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NEET 2019 Solved Paper

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NEET - 2019
Solved Paper

Time : 3 hours **MM : 720**

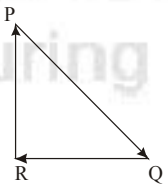
PHYSICS

1. The unit of thermal conductivity is :
(a) $J\,m\,K^{-1}$ (b) $J\,m^{-1}\,K^{-1}$
(c) $W\,m\,K^{-1}$ (d) $W\,m^{-1}\,K^{-1}$

2. In an experiment, the percentage of error occurred in the measurement of physical quantities A, B, C an D are 1%, 2%, 3% and 4% respectively. Then the maximum percentage of error in the measurement X, where $X = \frac{A^2\,B^{1/2}}{C^{1/3}\,D^3}$ will be :
(a) $\left(\frac{3}{13}\right)\%$ (b) 16%
(c) –10% (d) 10%

3. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10 m/s and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path, the angle at which he should make his strokes w.r.t. north is given by :
(a) 30°west (b) 0°
(c) 60° west (d) 45° west

4. A particle moving with velocity is acted by three forces shown by the vector triangle PQR. The velocity of the particle will :
(a) increase
(b) decrease
(c) remain constant
(d) change according to the smallest force



5. A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1 m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. The minimum angular velocity needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis, will be : ($g = 10\ m/s^2$)
(a) $\sqrt{10}$ rad/s (b) $\frac{10}{2\pi}$ rad/s
(c) 10 rad/s (d) $10\,\pi$ rad/s

6. A force $F = 20 + 10y$ acts on a particle in y-direction where F is in newton and y in meter. Work done by this force to move the particle from $y = 0$ to $y = 1$ m is :
(a) 30 J (b) 5 J (c) 25 J (d) 20 J

7. Body A of mass 4m moving with speed u collides with another body B of mass 2m, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is :
(a) $\frac{1}{9}$ (b) $\frac{8}{9}$
(c) $\frac{4}{9}$ (d) $\frac{5}{9}$

8. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B respectively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be :
(a) $r_A : r_B$ (b) $v_A : v_B$
(c) $r_B : r_A$ (d) 1 : 1

9. A solid cylinder of mass 2 kg and radius 4 cm is rotating about its axis at the rate of 3 rpm. The torque required to stop after 2π revolutions is :
(a) 2×10^{-6} N m (b) 2×10^{-3} N m
(c) 12×10^{-4} N m (d) 2×10^{6} N m

10. A disc of radius 2 m and mass 100 kg rolls on a horizontal floor. Its centre of mass has speed of 20 cm/s. How much work is needed to stop it ?
(a) 3 J (b) 30 kJ
(c) 2 J (d) 1J

11. The work done to raise a mass m from the surface of the earth to a height h, which is equal to the radius of the earth, is :
(a) mgR (b) 2mgR
(c) $\frac{1}{2}$mgR (d) $\frac{3}{2}$mgR

12. When a block of mass M is suspended by a long wire of length L, the length of the wire becomes (L + l). The elastic potential energy stored in the extended wire is :
(a) Mgl (b) MgL
(c) $\frac{1}{2}$Mgl (d) $\frac{1}{2}$MgL

13. A small hole of area of cross-section 2 mm^2 is present near the bottom of a fully filled open tank of height 2 m. Taking g = 10 m/s^2, the rate of flow of water through the open hole would be nearly:
(a) 12.6 10^{-6} m^3/s (b) 8.9 10^{-6} m^3/s
(c) 2.23 10^{-6} m^3/s (d) 6.4 10^{-6} m^3/s

14. A soap bubble, having radius of 1 mm, is blown from a detergent solution having a surface tension of 2.5 10–2 N/m. The pressure inside the bubble equals at a point Z_0 below the free surface of water in a container. Taking g = 10 m/s^2, density of water = 10_3 kg/m_3, the value of Z_0 is :
(a) 100 cm (b) 10 cm
(c) 1 cm (d) 0.5 cm

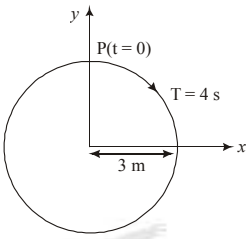
15. A copper rod of 88 cm and an aluminium rod of unknown length have their increase in length independent of increase in temperature. The length of aluminium rod is : ($\alpha_{Cu} = 1.7 \times 10^{-5}\ K^{-1}$ and $\alpha_{Al} = 2.2 \times 10^{-5} K^{-1}$)
(a) 6.8 cm (b) 113.9 cm
(c) 88 cm (d) 68 cm

16. A sample of 0.1 g of water at 100°C and normal pressure ($1.013 \times 10^5\ Nm^{-2}$) 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

17. In which of the following processes, heat is neither absorbed nor released by a system ?
(a) isothermal (b) adiabatic
(c) isobaric (d) isochoric

18. Increase in temperature of a gas filled in a container would lead to:
(a) increase in its mass
(b) increase in its kinetic energy
(c) decrease in its pressure
(d) decrease in intermolecular distance

19. The radius of circle, the period of revolution, initial position and sense of revolution are indicated in the fig.



y - projection of the radius vector of rotating particle P is :
(a) $y(t) = -3\cos 2\pi t$, where y in m
(b) $y(t) = 4 \sin\left(\frac{\pi t}{2}\right)$, where y in m
(c) $y(t) = 3\left(\frac{3\pi t}{2}\right)$, cos where y in m
(d) $y(t) = 3\cos\left(\frac{\pi t}{2}\right)$, where y in m

20. Average velocity of a particle executing SHM in one complete vibration is:
(a) $\frac{A\omega}{2}$ (b) $A\omega$
(c) $\frac{A\omega^2}{2}$ (d) zero

21. The displacement of a particle executing simple harmonic motion is given by
$y = A_0 + A\sin\omega t + B\cos\omega t$.
Then the amplitude of its oscillation is given by:
(a) $A_0 + \sqrt{A^2 + B^2}$ (b) $\sqrt{A^2 + B^2}$
(c) $\sqrt{A_0^2 + (A + B)^2}$ (d) A+B

22. Two point charges A and B, having charges +Q and –Q respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then force between the charges becomes :
(a) F (b) $\frac{9F}{16}$
(c) $\frac{16F}{9}$ (d) $\frac{4F}{3}$

23. Two parallel infinite line charges with linear charge densities $+\lambda$ C/m and $-\lambda$ C/m are placed at a distance of 2R in free space. What is the electric field mid-way between the two line charges?

(a) zero (b) $\frac{2\lambda}{\pi \epsilon_0 R}$ N/C

(c) $\frac{\lambda}{\pi \epsilon_0 R}$ N/C (d) $\frac{\lambda}{2\pi\varepsilon_0 R}$ N/C

24. A hollow metal sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre :

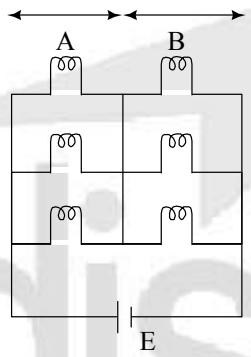
(a) increases as r increases for r < R and for r > R

(b) zero as r increases for r < R, decreases as r increases for r > R

(c) zero as r increases for r < R, increases as r increases for r > R

(d) decreases as r increases for r < R and for r > R

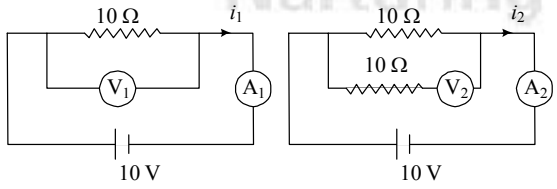
25. Six similar bulbs are connected as shown in the figure with a DC source of emf E, and zero internal resistance. The ratio of power consumption by the bulbs when (i) all are glowing and (ii) in the situation when two from section A and one from section B are glowing, will be:



(a) 4 : 9 (b) 9 : 4

(c) 1 : 2 (d) 2 : 1

26. In the circuits shown below, the readings of the voltmeters and the ammeters will be :



Circuit 1 **Circuit 2**

(a) $V_2 > V_1$ and $i_1 = i_2$

(b) $V_1 = V_2$ and $i_1 > i_2$

(c) $V_1 = V_2$ and $i_1 = i_2$

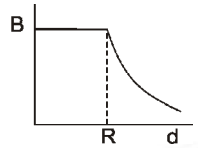
(d) $V_2 > V_1$ and $i_1 > i_2$

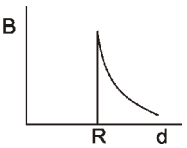
27. Ionized hydrogen atoms and α-particles with same momenta enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be :

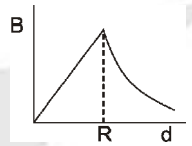
(a) 2 : 1 (b) 1 : 2

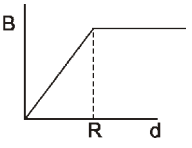
(c) 4 : 1 (d) 1 : 4

28. A cylindrical conductor of radius R is carrying a constant current. The plot of the magnitude of the magnetic field, B with the distance, *d*, from the centre of the conductor, is **correctly** represented by the figure :

(a) 

(b) 

(c) 

(d) 

29. At a point A on the earth's surface the angle of dip, $\delta = +25°$. At a point B on the earth's surface the angle of dip, $\delta = -25°$. We can interpret that:

(a) A and B are both located in the northern hemisphere.

(b) A is located in the southern hemisphere and B is located in the northern hemisphere.

(c) A is located in the northern hemisphere and B is located in the southern hemisphere.

(d) A and B are both located in the southern hemisphere.

30. A 800 turn coil of effective area 0.05 m^2 is kept perpendicular to a magnetic field 5 10^{-5} T. When the plane of the coil is rotated by 90° around any of its coplanar axis in 0.1 s, the emf induced in the coil will be :

(a) 2V (b) 0.2V

(c) 2×10^{-3} V (d) 0.02V

31. In which of the following devices, the eddy current effect is not used ?

(a) induction furnace

(b) magnetic braking in train

(c) electromagnet

(d) electric heater

32. Which colour of the light has the longest wavelength ?

(a) red (b) blue

(c) green (d) violet

33. In total internal reflection when the angle of incidence is equal to the critical angle for the pair of media in contact, what will be angle of refraction ?
(a) 180°
(b) 0°
(c) equal to angle of incidence
(d) 90°

34. Two similar thin equi-convex lenses, of focal length f each, are kept coaxially in contact with each other such that the focal length of the combination is F_1. When the space between the two lenses is filled with glycerin (which has the same refractive index (= 1.5) as that of glass) then the equivalent focal length is F_2. The ratio $F_1 : F_2$ will be :
(a) 2 : 1 (b) 1 : 2
(c) 2 : 3 (d) 3 : 4

35. Pick the wrong answer in the context with rainbow.
(a) When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.
(b) The order of colours is reversed in the secondary rainbow.
(c) An observer can see a rainbow when his front is towards the sun.
(d) Rainbow is a combined effect of dispersion, refraction and reflection of sunlight.

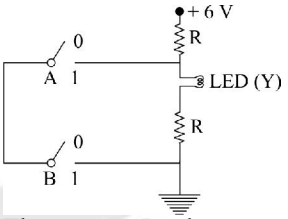
36. In a double slit experiment, when light of wavelength 400 nm was used, the angular width of the first minima formed on a screen placed 1 m away, was found to be 0.2°. What will be the angular width of the first minima, if the entire experimental apparatus is immersed in water? ($\mu_{water} = 4/3$)
(a) 0.266° (b) 0.15°
(c) 0.05° (d) 0.1°

37. An electron is accelerated through a potential difference of 10,000 V. Its de Broglie wavelength is, (nearly): ($m_e = 9\ 10^{-31}$ kg)
(a) $12.2\ 10^{-13}$ m (b) $12.2\ 10^{-12}$ m
(c) $12.2\ 10^{-14}$ m (d) 12.2 nm

38. The total energy of an electron in an atom in an orbit is –3.4 eV. Its kinetic and potential energies are, respectively:
(a) –3.4 eV, –3.4 eV (b) –3.4 eV, –6.8 eV
(c) 3.4 eV, –6.8 eV (d) 3.4 eV, 3.4 eV

39. α-particle consists of:
(a) 2 protons and 2 neutrons only
(b) 2 electrons, 2 protons and 2 neutrons
(c) 2 electrons and 4 protons only
(d) 2 protons only

40. For a p-type semiconductor, which of the following statements is **true** ?
(a) Electrons are the majority carriers and trivalent atoms are the dopants.
(b) Holes are the majority carriers and trivalent atoms are the dopants.
(c) Holes are the majority carriers and pentavalent atoms are the dopants.
(d) Electrons are the majority carriers and pentavalent atoms are the dopants.

41. 

