\underset{OH}{CH}} - \quad\text{Group}$$

$$\underset{OH}{\bigcirc - \overset{|}{CH} - CH_3} \xrightarrow[\text{NaOH + I}_2]{\overset{\text{NaOI}}{\text{or}}}$$

$$\bigcirc - \overset{\parallel}{\underset{O}{C}} - \bar{O}\overset{+}{Na} + CHI_3 \quad\underset{\text{ppt.}}{\text{Yellow}}$$

84. (c) Mechanism :

$$CH_3 - CH_2 - CH_2 - Cl \xrightarrow{AlCl_3}$$

$$CH_3 - CH_2 - \overset{+}{CH_2} + \overset{-}{AlCl_4}$$
$$\text{1° Carbocation}$$

$$\underset{(P)}{\underset{\bigcirc}{CH_3 - CH - CH_3}} \xleftarrow{\text{ESR}} \underset{\bigcirc}{CH_3 - \overset{+}{CH} - CH_3} \underset{\text{shift}}{\overset{H^-}{\leftarrow}}$$
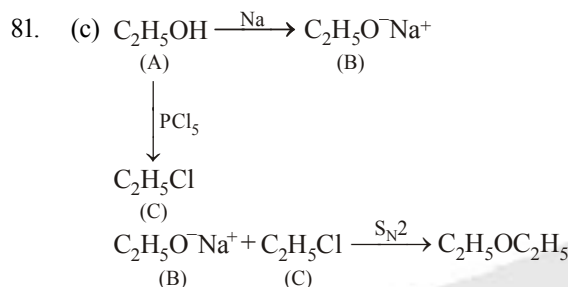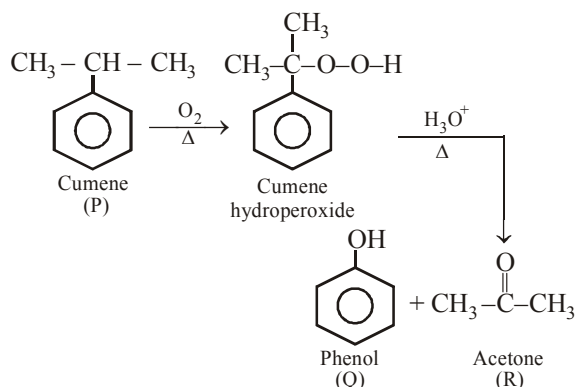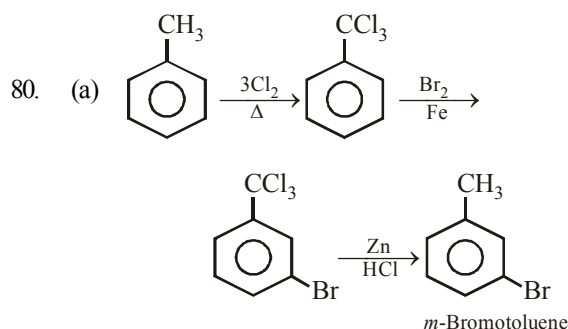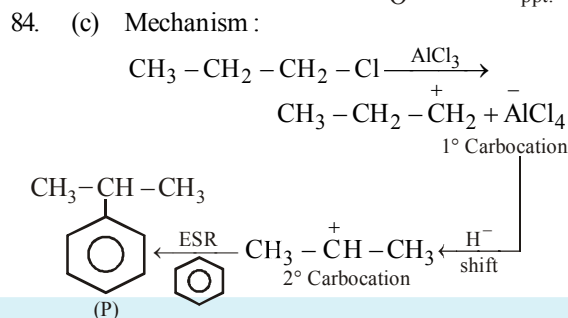$$\text{2° Carbocation}$$

$$\underset{(P)}{\bigcirc} \text{CH}_3 - \overset{+}{CH} - CH_3$$

$$\underset{\text{Cumene}}{\underset{(P)}{\bigcirc}} \underset{CH_3 - CH - CH_3}{} \xrightarrow[\Delta]{O_2} \underset{\underset{\text{hydroperoxide}}{\text{Cumene}}}{\bigcirc} \underset{CH_3 - \overset{\overset{CH_3}{|}}{C} - O - O - H}{} \xrightarrow[\Delta]{H_3O^+}$$

$$\underset{\underset{(Q)}{\text{Phenol}}}{\bigcirc_{OH}} + \underset{\underset{(R)}{\text{Acetone}}}{CH_3 - \overset{O}{\overset{\parallel}{C}} - CH_3}$$