The **correct** Boolean operation represented by the circuit diagram drawn is :
(a) AND (b) OR
(c) NAND (d) NOR

42. A body weighs 200 N on the surface of the earth. How much will it weigh half way down to the centre of the earth ?
(a) 200 N (b) 250 N
(c) 100 N (d) 150 N

43. Which of the following acts as a circuit protection device ?
(a) Inductor (b) Switch
(c) Fuse (d) Conductor

44. A parallel plate capacitor of capacitance 20 μF is being charged by a voltage source whose potential is changing at the rate of 3 V/s. The conduction current through the connecting wires and the displacement current through the plates of the capacitor, would be, respectively:
(a) 60 μA, 60 μA (b) 60 μA, zero
(c) zero, zero (d) zero, 60 μA

45. When an object is shot from the bottom of a long smooth inclined plane kept at an angle 60° with horizontal, it can travel a distance x_1 along the plane. But when the inclination is decreased to 30° and the same object is shot with the same velocity, it can travel x_2 distance. Then $x_1 : x_2$ will be
(a) $\sqrt{2} : 1$ (b) $1 : \sqrt{3}$
(c) $1 : 2\sqrt{3}$ (d) $1 : \sqrt{2}$

46. The number of moles of hydrogen molecule required to produce 20 moles of ammonia through Haber' s process is:
(a) 10 (b) 20 (c) 30 (d) 40

47. Which of the following series of transitions in the spectrum of hydrogen atom falls in visible region ?
(a) Lyman series (b) Balmer series
(c) Paschen series (d) Brackett series

48. 4*d*, 5*p*, 5*f* and 6*p* orbitals are arranged in the order of decreasing energy. The **correct** option is:
(a) $5f > 6p > 5p > 4d$ (b) $6p > 5f > 5p > 4d$
(c) $6p > 5f > 4d > 5p$ (d) $5f > 6p > 4d > 5p$

49. For the second period elements the correct increasing order of first ionisation enthalpy is :
(a) Li < Be < B < C < N < O < F < Ne
(b) Li < B < Be < C < O < N < F < Ne
(c) Li < B < Be < C < N < O < F < Ne
(d) Li < Be < B < C < O < N < F < Ne

50. The manganate and permanganate ions are tetrahedral, due to:
(a) The π-bonding involves overlap of *p*-orbitals of oxygen with *d*-orbitals of manganese
(b) There is no π-bonding
(c) The π-bonding involves overlap of *p*-orbital of oxygen with *p*-orbitals of manganese
(d) The π- bonding involves overlap of *d*-orbital of oxygen with *d*-orbitals of manganese

51. Which of the following diatomic molecular species has only π–bonds according to Molecular Orbital Theory ?
(a) O_2 (b) N_2 (c) C_2 (d) Be_2

52. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The **correct** option about the gas and its compressibility factor (*Z*) is:
(a) $Z > 1$ and attractive forces are dominant
(b) $Z > 1$ and repulsive forces are dominant
(c) $Z < 1$ and attractive forces are dominant
(d) $Z < 1$ and repulsive forces are dominant

53. Under isothermal condition, a gas at 300 K expands front 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is [Given that 1 L bar = 100 J]
(a) –30 J (b) 5 kJ (c) 25 J (d) 30 J

54. In which case change in entropy is negative ?
(a) Evaporation of water
(b) Expansion of a gas at constant temperature
(c) Sublimation of solid to gas
(d) $2H(g) \rightarrow H_2(g)$

55. Conjugate base for Brönsted acids H_2O and HF are:
(a) OH^- and H_2F^+, respectively
(b) H_3O^+ and F^-, respectively
(c) OH^- and F^-, respectively
(d) H_3O^+ and H_2F^+, respectively

56. pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is:
(a) 0.5×10^{-15} (b) 0.25×10^{-10}
(c) 0.125×10^{-15} (d) 0.5×10^{-10}

57. Which of the following reactions are disproportionation reaction?
(a) $2Cu^+ \rightarrow Cu^{2+} + Cu$
(b) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
(c) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$
(d) $2MnO_4^- + 3Mn^{2+} + 2H_2O \xrightarrow{\Delta} 5MnO_2 + 4H^+$
Select the **correct** option from the following:
(a) (a) and (b) only (b) (a), (b) and (c)
(c) (a), (c) and (d) (d) (a) and (d) only

58. The method used to remove temporary hardness of water is:
(a) Calgon's method
(b) Clark's method
(c) Ion-exchange method
(d) Synthetic resins method

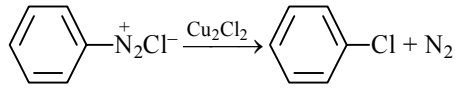
59. Which of the following is an amphoteric hydroxide?
(a) $Sr(OH)_2$ (b) $Ca(OH)_2$
(c) $Mg(OH)_2$ (d) $Be(OH)_2$

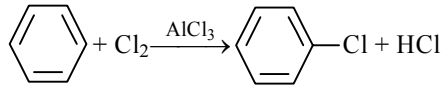
60. Enzymes that utilize ATP in phosphate transfer require an alkaline earth metal (*M*) as the cofactor. *M* is:
(a) Be (b) Mg (c) Ca (d) Sr

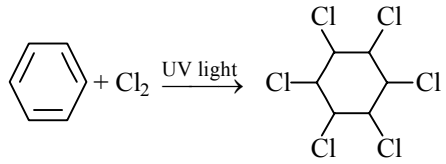
61. Which of the following is incorrect statement?
(a) PbF_4 is covalent in nature
(b) $SiCl_4$ is easily hydrolysed
(c) GeX_4 (X= F, Cl, Br, I) is more stable than GeX_2
(d) SnF_4 is ionic in nature

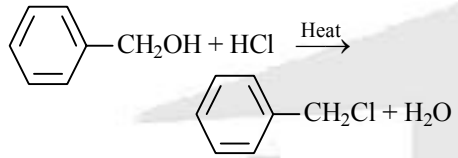
62. Which of the following species is not stable ?
(a) $[SiF_6]^{2-}$ (b) $[GeCl_6]^{2-}$
(c) $[Sn(OH)_6]^{2-}$ (d) $[SiCl_6]^{2-}$

63. Among the following, the reaction that proceeds through an electrophilic substitution, is:

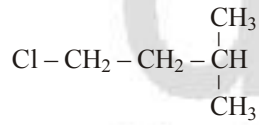
(a) 

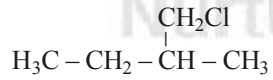
(b) 

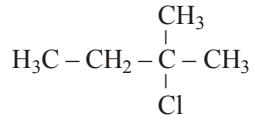
(c) 

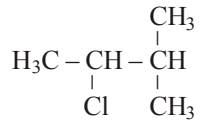
(d) 

64. An alkene "A" on reaction with O_3 and $Zn - H_2O$ gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene "A" gives "B" as the major product. The structure of product "B" is:

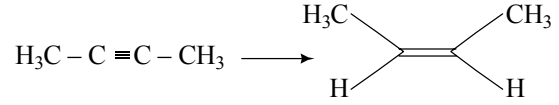
(a) 

(b) 

(c) 

(d) 

65. The most suitable reagent for the following conversion, is:



cis-2-butene

(a) Na/liquid NH_3 (b) H_2, Pd/C, quinoline
(c) Zn/HCl (d) Hg^{2+}/H^+, H_2O

66. Among the following, the one that is not a green house gas is:
(a) nitrous oxide (b) methane
(c) ozone (d) sulphur dioxide

67. A compound is formed by cation *C* and anion *A*. The anions form hexagonal close packed (*hcp*) lattice and the cations occupy 75% of octahedral voids. The formula of the compound is:
(a) C_2A_3 (b) C_3A_2 (c) C_3A_4 (d) C_4A_3

68. The mixture which shows positive deviation from Raoult's law is
(a) Benzene + Toluene
(b) Acetone + Chloroform
(c) Chloroethane + Bromoethane
(d) Ethanol + Acetone

69. The mixture that forms maximum boiling azeotrope is:
(a) Water + Nitric acid
(b) Ethanol + Water
(c) Acetone + Carbon disulphide
(d) Heptane + Octane

70. For a cell involving one electron $E^{\ominus}_{cell} = 0.59$ V at 298 K, the equilibrium constant for the cell reaction is :

$$\left[\text{Given that } \frac{2.303RT}{F} = 0.059 \text{ V at T} = 298 \text{ K}\right]$$

(a) 1.0×10^2 (b) 1.0×10^5
(c) 1.0×10^{10} (d) 1.0×10^{30}

71. For the cell reaction
$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(aq)$
0.24 V at 298 K. The standard Gibbs energy (Δ, $G°$) of the cell reaction is:
[Given that Faraday constant $F = 96500$ C mol^{-1}]
(a) -46.32 kJ mol^{-1} (b) -23.16 kJ mol^{-1}
(c) 46.32 kJ mol^{-1} (d) 23.16 kJ mol^{-1}

72. If the rate constant for a first order reaction is k, the time (t) required for the completion of 99% of the reaction is given by :
(a) $t = 0.693/k$ (b) $t = 6.909/k$
(c) $t = 4.606/k$ (d) $t = 2.303/k$

73. For the chemical reaction
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
the **correct** option is:
(a) $-\frac{1}{3}\frac{d[H_2]}{dt} = -\frac{1}{2}\frac{d[NH_3]}{dt}$
(b) $-\frac{d[N_2]}{dt} = 2\frac{d[NH_3]}{dt}$
(c) $-\frac{d[N_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$
(d) $3\frac{d[H_2]}{dt} = 2\frac{d[NH_3]}{dt}$

74. Which mixture of the solutions will lead to the formation of negatively charged colloidal $[AgI]I^-$ sol. ?
(a) 50 mL of 1 M $AgNO_3$ + 50 mL of 1.5 M KI
(b) 50 mL of 1 M $AgNO_3$ + 50 mL of 2 M KI
(c) 50 mL of 2 M $AgNO_3$ + 50 mL of 1.5 M KI
(d) 50 mL of 0.1 M $AgNO_3$ + 50 mL of 0.1 M KI

75. Which one is malachite from the following ?
(a) $CuFeS_2$ (n) $Cu(OH)_2$
(c) Fe_3O_4 (d) $CuCO_3.Cu(OH)_2$

76. Which is the correct thermal stability order for H_2E (E = O, S, Se, Te and Po) ?
(a) $H_2S < H_2O < H_2Se < H_2Te < H_2Po$
(b) $H_2O < H_2S < H_2Se < H_2Te < H_2Po$
(c) $H_2Po < H_2Te < H_2Se < H_2S < H_2O$
(d) $H_2Se < H_2Te < H_2Po < H_2O < H_2S$

77. Match the following:

(A)	Pure nitrogen	(i)	Chlorine
(B)	Haber process	(ii)	Sulphuric acid
(C)	Contact proces	(iii)	Ammonia
(D)	Deacon's process	(iv)	Sodium azide or Barium azide

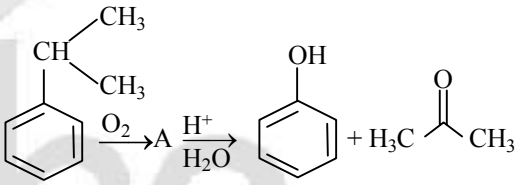
Which of the following is the **correct** option ?

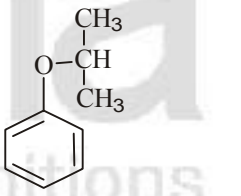
	(A)	(B)	(C)	(D)
(a)	(i)	(ii)	(iii)	(iv)
(b)	(ii)	(iv)	(i)	(iii)
(c)	(iii)	(iv)	(ii)	(i)
(d)	(iv)	(iii)	(ii)	(i)

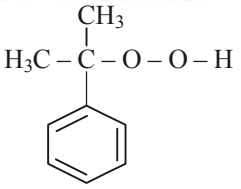
78. Identify the incorrect statement related to PCl_5 from the following:
(a) Three equatorial P – Cl bonds make an angle of 120° with each other
(b) Two axial P – Cl bonds make an angle of 180° with each other
(c) Axial P – Cl bonds are longer than equatorial P – Cl bonds
(d) $PC1_5$ molecule is non-reactive

79. What is the **correct** electronic configuration of the central atom in $K_4[Fe(CN)_6]$ based on crystal field theory ?
(a) $t_{2g}^4 e_g^2$ (b) $t_{2g}^6 e_g^0$ (c) $e_g^3 t_{2g}^3$ (d) $e_g^4 t_{2g}^2$

80. The structure of intermediate A in the following reaction, is:



(a)


(b)


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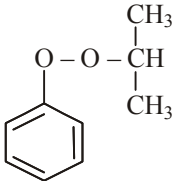
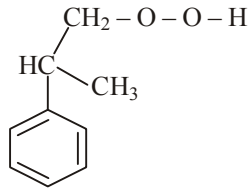
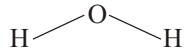
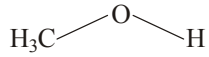
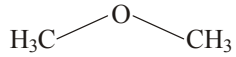


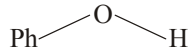
(d) 

81. The compound that is most difficult to protonate is :

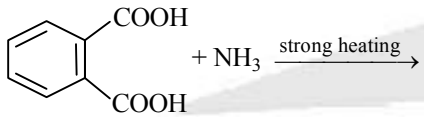
(a) 

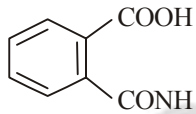
(b) 

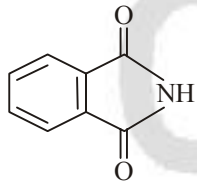
(c) 

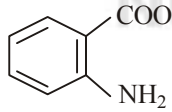
(d) 

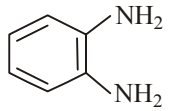
82. The major product of the following reaction is :



(a) 

(b) 

(c) 

(d) 