85. (c) Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass.
This is due to more extensive association through intermolecular H-bonding.

$$R - \overset{O \cdots\cdots H - O}{\underset{O - H \cdots\cdots O}{C}} \overset{}{\underset{}{C}} - R$$

86. (c)

$$\underset{NH_2}{\bigcirc} \xrightarrow[\text{nitrating}]{\overset{H^+}{\text{mixture}}} \underset{\overset{+}{NH_3}}{\bigcirc} \xrightarrow[]{\overset{+}{NO_2}} \underset{\overset{+}{NH_3}, NO_2}{\bigcirc}$$

In acidic medium aniline is protonated to form anilinium ion which is meta-directing.

87. (c) $\underset{\text{Glycine}}{HOOC - CH_2 - NH_2} \rightleftharpoons$

$$\underset{\text{Zwitter ion}}{\bar{O}OC - CH_2 - \overset{+}{NH_3}}$$

88. (c) Cross-linked or network polymers are usually formed from bi-functional and tri-functional monomers and contain strong covalent bonds between various linear polymer chains like melamine, bakelite etc.
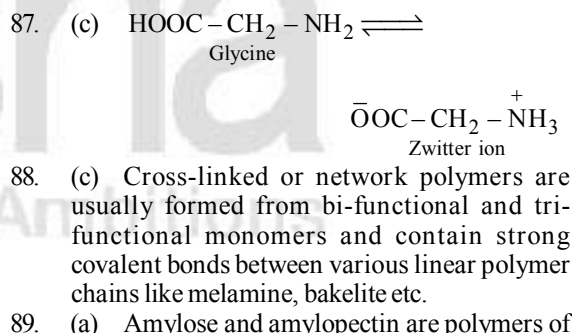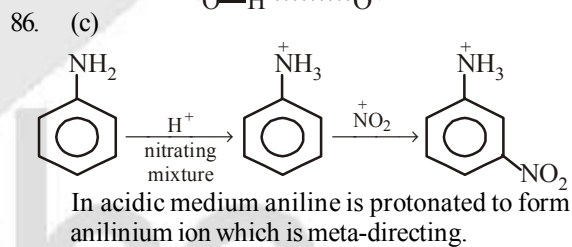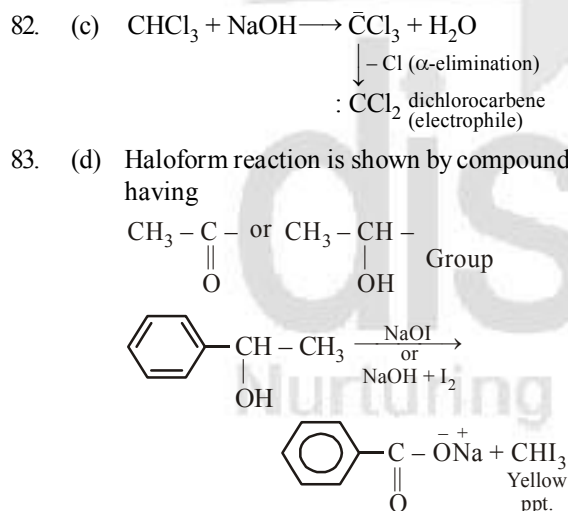
89. (a) Amylose and amylopectin are polymers of α-D-glucose, so β-link is not possible. Amylose is linear with $1 \rightarrow 4$ α-linkage whereas amylopectin is branched and has both $1 \rightarrow 4$ and $1 \rightarrow 6$ α-linkages.
So option (1) should be the correct option.

90. (b) In metals moving down the group metallic character increases, so basic nature increases hence most acidic will be BeO.

$$\xrightarrow[\text{increasing basic character}]{BeO < MgO < CaO < BaO}$$
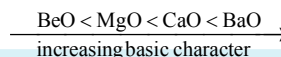
BIOLOGY

91. (c) Sporopollenin cannot be degraded by enzyme; strong acids and alkali, therefore it is helpful in preserving pollen as fossil.

NOTES Sporopollenin contains a mixture of biopolymers, such as long-chain factory acids, phenylpro-ponoids, phenolics and traces of caretenoids.

92. (a) *Saccharomyces* i.e. yeast is an eukaryote (unicellular fungi). *Mycobacterium* is a bacterium. *Oscillatoria* and *Nostoc* are cyanobacteria.

93. (b) Diatoms are the chief producers in some oceans and in some seasons as they are the primary producers and the food chain in marine ecosystem depends on it.

94. (c) Ciliates differs from other protozoans in having two types of nuclei. E.g., *Paramoecium* have two types of nuclei i.e. macronucleus & micronucleus.

95. (a) *Polysiphonia* is a genus of red algae, where asexual spores and gametes are non-motile or non-flagellated.

96. (d) In *Agaricus* (a genus of basidiomycetes), basidiospores or meiospores are produced exogenously. *Neurospora* (a genus of ascomycetes) produces ascospores as meiospores but endogenously inside the ascus). *Alternaria* (a genus of deuteromycetes) does not produce sexual spores. Saccharomyces (Unicellular ascomycetes) produces ascospores, endogenously.

97. (d) *Pseudopodia* are locomotory structures in sarcodines (amoeboid).

98. (a) Metamorphosis refers to transformation of larva into adult. Animal that perform metamorphosis are said to have indirect development. Metamorphosis includes, in insects, the transformation of a maggot into an adult fly and a caterpillar into a butterfly and, in amphibians, the changing of a tadpole into a frog. In earthworm development is direct which means no larval stage are there and hence no metamorphosis.

99. (a) Some lateral roots of mangroves become specialised as pneumatophores in saline mud flats. These are lateral roots that grow upward (negative geotropism) for varying distances and function as the site of oxygen intake for the submerged primary root system.

100. (c) Winged pollen grains are present in Pinus. Each pollen grain has two wing-like structures which enables it to float in air, as an adaptation for dispersal by the wind.

101. (c) Casparian strip is a band of cell wall material deposited in the radial and transverse walls of the endodermis. Casparian strip is made of suberin and sometimes lignin.

102. (b) Secondary tissues are generated from the growth of a cambium. Vascular cambium gives rise to secondary xylem to the inside, and to secondary phloem to the outside.

103. (a) Grasses are monocots and monocots usually do not have secondary growth. Palm like monocots have anomalous secondary growth.

104. (c) Sugar is a carbohydrate. These are poly-hydroxy aldehyde, ketone or their derivatives, which means they have carbonyl and hydroxyl groups in its structure.

105. (b) Diplotene is a stage of meiotic prophase which follows the pachytene and during which the paired homologous chromosomes begin to separate and chiasmata become visible.

106. (d) Light, temperature and concentration of CO_2 affect opening and closing of stomata. They are not affected by O_2 concentration.

107. (a) Grass being a monocot, has dumb-bell shaped stomata in their leaves.

108. (a) Iron is absorbed by plants in the form of ferric ions.

NOTES Plants uptake iron in its oxidized forms, Fe^{2+} (ferrous form) or Fe^{3+} (ferric form). Another mechanism involves the release of protons (H^+) and reductants by the plant roots, to lower pH levels in root zone. Iron is considered a micro-nutrient because only small amounts are required to aid in normal plant growth. Plants can suffer iron deficiency with symptoms of chlorosis and stunted growth, but plants can also take in too much iron, especially under certain growing conditions.

109. (d) Plants require potassium ions (K+) for protein synthesis and for the opening and closing of stomata, which is regulated by proton pumps to make surrounding guard cells either turgid or flaccid.

110. (a) Green sulphur bacteria do not use H_2O as source of proton, therefore they do not evolve O_2.

111. (b) The light reactions of photosynthesis take place on the thylakoid membranes of the chloroplast. During light reactions of photosynthesis, light is absorbed and the energy is used to drive electrons from water to generate NADPH and to drive protons across a membrane. These protons return through ATP synthase to make ATP. ATP, NADPH and oxygen are products of light reaction, while NADH is a product of respiration process.