83. The correct order of the basic strength of methyl substituted amines in aqueous solution is :

(a) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$

(b) $(CH_3)_3N > CH_3NH_2 > (CH_3)_2NH$

(c) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2$

(d) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$

84. The non-essential amino acid among the following is:

(a) valine (b) leucine

(c) alanine (d) lysine

85. The biodegradable polymer is:

(a) nylon-6, 6 (b) nylon 2-nylon 6

(c) nylon-6 (d) Buna-S

86. Among the following, the narrow spectrum antibiotic is:

(a) penicillin G (b) ampicillin

(c) amoxycillin (d) chloramphenicol

87. For an ideal solution, the correct option is:

(a) $\Delta_{mix} V \neq 0$ at constant T and P

(b) $\Delta_{mix} H = 0$ at constant T and P

(c) $\Delta_{mix} G = 0$ at constant T and P

(d) $\Delta_{mix} S = 0$ at constant T and P

88. Which will make basic buffer ?

(a) 100 mL of 0.1 M CH_3COOH + 100 mL of 0.1 M NaOH

(b) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH

(c) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH

(d) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH_3COOH

89. The number of sigma (σ) and pi (π) bonds in pent-2-en-4-yne is:

(a) 8σ bonds and 5π-bonds

(b) 11σ bonds and 2π-bonds

(c) 13σ bonds and no π-bond

(d) 10σ bonds and 3π-bonds

90. Match the Xenon compounds in Column-I with its structure in Column-II and assign the correct code:

Column-I	**Column-II**
(A) XeF_4	(i) Pyramidal
(B) XeF_6	(ii) Square planar
(C) $XeOF_4$	(iii) Distorted octahedral
(D) XeO_3	(iv) Square pyramidal

Codes

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

BIOLOGY

91. Select the **correctly** written scientific name of Mango which was first described by Carolus Linnaeus:
(a) *Mangifera indica* Car. Linn.
(b) *Mangifera indica* Linn.
(c) Mangifera indica
(d) *Mangifera Indica*

92. The contrasting characteristics generally in a pair used for identification of animals in Taxonomic Key are referred to as :
(a) Alternate (b) Lead
(c) Couplet (d) Doublet

93. One scientist cultured Cladophora in a suspension of Azotobacter and illuminated the culture by splitting light through a prism. He observed that bacteria accumulated mainly in the region of:
(a) Blue and red light
(b) Violet and green light
(c) Indigo and green light
(d) Orange and yellow light

94. Match the organisms in column I with habitats in column II.

Column-I		Column-II
(A) Halophiles	(i)	Hot springs
(B) Thermoacidophiles	(ii)	Aquatic environment
(C) Methanogens	(iii)	Guts of ruminants
(D) Cyanobacteria	(iv)	Salty areas

Select the correct answer from the options given below:
(a) (A)-(ii), (B)-(iv), (C)-(iii), (D)-(i)
(b) (A)-(iv), (B)-(i), (C)-(iii), (D)-(ii)
(c) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
(d) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)

95. Which of the following statements is **incorrect**?
(a) Morels and truffles are edible delicacies.
(b) *Claviceps* is a source of many alkaloids and LSD.
(c) Conidia are produced exogenously and ascospores endogenously.
(d) Yeasts have filamentous bodies with long thread-like hyphae.

96. Which of the following statements is **incorrect**?
(a) Viroids lack a protein coat.
(b) Viruses are obligate parasites.
(c) Infective constituent in viruses is the protein coat.
(d) Prions consist of abnormally folded proteins.

97. Mad cow disease in cattle is caused by an organism which has :
(a) Free DNA without protein coat
(b) Inert crystalline structure
(c) Abnormally folded protein
(d) Free RNA without protein coat

98. Pinus seed cannot germinate and establish without fungal association. This is because:
(a) its embryo is immature.
(b) it has obligate association with mycorrhizae.
(c) it has very hard seed coat.
(d) its seeds contain inhibitors that prevent germination.

99. Phloem in gymnosperms lacks:
(a) Albuminous cells and sieve cells
(b) Sieve tubes only
(c) Companion cells only
(d) Both sieve tubes and companion cells

100. Which of the following animals are true coelomates with bilateral symmetry ?
(a) Annelids (b) Adult echinoderms
(c) Aschelminthes (d) Platyhelminthes

101. Consider following features:
(a) Organ system level of organisation
(b) Bilateral symmetry
(c) True coelomates with segmentation of body
Select the correct option of animal groups which possess all the above characteristics.
(a) Annelida, Arthropoda and Chordata
(b) Annelida, Arthropoda and Mollusca
(c) Arthropoda, Mollusca and Chordata
(d) Annelida, Mollusca and Chordata

102. Match the following organisms with their respective characteristics:

(A)	*Pila*	(i)	Flame cells
(B)	*Bombyx*	(ii)	Comb plates
(C)	*Pleurobrachia*	(iii)	Radula
(D)	*Taenia*	(iv)	Malpighian tubules

Select the correct option from the following:

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

103. Regeneration of damaged growing grass following grazing is largely due to:

(a) Secondary meristem (b) Lateral meristem

(c) Apical meristem (d) Intercalary meristem

104. Xylem translocates:

(a) Water only

(b) Water and mineral salts only

(c) Water, mineral salts and some organic nitrogen only

(d) Water, mineral salts, some organic nitrogen and hormones

105. Which of the statements given below is not true about formation of annual rings in trees?

(a) Annual ring is a combination of spring wood and autumn wood produced in a year.

(b) Differential activity of cambium causes light and dark bands of tissue - early and late wood respectively.

(c) Activity of cambium depends upon variation in climate.

(d) Annual rings are not prominent in trees of temperate region.

106. Match the following cell structure with its characteristic feature :

	Column-I		Column-II
(A)	Tight junctions	(i)	Cement neighbouring cells together to form sheet.
(B)	Adhering junctions	(ii)	Transmit information through chemical to another cells.
(C)	Gap junctions	(iii)	Establish a barrier to prevent leakage of fluid across epithelial cells.
(D)	Synaptic junctions	(iv)	Cytoplasmic channels to facilitate communication between adjacent cells.

Select correct option from the following :

(a) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)

(b) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)

(c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)

(d) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)

107. Which of the following statements is INCORRECT?

(a) Female cockroach possesses sixteen ovarioles in the ovaries.

(b) Cockroaches exhibit mosaic vision with less sensitivity and more resolution.

(c) A mushroom-shaped gland is present in the 6th-7th abdominal segments of male cockroach.

(d) A pair of spermatheca is present in the 6th segment of female cockroach.

108. Which of the following nucleic acids is present in an organism having 70S ribosomes only?

(a) Double stranded circular DNA with histone proteins.

(b) Single stranded DNA with protein coat.

(c) Double stranded circular naked DNA.

(d) Double stranded DNA enclosed in nuclear membrane.

109. Match the column I with column II.

	Column I		Column II
(A)	Golgi apparatus	(i)	Synthesis of protein
(B)	Lysosomes	(ii)	Trap waste and excretory products
(C)	Vacuoles	(iii)	Formation of glycoproteins and glycolipids
(D)	Ribosomes	(iv)	Digesting biomolecules

Choose the right match from options given below:

(a) (A)-(i), (B)-(ii), (C)-(iv), (D)-(iii)

(b) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)

(c) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)

(d) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)

110. Which of the following cell organelles is present in the highest number in secretory cells?
(a) Lysosome
(b) Mitochondria
(c) Golgi complex
(d) Endoplasmic reticulum

111. Concanavalin A is:
(a) an alkaloid (b) an essential oil
(c) a lectin (d) a pigment

112. Purines found both in DNA and RNA are:
(a) Adenine and thymine
(b) Adenine and guanine
(c) Guanine and cytosine
(d) Cytosine and thymine

113. Which of the following glucose transporters is insulin-dependent?
(a) GLUT I (b) GLUT II
(c) GLUT III (d) GLUT IV

114. Consider the following statements:
(A) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group.
(B) A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme.
Select the **correct** option.
(a) Both **(A)** and **(B)** are true.
(b) **(A)** is true but **(B)** is false.
(c) Both **(A)** and **(B)** are false.
(d) **(A)** is false but **(B)** is true.

115. Cells in G_0 phase :
(a) exit the cell cycle
(b) enter the cell cycle
(c) suspend the cell cycle
(d) terminate the cell cycle

116. The **correct** sequence of phases of cell cycle is:
(a) $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$ (b) $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$
(c) $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$ (d) $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

117. Which of the following is not a feature of active transport of solutes in plants ?
(a) Requires ATP
(b) Occurs against concentration gradient
(c) Non-selective
(d) Occurs through membranes

118. What will be the direction of flow of water when a plant cell is placed in a hypotonic solution ?
(a) No flow of water in any direction.
(b) Water will flow in both directions.
(c) Water will flow out of the cell.
(d) Water will flow into the cell.

119. The main difference between active and passive transport across cell membrane is :
(a) active transport occurs more rapidly than passive transport.
(b) passive transport is non-selective whereas active transport is selective.
(c) passive transport requires a concentration gradient across a biological membrane whereas active transport requires energy to move solutes.
(d) passive transport is confined to anionic carrier proteins whereas active transport is confined to cationic channel proteins.

120. What is the direction of movement of sugars in phloem?
(a) Non-multidirectional
(b) Upward
(c) Downward
(d) Bi-directional

121. Grass leaves curl inwards during very dry weather. Select the most appropriate reason from the following:
(a) Closure of stomata
(b) Flaccidity of bulliform cells
(c) Shrinkage of air spaces in spongy mesophyll
(d) Tyloses in vessels

122. Which of the following bacteria reduce nitrate in soil into nitrogen ?
(a) *Nitrosomonas* (b) *Nitrobacter*
(c) *Nitrococcus* (d) *Thiobacillus*

123. *Thiobacillus* is a group of bacteria helpful in carrying out:
(a) Nitrogen fixation
(b) Chemoautotrophic fixation
(c) Nitrification
(d) Denitrification

124. In Hatch and Slack pathway, the primary CO_2 acceptor is
(a) Rubisco
(b) Oxaloacetic acid
(c) Phosphoglyceric acid
(d) Phosphoenol pyruvate

125. Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalysed by:
(a) Aldolase
(b) Hexokinase
(c) Enolase
(d) Phosphofructokinase

126. Where is the respiratory electron transport system (ETS) located in plants ?
(a) Intermembrane space
(b) Mitochondrial matrix
(c) Outer mitochondrial membrane
(d) Inner mitochondrial membrane

127. Respiratory Quotient (RQ) value of tripalmitin is:
(a) 0.9 (b) 0.7
(c) 0.07 (d) 0.09

128. Removal of shoot tips is a very useful technique to boost the production of tealeaves. This is because :
(a) Gibberellins delay senescence of leaves.
(b) Gibberellins prevent bolting and are inactivated.
(c) Auxins prevent leaf drop at early stages.
(d) Effect of auxins is removed and growth of lateral buds is enhanced.

129. In order to increase the yield of sugarcane crop, which of the following plant growth regulators should be sprayed?
(a) Cytokinins (b) Ethylene
(c) Auxins (d) Gibberellins

130. It takes very long time for pineapple plants to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield?
(a) Auxin and Ethylene
(b) Gibberellin and Cytokinin
(c) Gibberellin and Abscisic acid
(d) Cytokinin and Abscisic acid

131. What is the site of perception of photoperiod necessary for induction of flowering in plants ?
(a) Lateral buds (b) Pulvinus
(c) Shoot apex (d) Leaves

132. Match the items given in Column-I with those in Column-II and choose the correct option.

Column-I	Column-II
(A) Rennin	(i) Vitamin B_{12}
(B) Enterokinase	(ii) Facilitated transport
(C) Oxyntic cells	(iii) Milk proteins
(D) Fructose	(iv) Trypsinogen

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

133. Identify the cells whose secretion protects the lining of gastro-intestinal tract from various enzymes.
(a) Chief cells (b) Goblet cells
(c) Oxyntic cells (d) Duodenal cells

134. Match the following structures with their respective location in organs:

(A) Crypts of Lieberkuhn	(i) Pancreas
(B) Glisson's capsule	(ii) Duodenum
(C) Islets of Langerhans	(iii) Small intestine
(D) Brunner's glands	(iv) Liver

Select the **correct** option from the following:

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

135. Tidal volume and Expiratory reserve volume of an athlete is 500 mL and 1000 mL respectively. What will be his Expiratory capacity if the residual volume is 1200 mL?
(a) 1500 mL (b) 1700 mL
(c) 2200 mL (d) 2700 mL

136. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to:
(a) benign growth on mucous lining of nasal cavity.
(b) inflammation of bronchi and bronchioles.
(c) proliferation of fibrous tissues and damage of the alveolar walls.
(d) reduction in the secretion of surfactants by pneumocytes.

137. All the components of the nodal tissue are autoexcitable. Why does the SA node act as the normal pacemaker?

(a) SA node has the highest rate of depolarisation.

(b) SA node has the lowest rate of depolarisation.

(c) SA node is the only component to generate the threshold potential.

(d) Only SA node can convey the action potential to the other components.

138. A specialised nodal tissue embedded in the lower corner of the right atrium, close to Atrio-ventricular septum, delays the spreading of impulses to heart apex for about 0.1 sec.

This delay allows

(a) the atria to empty completely.

(b) blood to enter aorta.

(c) the ventricles to empty completely.

(d) blood to enter pulmonary arteries.

139. Match the Column-I with Column-II.

	Column-I		Column-II
(A)	P-wave	(i)	Depolarisation of ventricles
(B)	QRS complex	(ii)	Repolarisation of ventricles
(C)	T - wave	(iii)	Coronary ischemia
(D)	Reduction in the size of T-wave	(iv)	Depolarisation of atria
		(v)	Repolarisation of atria

Select the **correct** option.

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

140. What would be the heart rate of a person if the cardiac output is 5 L, blood volume in the ventricles at the end of diastole is 100 mL and at the end of ventricular systole is 50 mL?