112. (c) Oxidative phosphorylation takes place in inner mitochondrial membrane.

113. (b) In cellular respiration, NAD+ act as an electron carrier.

114. (b) In thecodont teeth are present in the sockets of the jaw bone called alveoli. In diphyodont teeth erupts twice, temporary milk or deciduous teeth are replaced by a set of permanent or adult teeth. In heterodont dentition it consists of different types of teeth namely incisors, canine, premolars and molars.

115. (b) Tidal volume (TV) is volume of air inspired or expired during normal respiration. It is approximately 500 mL. Inspiratory reserve volume (IRV) is additional volume of air a person can inspire by a forceful inspiration. It is around 2500 - 3000 mL. Expiratory reserve volume (ERV) is additional volume of air a person can be expired by a forceful expiration. This averages 1000 - 1100 mL. Residual volume (RV) is volume of air remaining in lungs even after forceful expiration. This averages 1100 - 1200 mL.

116. (b) 'Smack' also called as brown sugar/Heroin is formed by acetylation of morphine. It is obtained from the latex of unripe capsule of Poppy plant (Papaver somniferum).

117. (b) Silicosis is an occupational disease caused due to excess inhalation of silica dust in the workers involved grinding or stone breaking industries.

NOTES Diagnosis is made when someone who has worked with silica has chest computed tomography (CT) that shows distinctive patterns consistent with the disease. A chest x-ray can also be done to help diagnose silicosis. When imaging findings are unclear, samples of lung tissue can help confirm the diagnosis.

118. (c) Fibrinogen forms fibrin strands during coagulation. These strands forms a network and the meshes of which are occupied by blood cells, this structure finally forms a clot.

NOTES Antibodies are derived from Gamma-Globulin fraction of plasma proteins which means globulins are involved in defence mechanisms. Albumin is a plasma protein mainly responsible for Blood Colloidal Osmotic Pressure (BCOP).

119. (a) Tricuspid valves are AV valve present between right atrium and right ventricle in heart. Bicuspid valves (mitral valves) are AV valve present between left atrium and left ventricle. Semilunar valves are present at the openings of aortic and pulmonary aorta.

120. (c) Glycosuria denotes presence of glucose in the urine. Gout is due to deposition of uric acid crystals in the joint. Renal calculi are precipitates of calcium phosphate produced in the pelvis of the kidney. Glomerular nephritis is the inflammatory condition of glomerulus characterised by proteinuria and haematuria.

121. (a) The sarcoplasmic reticulum to release calcium ions into the muscle interior where they bind to troponin, thus causing tropomyosin to shift from the face of the actin filament to which myosin heads need to bind to produce contraction.

122. (d) Alzheimer's disease is a neurodegenerative disorder due to deficiency of neurotransmitter acetylcholine. Rheumatoid arthritis is an autoimmune disorder in which antibodies are produced against the synovial membrane and cartilage. Vitiligo causes white patches on skin also characterized as autoimmune disorder. Psoriasis is a skin disease that causes itchy or sore patches of thick red skin and is also autoimmune.

123. (d) Osteoporosis has three causes: excess parathyroid hormone, advanced age, and lack of estrogen in older females. Estrogen promotes the activity of osteoblast and inhibits osteoclast. Parathormone promotes mobilisation of calcium from bone into blood. Excessive activity of parathormone causes demineralisation leading to osteoporosis.

124. (b) The limbic system (emotional motor system) is responsible for the experience and expression of emotion but not movement. It is located in the core of the brain and includes the amygdala, hippocampus and hypothalamus.

125. (c) Nissl bodies are present in the soma or cell body of a neuron. When observed under electron microscope, they appear to be composed of rough endoplasmic reticulum (RER) and free ribosomes hence help in protein synthesis.

NOTES Nissl Granules or bodies are very useful for protein synthesis also help to transport these proteins to the part known as cyton.

126. (a) The muscles that move the eyeball are attached to the sclera. Suspensory ligament of lens - a series of fibers that connect the ciliary body of the eye with the lens, holding it in place.

127. (a) Epinephrine is derived from tyrosine by the removal of carboxyl group. It is a catecholamine.

NOTES Epinephrine and norepinephrine are very similar neurotransmitters and hormones. While epinephrine has slightly more of an effect on your heart, norepinephrine has more of an effect on your blood vessels. Both play a role in your body's natural fight-or-flight response to stress and have important medical uses as well.

128. (b) An offset is a small, virtually complete daughter plant that has been naturally and asexually produced on the mother plant. They are clones, meaning that they are genetically identical to the mother plant. Offset is a vegetative part of a plant, formed by mitosis.

129. (a) A monocarpic plant flowers and produces seeds only once before dying, e.g. bamboo. A polycarpic plant reproduces sexually more than once in its lifetime, e.g. jackfruit, papaya, mango, etc.

130. (d) Pollen grains can be stored for several years in liquid nitrogen at -196°C (cryopreservation). Cryopreservation is the process of cooling and storing cells, tissues, or organs at very low temperatures; most common -196°C/-321°F in liquid nitrogen (N_2) to maintain their viability.

NOTES Liquid nitrogen is commercially produced from the cryogenic distillation of liquified air or from the liquification of pure nitrogen derived from air using pressure swing adsorption.

131. (c) Double fertilization is a unique phenomenon that occurs in angiosperms only.
Double fertilization = Syngamy + Triple fusion

132. (a) Ovulation is followed by the luteal phase during which the corpus luteum secretes oestrogen and progesterone hormones that exerts negative feedback on hypothalamus which in turn inhibits the release of FSH and LH. This prevents the development of new follicles during the luteal phase.

133. (c) Spermiogenesis is conversion of spermatids into spermatozoa whereas spermiation is the release of the sperms from sertoli cells into the cavity of seminiferous tubule.

134. (a) The extraembryonic membranes are amnion, chorion, allantois and yolk sac. Amnion is derived from mesoderm on the outer side and ectoderm on the inner side. Chorion is formed from trophoectoderm and mesoderm, whereas allantois and yolk sac membrane have mesoderm on outerside and endoderm in inner side.

135. (d) The placenta is an endocrine gland that is only present during pregnancy. It relases hCG, hPL, progestogens, estrogens, etc. Human chorionic gonadotropic hormone (hCG) stimulates the corpus luteum during pregnancy to release estrogen and progesterone. Human placental lactogen (hPL) is involved in growth of body of mother and breast. Progesterone maintains pregnancy.

136. (a) Saheli is world's first and only oral non steroidal contraceptive pill, dosage-once a week pill. Its functioning is based upon selective estrogen receptor modulation and prevents egg from getting implanted.

137. (c) Woman acts as a carrier. Both son & daughter inherit X-chromosome. Although only son would be the diseased one.

$$X^cX \times XY$$
$$\downarrow$$
$$X^cX \quad X^cY \quad XX \quad XY$$
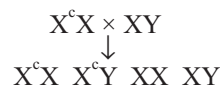
NOTES Sex-linked diseases are passed down through families through one of the X or Y chromosomes. X and Y are sex chromosomes. Dominant inheritance occurs when an abnormal gene from one parent causes disease, even though the matching gene from the other parent is normal.

138. (b) IAIO, IBIO - Dominant-recessive relationship
IAIB - Codominance
IA, IB & IO - Three different allelic forms of a gene (multiple allelism)

139. (a) Coding strand and mRNA have the similar nucleotide sequence except, Thymine (T) is replaced by Uracil (U) in mRNA.

140. (c) Francois Jacob and Jacque Monod proposed the model of gene regulation known as operon model/lac operon. Alec Jeffreys gave DNA fingerprinting technique. Matthew Meselson and F. Stahl gave semi-conservative DNA replication in E.coli. Alfred Hershey and Martha Chase proved DNA as genetic material not protein.

141. (b) Semi-conservative DNA replication was first shown in bacterium Escherichia coli by Matthew Meselson and Franklin Stahl.

142. (d) Unlike eukaryotes in prokaryotes the genes are organised into operon. Operon is a co-ordinated group of genes which are all transcribed together & regulate a metabolic pathway as a unit.

143. (b) As per mutation theory which was given by Hugo de Vries state that the evolution is a discontinuous phenomenon or saltatory phenomenon/saltation.

144. (c) Divergent evolution demonstrates how species can have common (homologous) anatomical structures, whereas eye of octopus, bat and man are examples of analogous organs showing convergent evolution.