(a) 50 beats per minute (b) 75 beats per minute

(c) 100 beats per minute (d) 125 beats per minute

141. Which of the following factors is responsible for the formation of concentrated urine ?

(a) Low levels of antidiuretic hormone.

(b) Maintaining hyperosmolarity towards inner medullary interstitium in the kidneys.

(c) Secretion of erythropoietin by juxtaglomerular complex.

(d) Hydrostatic pressure during glomerular filtration.

142. Use of an artificial kidney during hemodialysis may result in:

(A) Nitrogenous waste build-up in the body.

(B) Non-elimination of excess potassium ions.

(C) Reduced absorption of calcium ions from gastro-intestinal tract.

(D) Reduced RBC production.

Which of the following options is the most **appropriate**?

(a) (A) and (B) are correct

(b) (B) and (C) are correct

(c) (C) and (D) are correct

(d) (A) and (D) are correct

143. Select the correct option:

(a) 8^{th}, 9^{th} and 10^{th} pairs of ribs articulate directly with the sternum.

(b) 11^{th} and 12^{th} pairs of ribs are connected to the sternum with the help of hyaline cartilage.

(c) Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum.

(d) There are seven pairs of vertebrosternal, three pairs of vertebrochondral and two pairs of vertebral ribs.

144. Which of the following muscular disorders is inherited?

(a) Tetany (b) Muscular dystrophy

(c) Myasthenia gravis (d) Botulism

145. Which of the following statements is not correct?

(a) In the knee-jerk reflex, stimulus is the stretching of muscle and response is its contraction.

(b) An action potential in an axon does not move backward because the segment behind is in a refractory phase.

(c) Depolarisation of hair cells of cochlea results in the opening of the mechanically gated potassium-ion channels.

(d) Rods are very sensitive and contribute to daylight vision.

146. Match the following hormones with the respective disease:

(A)	Insulin	(i)	Addison's disease
(B)	Thyroxine	(ii)	Diabetes insipidus
(C)	Corticoids	(iii)	Acromegaly
(D)	Growth hormone	(iv)	Goitre
		(v)	Diabetes mellitus

Select the correct option.

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

147. In some plants, the female gamete develops into embryo without fertilisation. This phenomenon is known as :

(a) Autogamy (b) Parthenocarpy

(c) Syngamy (d) Parthenogenesis

148. What is the fate of the male gametes discharged in the synergid?

(a) One fuses with the egg, other(s) degenerate(s) in the synergid.

(b) All fuse with the egg.

(c) One fuses with the egg, other(s) fuse(s) with synergid nucleus.

(d) One fuses with the egg and other fuses with central cell nuclei.

149. Which one of the following statements regarding post-fertilisation development in flowering plants is incorrect?

(a) Ovary develops into fruit.

(b) Zygote develops into embryo.

(c) Central cell develops into endosperm.

(d) Ovules develop into embryo sac.

150. Persistent nucellus in the seed is known as:

(a) Chalaza (b) Perisperm

(c) Hilum (d) Tegmen

151. Extrusion of second polar body from egg nucleus occurs:

(a) after entry of sperm but before fertilisation

(b) after fertilisation

(c) before entry of sperm into ovum

(d) simultaneously with first cleavage

152. Select the **correct** sequence for transport of sperm cells in male reproductive system

(a) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra

(b) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus

(c) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra

(d) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal → Urethra → Urethral meatus

153. Which of the following contraceptive methods do involve a role of hormone?

(a) Lactational amenorrhea, Pills, Emergency contraceptives

(b) Barrier method, Lactational amenorrhea, Pills

(c) CuT, Pills, Emergency contraceptives

(d) Pills, Emergency contraceptives, Barrier methods

154. Select the hormone-releasing Intra-Uterine Devices.

(a) Vaults, LNG-20

(b) Multiload 375, Progestasert

(c) Progestasert, LNG-20

(d) Lippes Loop, Multiload 375

155. Which of the following sexually transmitted diseases is not completely curable?

(a) Gonorrhoea (b) Genital warts

(c) Genital herpes (d) Chlamydiasis

156. In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation, pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the incorrect statement from the following:

(a) This experiment does not follow the principle of dominance.

(b) Pink colour in F_1 is due to incomplete dominance.

(c) Ratio of F_2 is $\frac{1}{4}$ (Red): $\frac{1}{2}$ (Pink): $\frac{1}{4}$ (White)

(d) Law of Segregation does not apply in this experiment.

157. What map unit (Centimorgan) is adopted in the construction of genetic maps?
(a) A unit of distance between two expressed genes, representing 10% cross over.
(b) A unit of distance between two expressed genes, representing 100% cross over.
(c) A unit of distance between genes on chromosomes, representing 1% cross over.
(d) A unit of distance between genes on chromosomes, representing 50% cross over

158. Select the incorrect statement.
(a) Male fruit fly is heterogametic.
(b) In male grasshoppers, 50% of sperms have no sex-chromosome.
(c) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.
(d) Human males have one, of their sex-chromosome much shorter than the other.

159. Under which of the following conditions will there be no change in the reading frame of following mRNA ?
5′ AACAGCGGUGCUAUU 3′
(a) Insertion of G at 5^{th} position
(b) Deletion of G from 5^{th} position
(c) Insertion of A and G at 4^{th} and 5^{th} positions respectively
(d) Deletion of GGU from 7^{th}, 8^{th} and 9^{th} positions

160 Expressed Sequence Tags (ESTs) refers to:
(a) Genes expressed as RNA
(b) Polypeptide expression
(c) DNA polymorphism
(d) Novel DNA sequences

161. Match the following genes of the Lac operon with their respective products:

(A)	i gene	(i)	β-galactosidase
(B)	z gene	(ii)	Permease
(C)	a gene	(iii)	Repressor
(D)	y gene	(iv)	Transacetylase

Select the **correct** option.

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

162. A population of a species invades a new area. Which of the following condition will lead to adaptive radiation?
(a) Area with many habitats occupied by a large number of species.
(b) Area with large number of habitats having very low food supply.
(c) Area with a single type of vacant habitat.
(d) Area with many types of vacant habitats.

163. In Australia, marsupials and placental mammals have evolved to share many similar characteristics. This type of evolution may be referred to as
(a) Convergent evolution
(b) Adaptive radiation
(c) Divergent evolution
(d) Cyclical evolution

164. In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weights from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place?
(a) Directional selection (b) Stabilising selection
(c) Disruptive selection (d) Cyclical selection

165. Which of the following statements is correct about the origin and evolution of men?
(a) Neanderthal men lived in Asia between 1,00,000 and 40,000 years back.
(b) Agriculture came around 50,000 years back.
(c) The *Dryopithecus* and *Ramapithecus* primates existing 15 million years ago, walked like men.
(d) *Homo habilis* probably ate meat.

166. A gene locus has two alleles A, a. If the frequency of dominant allele A is 0.4, then what will be the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population ?
(a) 0.36 (AA); 0.48 (Aa); 0.16 (aa)
(b) 0.16 (AA); 0.24 (Aa); 0.36 (aa)
(c) 0.16 (AA); 0.48 (Aa); 0.36 (aa)
(d) 0.16 (AA); 0.36 (Aa); 0.48 (aa)

167. Match the hominids with their **correct** brain size:

(A)	*Homo habilis*	(i)	900 cc
(B)	*Homo neanderthalensis*	(ii)	1350 cc
(C)	*Homo erectus*	(iii)	650 - 800 cc
(D)	*Homo sapiens*	(iv)	1400 cc

Select the **correct** option.

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

168. Variations caused by mutation, as proposed by Hugo de Vries, are:
(a) random and directional
(b) random and directionless
(c) small and directional
(d) small and directionless

169. Identify the **correct** pair representing the causative agent of typhoid fever and the confirmatory test for typhoid.
(a) *Plasmodium vivax* / UTI test
(b) *Streptococcus pneumoniae* / Widal test
(c) *Salmonella typhi* / Anthrone test
(d) *Salmonella typhi* / Widal test

170. Colostrum, the yellowish fluid, secreted by mother during the initial days of lactation is very essential to imparting immunity to the newborn infants because it contains:
(a) Natural killer cells (b) Monocytes
(c) Macrophages (d) Immunoglobulin A

171. Select the incorrect statement regarding inbreeding.
(a) Inbreeding depression cannot be overcome by out-crossing.
(b) Inbreeding helps in elimination of deleterious alleles from the population.
(c) Inbreeding is necessary to evolve a pure line in any animal.
(d) Continued inbreeding reduces fertility and leads to inbreeding depression.

172. Select the **incorrect** statement.
(a) Inbreeding increases homozygosity.
(b) Inbreeding is essential to evolve purelines in any animal.
(c) Inbreeding selects harmful recessive genes that reduce fertility and productivity.
(d) Inbreeding helps in accumulation of superior genes and elimination of undesirable genes.

173. 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)

174. Match the following organisms with the products they produce:

(A)	*Lactobacillus*	(i) Cheese
(B)	*Saccharomyces cerevisiae*	(ii) Curd
(C)	*Aspergillus niger*	(iii) Citric acid
(D)	*Acetobacter aceti*	(iv) Bread
		(v) Acetic acid

Select the correct option.

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

175. Which of the following is a commercial blood cholesterol lowering agent?
(a) Cyclosporin A (b) Statin
(c) Streptokinase (d) Lipases

176. Select the correct group of biocontrol agents.
(a) *Bacillus thuringiensis*, Tobacco mosaic virus, Aphids
(b) Trichoderma, *Baculovirus*, *Bacillus thuringiensis*
(c) *Oscillatoria*, *Rhizobium*, *Trichoderma*
(d) *Nostoc*, *Azospirillium*, *Nucleopolyhedrovirus*

177. Which of the following can be used as a biocontrol agent in the treatment of plant disease?
(a) *Trichoderma* (b) *Chlorella*
(c) *Anabaena* (d) *Lactobacillus*

178. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes?
(a) BOD incubator (b) Sludge digester
(c) Industrial oven (d) Bioreactor

179. Following statements describe the characteristics of the enzyme Restriction Endonuclease. Identify the **incorrect** statement.
(a) The enzyme cuts DNA molecule at identified position within the DNA.
(b) The enzyme binds DNA at specific sites and cuts only one of the two strands.
(c) The enzyme cuts the sugar-phosphate backbone at specific sites on each strand.
(d) The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.

180. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with:
(a) Isopropanol
(b) Chilled ethanol
(c) Methanol at room temperature
(d) Chilled chloroform

HINTS & SOLUTIONS

PHYSICS

1. (d) In steady state, the amount of heat flowing from one face to the other face in time dt is given by

$$H \quad \frac{kA(T_1 - T_2)dt}{\ell}$$

$$\Rightarrow \frac{dH}{dt} \quad \frac{kA}{\ell} \; \Delta T \; (k = \text{coefficient of thermal conductivity})$$

$$\therefore \; k \quad \frac{\ell dH}{A \, dt \, \Delta T}$$

Unit of $k = Wm^{-1} K^{-1}$

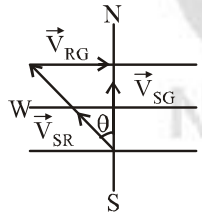
2. (b) Given, $x \quad \frac{A^2 B^{1/2}}{C^{1/3} D^3}$

$$\% \text{ error}, \frac{\Delta x}{x} \times 100 = 2\frac{\Delta A}{A} \times 100 + \frac{1}{2}\frac{\Delta B}{B} \times 100 + \frac{1}{3}\frac{\Delta C}{C} \times 100 + 3\frac{\Delta D}{D} \times 100$$

$$= 2 \times 1\% + \frac{1}{2} \times 2\% + \frac{1}{3} \times 3\% + 3 \times 4\%$$

$$= 2\% + 1\% + 1\% + 12\% = 16\%$$

3. (a) Velocity of swimmer w.r.t. river $V_{SR} = 20$ m/s
Velocity of river w.r.t. ground $V_{RG} = 10$ m/s



$$\vec{V}_{SG} \quad \vec{V}_{SR} \quad \vec{V}_{RG}$$

$$\sin\theta = \left|\frac{\vec{V}_{RG}}{\vec{V}_{SR}}\right| \Rightarrow \sin\theta \quad \frac{10}{20}$$

$$\Rightarrow \quad \sin\theta = \frac{1}{2} \quad \therefore \quad \theta \quad 30 \quad \text{west}$$

i.e.,to cross the river along the shortest path, swimmer should make his strokes 30° west.