145. (a) Bird and bat wings are analogous, as forelimb is homologous. In different vertebrates, bones of forelimbs are similar but their forelimbs are adapted in different way as per their adaptation, show homology.

146. (b) 'Smack' also called as brown sugar/Heroin is formed by acetylation of morphine. It is obtained from the latex of unripe capsule of Poppy plant (Papaver somniferum).

147. (a) Retrovirus is a type of RNA virus that inserts a copy of its genome into the DNA of a host cell that it invades, thus changing the genome of that cell. Retrovirus is commonly used as vector for introducing a DNA fragment in human lymphocyte.

148. (c) PCR is based on three simple steps required for any DNA synthesis reaction: (i) denaturation of the template into single strands; (ii) annealing of primers to each original strand for new strand synthesis; and (iii) extension of the new DNA strands from the primers.

> **NOTES**
> PCR (Polymerase Chain Reaction) is a revolutionary method developed by Kary Mullis in the 1980s. PCR tests are used to directly detect the presence of an antigen instead of the presence of antibodies.

149. (b) Biopiracy refers to the use of bioresources by multinational companies and other organisation without proper authorisation from the countries and people concerned with compensatory payment.

150. (c) Indian Government has setup organisation such as GEAC (Genetic Engineering Appraisal Committee) which will make decisions regarding the validity of GM research and safety of introducing GM-organism for public services.

> **NOTES**
> The Genetic Engineering Appraisal Committee (GEAC) functions in the Ministry of Environment, Forest and Climate Change (MoEF&CC). As per Rules, 1989, it is responsible for appraisal of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle. The committee is also responsible for appraisal of proposals relating to release of genetically engineered (GE) organisms and products into the environment including experimental field trials. GEAC is chaired by the Special Secretary/Additional Secretary of MoEF&CC and co-chaired by a representative from the Department of Biotechnology (DBT). Presently, it has 24 members and meets every month to review the applications in the areas indicated above.

151. (c) In 1997, an American company got patent rights on Basmati rice through the US patent and trademark office that was actually been derived from Indian farmer's varieties. The diversity of rice in India is one of the richest in the world, 27 documented varieties of Basmati are grown in India.

> **NOTES**
> Indian basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty. Sharbati sonora and Lerma Rojo are varieties of wheat.

152. (b) The two extremes in the animal kingdom are endothermic homeotherms and ectothermic poikilotherms. Most mammals, including humans, as well as most birds are endothermic homeotherms, while most fish, invertebrates, reptiles, and amphibians are ectothermic poikilotherms. Chelone (Turtle) belongs to class reptilia which is poikilotherm or cold blooded.

153. (d) Saprophytes are organisms which live on dead organic matter and help in their decomposition.
    Parasites is an organisms that live in or on other living plants and animals and dependent on them for their food.
    Lichens represent a type of symbiotic association of algae and fungi, in which, both of them dependent on each other for their food and shelter.
    Mycorrhiza is also a type of symbiotic association of fungi and plant roots, e.g., *Cycas* coralloid root.

154. (a) Whenever the pre-reproductive individuals or the younger population size is larger than the reproductive group, the population will be an increasing population.

155. (c) Amensalism/antibiosis, association between organisms of two different species in which one is inhibited or destroyed and the other is unaffected. These are chemicals secreted by one microbial group (eg : Penicillium) which harm other microbes (eg : Staphylococcus). It has no effect on Penicillium or the organism which produces it.

156. (b) In obligate mutualism, one organism cannot survive without the other. Yucca have an obligate mutualism with a species of moth i.e. Pronuba.

157. (d) World Ozone day is celebrated on 16th September. 5th June is World Environment Day. 21st April is National Yellow Bat Day. 22nd April is National Earth Day.

NOTES

September 16 was designated by the United Nations General Assembly as the International Day for the Preservation of the Ozone Layer. This designation had been made on December 19, 2000, in commemoration of the date, in 1987, on which nations signed the Montreal Protocol on Substances that Deplete the Ozone Layer.

158. (c) Joseph Grinnell in 1917 coined the term niche, which he used as largely equivalent to a species habitat. It refers the functional role played by the organism where it lives.

159. (a) The given data depicts the inverted pyramid of biomass, usually present in aquatic ecosystem. Upright pyramid of biomass and numbers are not possible, as the data depicts primary producer is less than primary consumer and this is less than secondary consumers. Pyramid of energy is always upright.

160. (b) In-situ conservation is the on-site conservation or the conservation of genetic resources in natural populations of plant or animal species. E.g. Sacred groves.

161. (c) A primary pollutant is an air pollutant emitted directly from a source. A secondary pollutant is not directly emitted as such, but forms when other pollutants (primary pollutants) react in the atmosphere. O_3 (ozone) is a secondary pollutant.

162. (d)

NOTES

Snow blindness, also called arc eye or photokeratitis, is a painful eye condition caused by overexposure to ultraviolet (UV) light. When too much UV light hits the transparent outer layer of your eyes, called the cornea, it essentially gives your cornea a sunburn. Snow blindness symptoms can be disorienting.

163. (b) Chlorofluorocarbons (CFCs) and other halogenated ozone depleting substances (ODS) are mainly responsible for man-made chemical ozone depletion. CFCs rise into the stratosphere where they are eventually broken down by ultraviolet (UV) rays from the Sun. This causes them to release free chlorine which then reacts with oxygen leading to the chemical process of destroying ozone molecules.

164. (a) Asthma is a common long-term inflammatory disease of the airways of the lungs. It is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased, and is mainly caused by smoking.

165. (c) Polytene chromosomes are found in salivary glands of insects of order Diptera.

166. (c) Phospholipid synthesis does not take place in rough endoplasmic reticulum (RER). Smooth endoplasmic reticulum (SER) is involved in lipid synthesis.

167. (a) A polyribosome (or polysome) is a complex of an mRNA molecule and two or more ribosomes that act to translate mRNA instructions into polypeptides.

168. (d) The digestive tract of aves has additional chambers in their digestive system as crop and gizzard. Crop is concerned with storage of food grains, whereas gizzard is a masticatory organ in birds used to crush food grain.

169. (b) Males bear a pair of short, thread like anal styles which are absent in females. Anal/caudal styles arise from 9th abdominal segment in male cockroach.

170. (b) In renal physiology, ultrafiltration occurs at the barrier between the blood and the filtrate in the glomerular capsule (Bowman's capsule) in the kidneys. Concentration of urine refers to water absorption from glomerular filtrate created by counter-current mechanism in Henle's loop. Urine is carried from kidney to bladder through ureter. Urinary bladder is for storage of urine.

171. (b) Golgi complex after processing, packages them in vesicles, and either stores them for later use or sends them out of the cell. It is also the organelle that builds lysosomes (cell digestion machines).

172. (c) The nucleolus (plural nucleoli) is a large, distinct, spheroidal subcompartment of the nucleus of eukaryote cells that is the site of ribosomal RNA (rRNA) synthesis and assembly of ribosomal subunits.

173. (a) Ribozyme is a catalytic RNA, which is nucleic acid.

174. (a) Starch synthesis in pea is controlled by pleiotropic gene. Pleiotropy occurs when one gene influences two or more seemingly unrelated phenotypic traits.

175. (b) Natality is the birth rate within a population. When compared with the death or mortality rate, the growth or decrease in a population can be determined.

176. (c) Herbarium - Dried and pressed plant specimen.
     • Key - Identification of various taxa.
     • Museum - Plant and animal specimen are preserved.
     • Catalogue - Alphabetical listing of species.

177. (a) The gymnosperms are a group of seed-producing plants. The name is based on the unenclosed condition of their seeds (called ovules in their unfertilized state).

178. (b) Sweet potato is a modified adventitious root for storage of food. Rhizomes are underground modified stem. Tap root is primary root directly elongated from the radicle

179. (d) Curd has enriched presence of vitamins specially Vit-B_{12}, which improves its nutritional value than milk.

180. (c) Parietal or oxyntic cell is a source of HCl and intrinsic factor. HCl converts iron present in diet from ferric to ferrous form so that it can be absorbed easily and used during erythropoiesis. Intrinsic factor is essential for the absorption of vitamin B_{12} and its deficiency causes pernicious anaemia.