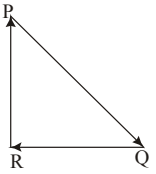
4. (c) As three forces are forming closed loop in same order, so net force is zero.

$$i.e., \; \vec{F}_{net} \quad 0$$

$$\text{or} \quad m\frac{d\vec{v}}{dt} \quad 0$$

$\therefore$ Velocity of the particle

$$\vec{v} = \text{Constant}$$



5. (c) Given mass of block, m = 10 kg; radius of cylindrical drum, r = 1m; coefficient of friction between the block and the inner wall of the cylinder $\mu = 0.1$;
Minimum angular velocity ω_{min}
For equilibrium of the block limiting friction

$$f_L \geq mg$$

$$\Rightarrow \quad \mu N \geq mg$$

$$\Rightarrow \quad \mu r\omega^2 \geq mg$$

Hrere, $N = mr\omega^2$

$$\text{or,} \quad m \geq \sqrt{\frac{g}{r\mu}}$$

$$\text{or,} \quad \omega_{min} \quad \sqrt{\frac{g}{r\mu}}$$

$$\therefore \; \omega_{min} \quad \sqrt{\frac{10}{0.1 \times 1}} \quad 10 \text{ rad/s}$$

6. (c) Work done by variable force

$$\text{Work done}, W = \int_{y_i}^{y_f} F dy \Rightarrow \int_{y \; 0}^{y_f \; 1} F \; dy$$

where, $F = 20 + 10y$

$$\therefore \quad W \quad \int_0^1 20 \quad 10y \; dy$$

$$\left[20y \quad \frac{10y^2}{2} \right]_0^1 \quad 25 \, J$$

7. (b) $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Also, $\frac{1}{2}m_1u_1^2 \quad \frac{1}{2}m_2u_2^2$

$$\frac{1}{2}m_1v_1^2 \quad \frac{1}{2}m_2v_2^2$$

For elastic collision

$$v_2 = \frac{2m_1u_1}{m_1 + m_2}$$

as $u_2 = 0$; $u_1 = u$

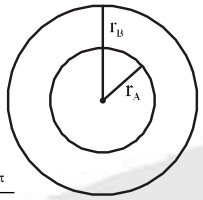
$m_1 = 4m$ and $m_2 = 2m$

so, $v_2 = \frac{4}{3}u$

$$\frac{\Delta KE}{KE} = \frac{1}{2} \times 2m \times \left(\frac{4}{3}u\right)^2$$

$$= \frac{1}{2} \times 2 \times \frac{16}{9}$$

8. (d) Let T_A and T_B are the time periods of particle A and B respectively. According to question,



$T_A = T_B = T$

If ω_A and ω_B are their angular speeds, then

$$\omega_A = \frac{2\pi}{T_A} \text{ and } \omega_B = \frac{2\pi}{T_B}$$

$$\therefore \frac{\omega_A}{\omega_B} = \frac{T_B}{TA} = \frac{T}{T} = 1:1$$

9. (a) According to the Work-energy theorem,

$$W = \frac{1}{2}I(\omega_f^2 - \omega_i^2)$$

Given that,

$\theta = 2\pi$ revolution/minute

$\theta = 2\pi \times 2\pi = 4\pi^2$ rad

$$\omega_i = 3 \times \frac{2\pi}{60} \text{ rad/s}$$

$\omega_f = 0$ rad/s

Putting the values of ω_f and ω_i we get

$$\Rightarrow -\tau\theta = \frac{1}{2} \times \frac{1}{2}mr^2(0^2 - \omega_i^2)$$

$$\Rightarrow -\tau = \frac{\frac{1}{2} \times \frac{1}{2} \times 2 \times 4 \times 10^{-2}\left(-3 \times \frac{2\pi}{60}\right)^2}{4\pi^2}$$

$\Rightarrow \tau = 2 \times 10^{-6}$ N-m

10. (a) Work done to stop the disc = change in total kinetic energy of disc

Final KE = 0

Initial KE = Translational K.E. + Rotational K.E.

$$\frac{1}{2}mv^2 \quad \frac{1}{2}I_\omega{}^2$$

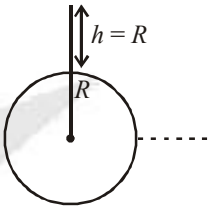
$$= \frac{1}{2}mv^2 + \frac{1}{2} \times \frac{mR^2}{2} \times \left(\frac{v}{R}\right)^2$$

$$\frac{1}{2}mv^2 \quad \frac{1}{4}mv^2 \quad \frac{3}{4}mv^2$$

$$= \frac{3}{4} \times 100 \times (20 \times 10^{-2})^2 = 3J$$

$|\Delta KE| = 3J$

11. (c) Mass to be raised = m



Potential energy at the surface of the earth

$$U_{surface} = \frac{-GMm}{R}$$

Potential energy at a height from the surface of the earth $h = R$

$$U_{height} = \frac{-GMm}{2R}$$

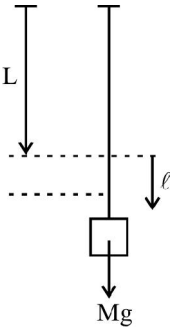
According to work-energy theorem, work done = change in PE

$\therefore W = U_{height} - U_{surface}$

$$\Rightarrow \frac{-GMm}{2R} - \left(-\frac{GMm}{R}\right)$$

$$\frac{GMm}{2R} \quad \frac{gR^2m}{2R} \quad \frac{mgR}{2} \quad (\because GM = gR^2)$$

12. (c) Here,



$Kx_0 \quad Mg$

where K = force constant

$$\Delta E = \frac{1}{2}Kx_0^2$$

$$= \frac{1}{2}\frac{Mg}{x_0} \times x_0^2$$

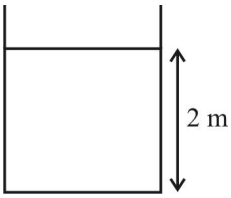
$$= \frac{1}{2}Mgx_0$$

Stored elastic potential energy in extended wire,

$$= \frac{1}{2}Mg\ell \text{ [here } x_0 = \ell]$$

13. (a) Volumetric flow rate of liquid

Q au $a\sqrt{2gh}$



$= 2\times10^{-6}\,m^2 \times \sqrt{2\times10\times2}$ m/s

$= 2\times2\times3.14\times10^{-6}\,m^3/s$

$= 12.56\times10^{-6}\,m^3/s$

$= 12.6\times10^{-6}\,m^3/s$

14. (c) Pressure inside the soap bubble

$= P_0 + \frac{4T}{R}$

And pressure at a point below the surface of water $= \rho\, gZ_0 + P_0$

[where P_0 = atmospheric pressure]

By equating these pressure we get,

$$P_0 + \frac{4T}{R} = P_0 + \rho g Z_0$$

$$Z_0 = \frac{4T}{R\times\rho g}$$

$$Z_0 = \frac{4\times2.5\times10^{-2}}{10^{-3}\times1000\times10}\,m$$

$Z_0 = 1$ cm

15. (d) $l'_{Cu} = l_{Cu}(1+\alpha_{Cu}\Delta T)$

$\Delta l_{Cu} = l_{Cu}\alpha_{Cu}\Delta T$

$l'_{Al} = l_{Al}(1+\alpha_{Al}\Delta T)$

$\Delta l_{Al} = l_{Al}\alpha_{Al}\Delta T$

Since, change in length is independent of temperature

$\therefore \alpha_{Cu} l_{Cu} = \alpha_{Al} l_{Al}$

$\Rightarrow 1.7\times10^{-5}\times88\text{ cm} = 2.2\times10^{-5}\times l_{Al}$

$\Rightarrow l_{Al} \quad \frac{1.7\times88}{2.2} \quad 68$ cm

16. (b) Using first law of thermodynamics equation,

$\Delta Q = \Delta U + \Delta W$

$\Rightarrow 54\times4.18$

$= \Delta U + 1.013\times10^5(167.1\times10^{-6}-0)$

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

$\Rightarrow \Delta U = 208.7$ J

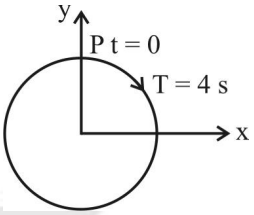
17. (b) In adiabatic process, there is no exchange of heat, with the surroundings.

18. (b) U $\frac{F}{2}$nRT

As U T

$\therefore$ Increase in temperature would lead to the increase in kinetic energy of gas.

19. (d) At t = 0, y = 3, which is maximum displacement so equation will be cosine function.



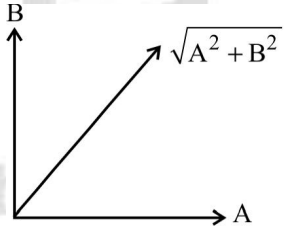
$\omega \quad \frac{2\pi}{T} \quad \frac{2\pi}{4} \quad \frac{\pi}{2}$ rad/s $(\because T = 4\text{ s})$

$y = a\cos\omega t \Rightarrow y \quad 3\cos\frac{\pi}{2}t$

20. (d) Displacement of the particle in one complete vibration is zero, so, average velocity in one complete vibration will be

$\frac{\text{Displacement}}{\text{Time interval}} \quad \frac{y_f - y_i}{T} \quad 0$

21. (b)



Given equation

$y = A_0 + A\sin\omega t + B\sin\omega t$

Now assume $(y - A_0) = \gamma$

$y - A_0 = A\sin\omega t + B\sin\omega t$

$\gamma = A\sin\omega t + B\cos\omega t$

$\sqrt{A^2 \quad B^2}\ \sin(\omega t + \phi)$

which is S.H.M.

where cos

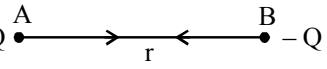
and sin ϕ $\frac{B}{\sqrt{A^2 \quad B^2}}$

so, resultant amplitude

$$\sqrt{A^2 \quad B^2}$$

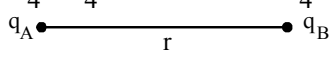
22. (b) We know that,

$$F \quad \frac{kQ^2}{r^2}$$



If 25% of charges of A transfer to B then

$$q_A = Q - \frac{Q}{4} \quad \frac{3Q}{4} \text{ and } q_B \quad -Q \quad \frac{Q}{4} \quad \frac{-3Q}{4}$$



$$F_1 \quad \frac{kq_Aq_B}{r^2}$$

$$\Rightarrow \quad F_1 \quad \frac{k\left(\frac{3Q}{4}\right)^2}{r^2} \quad \frac{9}{16}\frac{kQ}{r^2} \quad \frac{9F}{16}$$

23. (c) Electric field due to line charge (1)

$$\vec{E}_1 \quad \frac{\lambda}{2\pi\varepsilon_0 R}\hat{i}N/C$$

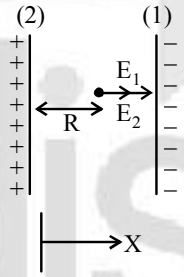
Electric field due to line charge (2)

$$\vec{E}_2 \quad \frac{\lambda}{2\pi\varepsilon_0 R}\hat{i}N/C$$

$$\vec{E}_{net} \quad \vec{E}_1 \quad \vec{E}_2$$

$$\frac{\lambda}{2\pi\varepsilon_0 R}\hat{i} \quad \frac{\lambda}{2\pi\varepsilon_0 R}\hat{i}$$

$$\frac{\lambda}{\pi\varepsilon_0 R}\hat{i}N/C$$



NOTES

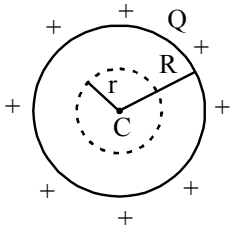
Both $\vec{E}_1$ and $\vec{E}_2$ are in the same direction.

Electric field at a point due to *+ve* charge (*+q*) acts away from the charge and due to negative charge (*–q*) it acts towards the charge.

24. (b) Charge Q will be distributed over the surface of hollow metal sphere.

(i) For r < R (inside)

[At a point inside the hollow sphere]



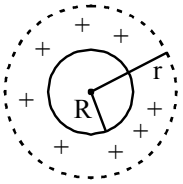
By Gauss's law, $\oint \vec{E}_{in} \cdot \vec{dS} \quad \frac{q_{en}}{\varepsilon_0} \quad 0$

As enclosed charge is = 0

So, $E_{in} = 0$ the electric field inside the hollow sphere is always zero.

(ii) For r > R (outside)

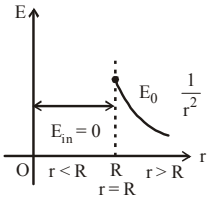
[At a point outside hollow sphere]



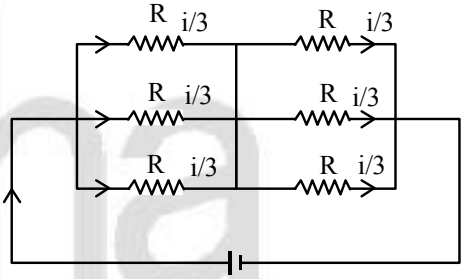
By Gauss's law, $\oint \vec{E}_0 \cdot \vec{dS} \quad \frac{q_{en}}{\varepsilon_0} \quad (\because q_{en} = Q)$

$$\therefore \quad E_0 4\pi r^2 \quad \frac{Q}{\varepsilon_0}$$

$$\therefore \quad E_0 \quad \frac{1}{r^2}$$



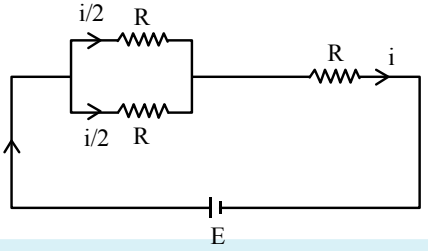
25. (b) When all bulbs are glowing



$$R_{eq} \quad \frac{R}{3} \quad \frac{R}{3} \quad \frac{2R}{3}$$

$$\text{Power } (P_i) \quad \frac{E^2}{R_{eq}} \quad \frac{3E^2}{2R} \qquad \ldots(i)$$

When two from section A and one from section B are glowing, then



$R_{eq} \quad \frac{R}{2} \quad R \quad \frac{3R}{2}$

Power $(P_f) \quad \frac{2E^2}{3R}$ ...(ii)

Dividing equation (i) by (ii) we get

$\frac{P_i}{P_f} \quad \frac{3E^2 3R}{2R\ 2E^2} \quad 9:4$

26. (c) Resistance for ideal voltmeter = ∞
Resistance for ideal ammeter = 0
For I[st] circuit,

$V_1 = i_1 \times 10 = \frac{10}{10} \times 10 \quad 10$ volt

For II[nd] circuit,

$V_2 = i_2 \times 10 = \frac{10}{10} \times 10 \quad 10$ volt

$V_1 = V_2$ and, $i_1 \quad i_2 \quad \frac{10V}{10\Omega} \quad 1A$

27. (a) Radius of the path $r \quad \frac{mv}{qB} \quad \frac{P}{qB}$

For H^+ion, $r_H \quad \frac{p_H}{eB}$

For α particle

$r_\alpha \quad \frac{p_\alpha}{2eB}$

$\frac{r_H}{r_\alpha} \quad \frac{\frac{p}{eB}}{\frac{p}{2eB}}$

[as given $p_H = p_\alpha = p$]

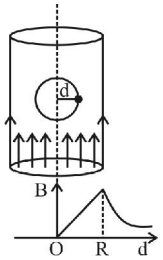
$\Rightarrow \quad \frac{r_H}{r_\alpha} \quad \frac{2}{1}$

28. (c) Inside $(d < R)$
Magnetic field inside conductor
$B = Kd$ ..... (i)
This is straight line passing through origin
At surface $(d = R)$

$B \quad \frac{\mu_0}{2\pi}\frac{1}{d}$

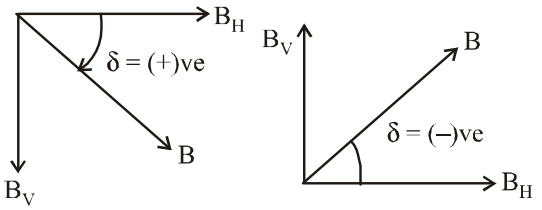
Maximum at surface
Outside $(d > R)$

$B \quad \frac{\mu_0}{2\pi}\frac{1}{d}$



or $B \quad \frac{1}{d} \quad \therefore$ Hyperbolic

29. (c) As we know that the angle of dip is the angle between earth's resultant magnetic field from horizontal.



At equator, dip is zero. At Northern hemisphere, dip is positive. At southern hemisphere, dip is negative.

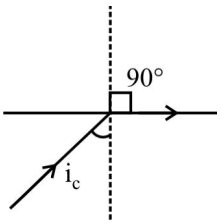
30. (d) Given :
Magnetic field $B = 5 \times 10^{-5}$ T
Number of turns in coil $N = 800$
Area of coil $A = 0.05\ m^2$
Time taken to rotate $= \Delta t = 0.1$ s
Initial angle $\theta_1 = 0°$
Final angle $\theta_2 = 90°$
Change in magnetic flux $\Delta\phi$
$= NBA \cos 90° - BA \cos 0°$
$= -NBA$
$= -800 \times 5 \times 10^{-5} \times 0.05$
$= -2 \times 10^{-2}$ weber

$\theta = -\frac{\Delta\phi}{\Delta t} \quad \frac{-(-)2\times10^{-3}\ Wb}{0.1\ s} \quad 0.02$ V

31. (d) An electric heater works on the principle of Joule's heating effect and it does not involve Eddy currents.

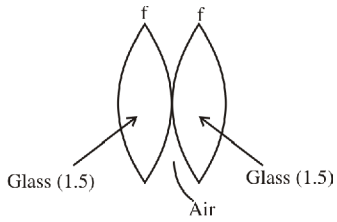
32. (a) $\lambda_{Red} > \lambda_{Green} > \lambda_{Blue} > \lambda_{Violet}$. Red has the longest wavelength.

33. (d) For total internal reflection when $i = i_c$, then



refracted ray grazes with the surface. That means the angle of refraction $r = 90°$.

34. (b)

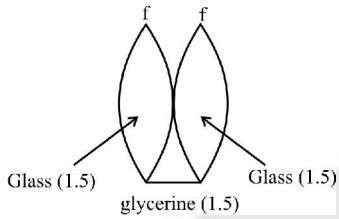


Equivalent focal length in air

$$\frac{1}{F_1} \quad \frac{1}{f} \quad \frac{1}{f} \quad \frac{2}{f}$$

$$\Rightarrow F_1 \quad \frac{f}{2} \qquad ...(i)$$

When glycerin is filled inside, it behaves like a concave lens of focal length (–f)



$$\therefore \quad \frac{1}{F_2} \quad \frac{1}{f} \quad \frac{1}{f} - \frac{1}{f} \qquad \Rightarrow F_2 = f \qquad ...(ii)$$

Dividing (i) by (ii), we get

$$\frac{F_1}{F_2} \quad \frac{1}{2}$$

35. (c) Rainbow will be observed only when the sun is at the back side of observer.

36. (b) For double slit experiment angular fringe width $\theta_0 \quad \frac{\beta}{D}$

Angular fringe width (in water)

$$\theta_w \quad \frac{\beta}{\mu D} \quad \frac{\theta_0}{\mu}$$

$$\frac{0.2}{\left(\frac{4}{3}\right)} \quad 0.15$$

37. (b) de-Broglie wavelength of electron

$$\lambda \quad \frac{12.27}{\sqrt{V}} \text{Å} \quad \frac{12.27\times10^{-10}}{\sqrt{10000}} \quad 12.27\times10^{-12}\,\text{m}$$

38. (c) According to Bohr's model of H-atom, the relation between kinetic energy, potential energy and total energy

$$\text{K.E.} \quad |\text{TE}| \quad \frac{|\text{P.E.}|}{2}$$

so, K.E. = – (T.E.)

$\therefore$ K.E. = 3.4 eV

and P.E. = 2 (T.E)

$\Rightarrow$ P.E. = – 6.8 eV

39. (a) α -particle is nucleus of helium He^{++} which has two protons and two neutrons.

40. (b) In p-type semiconductor, trivalent impurities are added to intrinsic semiconductor, which creates holes which are majority charge carriers.

41. (c) From the given logic circuit, LED will glow, when voltage across LED is high.

Truth Table

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

Boolean expression $Y = \overline{A.B}$

i.e., circuit represents NAND gate.

42. (c) Given, weight of the body, $w = 200$ N

As we know,

$w = mg$, where m is the mass of the body and g (= 10 m/s^2) is acceleration due to gravity of the body at the surface of the earth.

Since, mass m remains constant irrespective of the position of the body on the earth. However, g is not constant and its value at a depth d below the earth's surface is given as

$$g' = g\left(1-\frac{d}{R}\right) \qquad ...(i)$$

where, R is the radius of the earth.

Multiplying m on the both sides of Eq. (i), we get

$$mg' = mg\left(1-\frac{d}{R}\right)$$

Thus, the weight of the body at half way down $\left(\text{i.e. } d \quad \frac{R}{2}\right)$ to the centre of the earth is

$$mg' = 200\times\left(1-\frac{R/2}{R}\right)$$

$$= 200\left(1-\frac{1}{2}\right) = 200\times\frac{1}{2} = 100$$

$\therefore$ The body will weight 100 N half way down to the centre of the earth.

43. (c) Among given devices fuse is used in electric circuit as a protective device.

It helps in preventing excessive amount of current to flow in the circuit or from short circuiting.
It has low melting point and low resistivity, so when excess amount of current flow in the circuit, it melts and break the circuit.

44. (a) Given, $C = 20_{\mu}\,F = 20 \times 10^{-6}\,F$ and

$$\frac{dV}{dt} = 3V/s$$

The displacement current in a circuit is given by

$$I_d = \varepsilon_0 \frac{d\phi}{dt} \qquad \text{[from Maxwell's equation]}$$

$$= \varepsilon_0 \frac{d}{dt}(EA) \qquad [\because \phi = EA]$$

$$= \varepsilon_0 A \frac{d}{dt}\left(\frac{V}{d}\right) \qquad [\because V = Ed]$$

$$= \frac{\varepsilon_0 A}{d}\frac{dV}{dt}$$

As the capacitance, $C = \frac{\varepsilon_0 A}{d}$

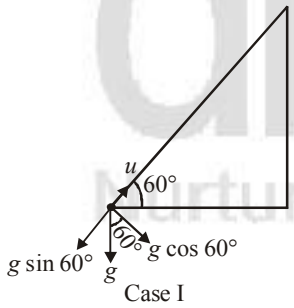
$$I_d = C\frac{dV}{dt}$$

Substituting the given values, we get

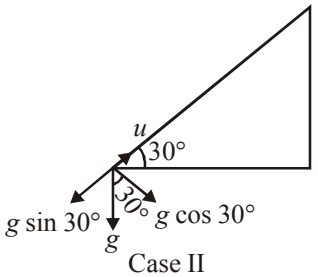
$I_d = 20 \times 10^{-6} \times 3$

$= 60 \times 10^{-6}\,A = 60_{\mu}\,A$

45. (b) The motion of object shot in two cases can be depicted as below



Case I



Case II

Using third equation of motion,

$v^2 = u^2 - 2gh$ ...(i)

As the object stops finally, so

$v = 0$

For inclined motion,

$g = g\sin\theta$ and $h = x$

Substituting these values in Eq. (i), we get

$$\Rightarrow \quad u^2 = 2g\sin\theta\, x \Rightarrow \quad x = \frac{u^2}{2g\sin\theta}$$

For case (I), $x_1 = \frac{u^2}{2g\sin 60}$

For case (II), $x_2 = \frac{u^2}{2g\sin 30}$

$$\Rightarrow \quad \frac{x_1}{x_2} = \frac{u^2}{2g\sin 60} \times \frac{2g\sin 30}{u^2}$$

$$= \frac{1}{2} \times \frac{2}{\sqrt{3}} \quad \frac{1}{\sqrt{3}} \text{ or } 1 : \sqrt{3}$$

CHEMISTRY

46. (c) $N_2 + 3H_2 \rightarrow 2NH_3$

$1\ \text{Mol}\ NH_3 = \frac{3}{2}\ \text{mol}\ H_2$

$20\ \text{mol}\ NH_3 = \frac{3}{2} \times 20\ \text{mol}\ H_2 = 30\ \text{mol}\ H_2$

$\therefore$ 30 moles of H_2 are required.

47. (b) Balmer series

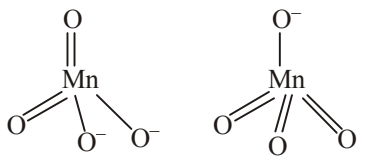
48. (a)

$5f$	$5+3=8$
$6p$	$6+1=7$
$5p$	$5+1=6$
$4d$	$4+2=6$

$5f > 6p > 5p > 4d$

49. (b) Consider the stability of electronic configuration after loss of one electron.

50. (a)



Manganate ion Permanganate ion

51. (c) Only π bond is present in C_2 molecule.

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2$

52. (c) Compressibility factor, $Z = \frac{PV}{nRT}$

Given: At 350 K and 15 bar,

molar volume < volume of ideal gas

$\therefore \quad Z < 1$

Therefore, attractive forces are dominant and the gas can be compressed easily.

53. (a) $W = -P_{ext}(V_2 - V_1)$ (Irreversible isothermal expansion)

$= -2(0.25 - 0.1)$

$= -2(0.15) = -0.3$ L Bar

$= -0.3 \times 100$ J $= -30$ J

54. (d) In $2H(g) \rightarrow H_2(g)$, no. of moles decreases, therefore entropy decreases.

55. (c) When a proton is removed from an acid, we obtain its conjugate base.

$H_2O \rightleftharpoons H^+ \quad OH^-$

$HF \rightleftharpoons H^+ \quad F^-$

56. (a) $Ca(OH)_2 \rightleftharpoons Ca^{2+} \quad 2OH^-$

$pH = 9, pOH = 14 - 9 = 5$

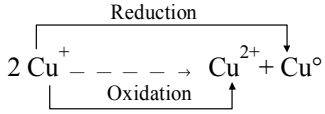
$[OH^-] = 10^{-5}$

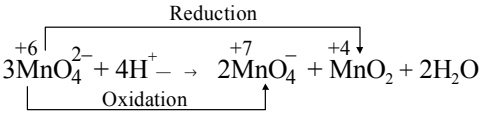
$\left[Ca^2\right] \quad \frac{10^{-5}}{2}$

$K_{sp} = [Ca^{2+}][OH^-]_2 = \left(\frac{10^{-5}}{2}\right) \times (10^{-5})^2$

$= 0.5 \times 10^{-15}$

57. (a) In a disproportionation reaction, one species undergoes both oxidation and reduction.





58. (b) In this method $Ca(OH)_2$ is used.

59. (d) Amphoteric hydroxide means it can react with both acid and base.

$Be(OH)_2 + 2HCl \longrightarrow BeCl_2 \quad 2H_2O$

$Be(OH)_2 + 2NaOH \longrightarrow Na_2[Be(OH)_4]$

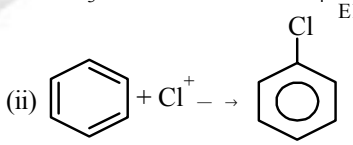
60. (b) Enzyme that utilise ATP in phosphate transfer require an alkaline earth metal (M) Mg as the cofactor.

61. (a) PbF_4 is ionic in nature due to high electronegativity difference.

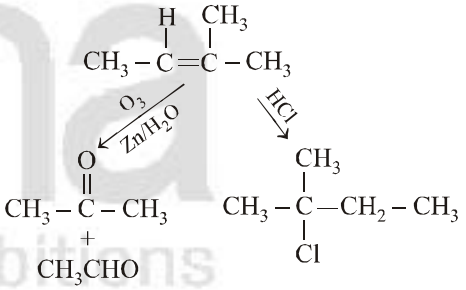
62. (d) $[SiCl_6]^{2-}$ does not exist because six large chloride ions cannot be accommodated around Si^{4+}, due to its small size.

63. (b) (i) $AlCl_3 + Cl - Cl \rightarrow [AlCl_4]^- + Cl^+$ (Electrophile)

(ii)



64. (c)



65. (b) Alkynes can be reduced to cis-alkenes with the use of Lindlar's catalyst

66. (d) Sulphur dioxide is not a green house gas.

67. (c) Oh void (C) : HCP (A)

No. of ions $\Rightarrow \quad 6 \times \frac{75}{100} \quad : \quad 6$

$\frac{3}{4} \quad : \quad 1$

$3 \quad : \quad 4 \quad C_3A_4$

68. (d) Hydron bond of ethanol gets weakened by addition of acetone. Thus the mixture of ethanol and acetone show positive deviation from Raoult's law.

69. (a) The solutions which show a large negative deviation from Raoult's law form maximum boiling azeotrope. Nitric acid and water forms a maximum boiling azeotrope with a boiling point of 393.5 K.

70. (c) E_{cell} $\frac{2.303RT}{nF}\log K$

Given : E_{cell} 0.59 V , n = 1

0.59 $\frac{0.059}{1}\log K$

$\frac{0.59}{0.059}$ $\log K$

$10 = \log k$

$K = 10^{10}$

71. (a) $\Delta G = -nFE°$

$= -2 \times 96500 \times 0.24 = -46320$ J/mol

$= -46.32$ kJ/mol

72. (c) For a first order reaction,

$$t = \frac{2.303}{k}\log\frac{[A]_o}{[A]}$$

for 99% completion of the reaction,

$$t = \frac{2.303}{k}\log\frac{100}{100 - 99}$$

$$t = \frac{2.303}{k}\log 10^2$$

$$t = \frac{4.606}{k}$$

73. (c) $N_2(g)$ $3H_2(g) \rightleftharpoons 2NH_3(g)$

$$\frac{-\,d\,N_2}{dt} \quad \frac{-\,1}{3}\frac{d\,H_2}{dt} \quad \frac{1}{2}\frac{d\,NH_3}{dt}$$

74. (b) $AgNO_3 + KI \longrightarrow$ AgI KNO_3

Negatively charged colloid

A solution of $AgNO_3$ and KI will form a negatively charged colloidal sol, $[AgI]I^-$, only when KI is present in excess (i.e., KI behaves as a solvent).

Millimole of KI is maximum in option (2) $(50 \times 2 = 100)$

75. (d) Malachite is a green copper carborate hydroxide mineral with chemical composition $CuCO_3.C_4(OH)_2$.

76. (c) On going down the group, bond dissociation enthalpy of the hydrides of oxygen family decreases. Therefore, thermal stability also decreases.

77. (d)

78. (d) PCl_5 is very reactive due to the presence of weak axial bonds. It is used in the synthesis of various organic compounds.

79. (b)

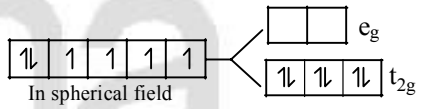
$K_4[Fe(CN)_6]^{4-} \longrightarrow 4K^+ + [Fe(CN)_6]^{4-}$

$x - 6 = -4$

$x = +2$

Fe: $4s^2\,3d^6$

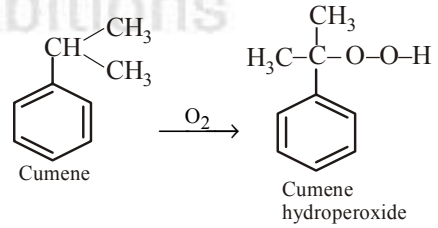
Fe^{2+} : $3d^6$

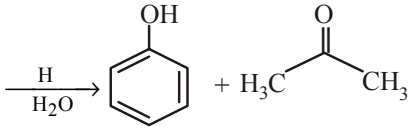


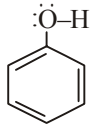
NOTES

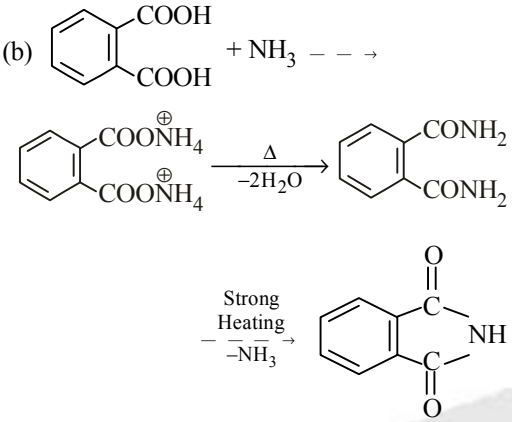
CN^- is a strong field ligand and causes pairing of electrons.

80. (b)





81. (d) In  lone pair of e⁻s present on oxygen atom is involved in delocalisation. Therefore, it is most difficult to protonate the phenol amongst the given compounds, due to less availability of e⁻s.

82. (b) 

83. (a) Account for the inductive effect, solvation effect (H-bonding.) and steric hinderance for basic character in aqueous solutions
$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$

84. (c) Alanine is non-essential amino acid.

85. (b) nylon 2 – nylon 6

86. (a) Penicillin G

87. (b) Ideal solutions are those which obey Raoult's law over all concentration ranges at a given temperature, e.g., benzene-toluence, *n*-hexane-*n*-heptane, etc.
For an ideal solution,
$\Delta V_{mix} = 0$, $\Delta H_{mix} = 0$
$\Delta G_{mix} = 0$, $\Delta S_{mix} = 0$
Hence, option (b) is correct.

88. (b) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH

$$HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$$

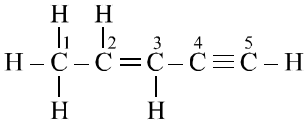
	100 mL × 0.1 M HCl = 10 mmol	200 mL 0.1 M = 20 mmol	0 mmol
Final conc.	0	10 m mol	10 m mol

It is basic buffer because final solution contains weak base and its salt with strong acid. Hence, option (b) is correct.

NOTES

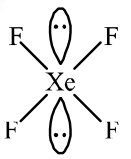
A buffer soluton having pH more than 7 is known as basic buffer. It is obtained by mixing weak base and its salt with strong acid in a fixed proportion.

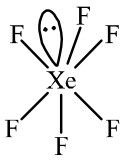
89. (d) Single bond = 1σ, Double bond = $1\sigma + 1\pi$, Triple bond = $1\sigma + 2\pi$.
The structure of pent-2-en-4-yne is

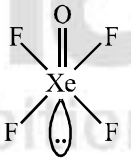

Pent-2-en-4-yne

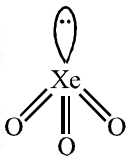
∴ The number of sigma (σ) bonds are 0 and pi(π) bonds are (d).

90. (a) The given xenon compounds with its structures are as follows :


XeF_4
Square planar


XeF_6
Distorted octahedral


$XeOF_4$
Square pyramidal


XeO_3
Pyramidal

Hence, the correct match is
(A) → (ii), (B) → (iii), (C) → (iv), (D) → (i)

91. (b) According to rules of binomial nomenclature, correctly written scientific name of mango is *Mangifera indica Linn*.
This system of nomenclature was given by Carl Linnaeus. The scientific name of mango is given as *Mangifera indica Linn. Mangifera* indicates the 'genus' while *indica* represents a particular species or 'specific epithet' and Linn indicates the Biologist Linnaeus who first described the species of mango.

92. (c) The keys are based on the set of contrasting characters in pair known as couplet.

93. (a) *Azotobacter is aerobic bacteria.* and *Cladophora* is green alga.
Engelmann used a prism to split light into its spectral components, and then illuminated a green alga, *Cladophora*, placed in a suspension of aerobic bacteria. The bacteria were used to detect the sites of oxygen evolution.
He observed that aerobic bacteria accumulated mainly in the region of blue and red light of the split spectrum thus giving the first action spectrum of photosynthesis.

NOTES
Theodor Wilhelm Engelmann was a German botanist, whose 1882 experiment measured the effects of different colours of light on photosynthetic activity and showed that the conversion of light energy to chemical energy took place in the chloroplast.

94. (b) *Halophiles* live in salty areas.
Thermoacidophiles are present in hot springs.
Methanogens are present in gut of several ruminants.
Cyanobacteria can be present in freshwater/ marine or terrestrial habitat.

95. (d) Yeast is an unicellular sac fungi. It lacks filamentous structure or hyphae.

96. (c) Infective constituent in viruses is either DNA or RNA, not protein. The simplest form consist of two basic components: nucleic acid (single- or double-stranded RNA or DNA) and a protein coat, the capsid, which functions as a shell to protect the viral genome from nucleases and which during infection attaches the virion to specific receptors exposed on the prospective host cell.

97. (c) Prions are disease causing agents having abnormally folded proteins. Prions induce other healthy proteins to fold incorrectly, leaving patches of useless debris and holes that turn brains to sponge, resulting in death. The disease has an incubation period in cattle of up to eight years.

NOTES
Mad cow disease (or bovine spongiform encephal-opathy) is a transmissible, slowly progressive, degenerative, and fatal disease affecting the central nervous system of adult cattle. It's related to a disease in humans called variant Creutzfeldt-Jakob disease (vCJD). Both disorders are universally fatal brain diseases caused by a prion.

98. (b) Fungus associated with roots of *Pinus* increases minerals and water absorption for the plant by increasing surface area and in turn fungus gets food from plant. Therefore, mycorrhizal association is obligatory for *Pinus* seed germination.

99. (d) Phloem, a complex tissue, is found in highly organised plants ("higher plants") and characterised by the possession of certain specialised cells, the sieve elements, and which functions as the major channel of rapid conduction of sugars over fairly long distances in the plant body. In addition to sieve elements, it always contains parenchyma cells, usually of more than one type, and frequently includes sclerenchyma cells.
Phloem in gymnosperms lacks both sieve tube and companion cells.

100. (a) Annelids exhibit bilateral symmetry with metameric segmentation where external segments correspond to internal segments.
Adult echinoderms are bilaterally symmetrical.
Aschelminthes are pseudocoelomates and platyhelminthes are acoelomates.

101. (a) Organ system of organisation, bilateral symmetry and true coelomates with segmented body are found in annelid, arthropoda and chordates.
In Mollusca, the body is unsegmented.

102. (b) (A) *Pila* is a member of mollusc. The mouth contains a rasping organ for feeding called radula.
(B) *Bombyx* is an arthropod. In Bombyx excretion takes place through malpighian tubules.
(C) *Pleurobrachia* is a ctenophore. The body bears eight external rows of ciliated comb plates, which help in locomotion.

(D) *Taenia* is a platyhelminth. In it specialised cells, called flame cells are present which help in osmoregulation and excretion.

103. (c) Intercalary Meristem.
The grass stem regenerates after initial growth due to intercalary meristem because this meristem helps in regeneration of parts in grasses removed in grazing herbivores.

104. (d) Xylem is a type of complex tissue. It translocates water, mineral salts, organic nitrogen and hormones.

105. (d) Growth rings are formed by the seasonal activity of cambium. In plants of temperate regions, cambium is more active in spring (less lignin deposition in xylem) and less active in autumn (more lignin deposition in xylem) seasons. In temperate regions climatic conditions are not uniform throughout the year. However in tropics climatic conditions are uniform throughout the year.

106. (d) *Tight junctions* provide a barrier which prevents leakage of fluid across epithelial cells. *Adherens junctions* aid to cement adjacent cells to form a sheet.
Gap junctions provide cytoplasmic channels to facilitate communication between adjacent cells.
Synaptic junctions help in transmission of information through chemicals.

107. (b) Cockroaches receive several images of an object with the help of ommatidia. This kind of vision possessed by cockroaches is known as mosaic vision which has more sensitivity but less resolution.

108. (c) The organisms which have ribosomes of 70 S type are prokaryotes. Prokaryotes have double stranded DNA which is not enclosed in membrane.

109. (b) *Golgi apparatus* is involved in the formation of glycoproteins and glycolipids.
Lysosomes are membrane enclosed organelle. It contains digestive enzymes, which digest excess or worn out organelles, food particles etc.
Vacuoles is a membrane enclosed fluid filled sac which traps waste and excretory products.
Ribosomes is a minute particle consisting of RNA and associated proteins. They bind mRNA and tRNA to synthesise polypeptides and proteins.

110. (c) The important function of Golgi apparatus is to process, package and transport the materials for secretion. Therefore secretory cells have Golgi apparatus in highest number.

111. (c) Concanavalin A is a secondary metabolite, e.g. lectin. Lectin is a mannose/glucose-binding protein isolated from Jack beans (*Canavalia ensiformis*). They are not antibodies and do not originate in an immune system but bind specifically to carbohydrate-containing receptors on cell surfaces (as of red blood cells).

112. (b) Purines, a heterocyclic compound, such as adenine and guanine are found both in DNA and RNA.

113. (d) GLUT1 and GLUTIV are glucose transport proteins which facilitate glucose transport into insulin-sensitive cells. GLUT1 is insulin-independent and is widely distributed in different tissues. GLUTIV is insulin-dependent and is responsible for the majority of glucose transport into muscle and adipose cells in anabolic conditions.

114. (b) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group. A complete catalytic active enzyme with its bound prosthetic group is called holoenzyme
A protein that forms an active enzyme system by combination with a coenzyme and determines the specificity of this system for a substrate is called apoenzyme.

115. (a) G_0 or resting phase is a non-growing state distinct from interphase. It is a period in the cell cycle in which cells exist in a quiescent state. It is viewed as either an extended G_1 phase, where the cell is neither dividing nor preparing to divide, or a distinct quiescent stage that occurs outside of the cell cycle.

116. (d) Cell cycle is the complete series of events from one cell division to the next. The correct sequence of phases of cell cycle is
$G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.

117. (c) Active transport is uphill transport. This transport takes place against the electrochemical potential gradient and requires additional input of energy that chiefly comes from hydrolysis of ATP. It is highly selective.

NOTES

There are two types of active transport: primary active transport that uses adenosine triphosphate (ATP), and secondary active transport that uses an electrochemical gradient. An example of active transport in human physiology is the uptake of glucose in the intestines.

118. (d) When a plant cell is placed in hypotonic solution water will flow into the cell as water moves from high water potential to low water potential.

119. (c) In active transport, materials are transported across a membrane with the help of mobile carrier protein and ATP.
In passive transport, substances move along the concentration gradient, *i.e.*, from its higher concentration to its lower concentration.

120. (d) The direction of movement of sugar in phloem is bi-directional.
The Pressure Flow Hypothesis, also known as the Mass Flow Hypothesis, is the best-supported theory to explain the movement of sap through the phloem. It was proposed by Ernst Munch, a German plant physiologist in 1930. A high concentration of organic substances, particularly sugar, inside cells of the phloem at a source, such as a leaf, creates a diffusion gradient (osmotic gradient) that draws water into the cells from the adjacent xylem. This creates turgor pressure, also known as hydrostatic pressure, in the phloem. Movement of phloem sap occurs by bulk flow (mass flow) from sugar sources to sugar sinks. The movement in phloem is bidirectional, whereas, in xylem cells, it is unidirectional (upward). Because of this multi-directional flow, coupled with the fact that sap cannot move with ease between adjacent sieve-tubes, it is not unusual for sap in adjacent sieve-tubes to be flowing in opposite directions.

121. (b) Bulliform cells are large, bubble-shaped epidermal cells that occur in groups on the upper surface of the leaves of many grasses. These cells become flaccid due to water loss. Loss of turgor pressure in these cells causes leaves to "roll up" during water stress.

122. (d) *Thiobacillus denitrificans,* a type of denitrifiers, converts nitrates in soil to free atmospheric nitrogen, thus depleting soil fertility and reducing agricultural productivity.

$$\text{Nitrates (soil)} \xrightarrow[\text{Denitrification}]{} \text{Nitrogen}$$

$$\downarrow$$

Pseudomonas denitrificans & *Thiobacillus denitrificans*

NOTES

Thiobacillus is a genus of Gram-negative Betaproteobacteria. Thiobacillus oxidizes thiosulfate and elemental sulphur to sulphate, and A. ferrooxidans oxidizes ferrous ions to the ferric form. This diverse oxidizing ability allows A. ferrooxidans to tolerate high concentrations of many different ions, including iron, copper, cobalt, nickel, and zinc.

123. (d) *Thiobacillus denitrificans* cause denitrification *i.e.*, conversion of oxides of nitrogen to free N_2.

124. (d) Hatch and Slack pathway is a cyclic pathway for CO_2 fixation. The primary CO_2 acceptor is a 3-carbon compound phosphoenol pyruvate (PEP) which is present in mesophyll cells.
PEP is converted to oxaloacetic acid (OAA), which is then further converted into a 4-carbon compound such as malic acid or aspartic acid, which is then transported to the bundle sheath cells. In the bundle sheath cells, it is again broken down into a 3-carbon compound with the release of CO_2. The CO_2 released enters the Calvin cycle in the bundle sheath cells, while the 3-carbon compound is transported back to the mesophyll cells. In the mesophyll cells, the 3-carbon compound is converted back to PEP, thus completing the cycle.

125. (b) Glycolysis is the anaerobic enzymatic conversion of glucose to lactate or pyruvate, resulting in energy stored in the form of ATP, as occurs in muscle.
The two irreversible steps in Glycolysis are:
(i) Conversion of glucose to glucose 6-phosphate, catalysed by hexokinase. It is the first step of activation phase of glycolysis.
(ii) Conversion of fructose 6-phosphate to fructose 1,6 biphosphate catalysed by phosphofructokinase-1.

NOTES

C4 plants capture carbon dioxide in their mesophyll cells forming oxaloacetate. This oxaloacetate is then converted to malate and is transported into the bundle sheath cells, where oxygen concentration is low to avoid photorespiration. So, C4 plants are more efficient in photosynthesis than C3 plants.

126. (d) Electron transport system is located in inner mitochondrial membrane, where it serves as the site of oxidative phosphorylation through the action of ATP synthase.

NOTES

Electron transport chains are redox reactions that transfer electrons from an electron donor to an electron acceptor. The transfer of electrons is coupled to the translocation of protons across a membrane, producing a proton gradient.

It is also found in the thylakoid membrane of the chloroplast in photosynthetic eukaryotes.

127. (b) Respiratory quotient may be defined as a ratio indicating the relation of the volume of carbon dioxide given off in respiration to that of the oxygen consumed.

Respiratory Quotient (RQ)

$$= \frac{\text{Amount of } CO_2 \text{ released}}{\text{Amount of } CO_2 \text{ consumed}}$$

$$2(C_{51}H_{98}O_6) + 145O_2 \rightarrow 102CO_2 + 98H_2O$$

Tripalmitin + Energy

$$RQ = \frac{102CO_2}{145O_2} = 0.7$$

128. (d) Auxin shows apical dominance. Removal of auxin by removal of shoot tips prevents the apical dominance and promotes the growth of lateral buds which is a very useful in tea leaves production.

NOTES

The plant invests its energy into growing taller in order to maximize the plant's exposure to light. Removing the shoot tip ("cutting back") will remove the source of auxin and will stimulate the growth of axillary buds, and make the plant thicker and bushier. Presence of cytokinin in an area causes preferential movement of nutrients towards it. When applied to lateral buds, they help in their growth despite the presence of apical bud. They thus act antagonistically to auxin which promotes apical dominance. Therefore cytokinin can overcome apical dominance, caused by auxins.

129. (d) Gibberellins (GAs) regulate various developmental processes, including stem elongation, germination, dormancy, flowering, flower development and leaf and fruit senescence. When gibberellin is sprayed on sugarcane crop, the length of the stem increases.

NOTES

Kurosawa, a Japanese botanist, discovered gibberellin while investigating the rice foolish seedling disease in which spindly seedlings are formed due to GA like compounds produced by the fungus (Gibberella fujikuroi) infecting the plant. They are produced in the plant cell's plastids, and are eventually transferred to the endoplasmic reticulum of the cell, where they are modified and prepared for use. There are more than 70 gibberellins isolated. They are GA1, GA2, GA3 and so on. GA3 Gibberellic acid is the most widely studied plant growth regulators.

130. (a) A pineapple plant flowers only once, and produces one pineapple. Then it dies. But before it dies it also produces offspring.

Auxin and ethylene can be applied to artificially induce flowering in pineapple to increase yield throughout the year. Applied auxin mimic the action of ethylene by stimulating ethylene formation, and that ethylene, not auxin, causes pineapples to flower. Ethylene initiates flowering and synchronising fruit-set in pineapples.

131. (d) During flowering, photoperiodic stimulus is perceived by leaves of plants.

NOTES

In 1920, W. W. Garner and H. A. Allard published their discoveries on photoperiodism and felt it was the length of daylight that was critical, but it was later discovered that the length of the night was the controlling factor.

132. (a) Rennin is a milk digesting proteolytic enzyme releted to pepsin that is synthesised by chief cells in the stomach of some animals.

Enterokinase, produced by cells of duodenum, is involved in digestion. It converts trypsinogen (a zymogen) into its active form trypsin, resulting in the subsequent activation of pancreatic digestive enzymes.

Fructose shows facilitated transport .

Oxyntic cells secrete HCl and intrinsic factors that are essential for absorption of vitamin B_{12}.

133. (b) Goblet cells secretes mucus. It is secreted along entire digestive tract where it lubricates food and lining, coats lining and protects it from mechanical digestion from acid and digestive enzymes.

NOTES

Goblet cells are mostly found scattered in the epithelia of the small intestines and respiratory tract. The morphology of goblet cells reflects their function, with the cell containing all the organelles necessary for the production of glycosylated proteins called **mucins**.

134. (c) Crypts of Lieberkuhn are tubular glands that lie between the finger-like projections of the inner surface of the small intestine. Glisson's capsule is a layer of connective tissue present in liver. Islets of langerhans constitute the endocrine portion of pancreas and are responsible for the production and release of hormones that regulate glucose levels. Brunner's glands are found in submucosa of duodenum and protect the intestinal walls from gastric juices.

NOTES

Argentaffin cells are identified with the production of serotonin (5-hydroxytryptamine), which is secreted into the lamina propria rather than the intestinal lumen. Serotonin is a powerful stimulant of smooth muscle, resulting in contraction, and may play a role in stimulating peristaltic activity of the intestine.

135. (a) Expiratory capacity is the total volume of air that a person can expire after a normal inspiration. this includes tidal volume and expirtory reserve volume (TV + ERV).
Tidal volume of an athelete = 500 ml
Expiratory reserve volume of an athelete = 1000 ml
Expiratory capacity = TV + ERV
= 500 + 1000
= 1500 ml

136. (b) Asthma (an allergic condition) is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. It can be due to increasing air born allergens and pollutants. Many people in urban areas are suffering from this respiratory disorder.

137. (a) SA node acts as pace-maker of heart because its autoexcitable tissue have the ability to generate heart impulses at highest rate (frequency).

NOTES

This electrical impulse is then transmitted by perinodal cells, or transitional (T) cells, to the right atrium and then through the rest of the heart's electrical conduction system, eventually resulting in myocardial contraction and blood distributed to the rest of the body. The sinus node continuously generates electrical impulses, thereby setting the normal rhythm and rate in a healthy heart. Hence, the SA node is referred to as the natural or normal pacemaker of the heart.

138. (a) The delay in transmission of impulse from SAN to the ventricles provided by AVN prevents simultaneous contraction of ventricles and auricles. This allows atria to empty completely before ventricles start contraction.

139. (a) Electrocardiogram is a diagnostic tool, used to assess the electrical and muscular functions of the heart. It consists of waveform components which indicate electrical events during one heart beat. These waveforms are labelled P, Q, R, S, T and U.
- P wave indicates atrial depolarisation *i.e.* that the atria are contracting, pumping blood into the ventricles.
- The QRS complex represents ventricular depolarisation and contraction.
- T wave is upwards waveform representing ventricular repolarisation. The normal T wave is slightly asymmetric with a steeper downward slope. Reduction in the size of T wave represents insufficient supply of oxygen *i.e.* coronary ischemia. Coronary ischemia is an intermediate condition in coronary artery disease during which the heart tissue is slowly or suddenly starved of oxygen and other nutrients.

140. (c) Cardiac output is the product of the heart rate (HR), or the number of heart beats per minute (bpm),and the stroke volume (SV), which is the volume of blood pumped from the ventricle per beat; thus,
Cardiac output = stroke volume × Heart rate
As per the given information,
Cardiac output = 5L or 5000 ml
Blood volume in ventricles at the end of diastole = 100 ml
Blood volume in ventricles at the end of systole = 50 ml
- Stroke volume = 100 – 50
= 50 ml.

So,
5000 ml = 50 ml × Heart rate
So,
Heart rate = 100 beats per minute.

141. (b) Loop of Henle along with vasa rectae plays an important role in the concentration of urine. The proximity between loop of Henle and vasa recta as well as counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium. This mechanism helps to maintain a concentration gradient in medullary interstitium so human urine is

nearly four times concentrated than initial filtrate formed. The urine concentrating mechanism plays a fundamental role in regulating water and sodium excretion.

142. (c) Statements (iii) and (iv) are correct.
Dialysis is a procedure that is a substitute for many of the normal functions of the kidney.
(a) It remove waste, salt and extra water to prevent them from building up in the body.
(b) It keep a safe level of certain chemicals in your blood, such as potassium, sodium and bicarbonate helping to control blood pressure.
(c) There will be reduced absorption of calcium ions from gastrointestinal tract.
(d) RBC production will be reduced, due to reduced erythropoietin hormone.

143. (d) There are 12 pairs of ribs in human body. First seven pairs are attached to the sternum ventrally with the help of hyaline carlilage, also called as true ribs. These are called vertebrosternal ribs. The next three pairs (8th, 9th and 10th) do not articulate directly with the sternum, also called vertebrochondral (false) ribs . The last two pairs (11th and 12th) are the free floating ribs because they are not connected ventrally.

144. (b) Muscular dystrophy is a inheritable disease that gradually cause the muscles to weaken, leading to an increasing level of disability.
Tetany, Myasthenia gravis and Botulism are not inheritable diseases**.**

145. (d) Rods and cones are two types of photoreceptor in human retina. Cones are very sensitive to operate in day light. They are capable of colour vision and responsible for high spatial acuity. Rods are very sensitive in dim light and do not mediate colour vision and have a low spatial acuity.

146. (c) Insulin is a pancreatic hormone, secreted from alpha cells of islets of Langerhans. Its deficiency leads to diabetes mellitus (characterised by high blood sugar levels over a prolonged period).
Thyroxine is an iodine containing hormone, secreted by the thyroid gland. It plays an important role in regulating the body's metabolic rate, heart and digestive function, muscle control, brain development and bone maintenance. Hyper secretion or hyposecretion of thyroxine can be associated with enlargement of thyroid gland called goitre.
Deficiency of corticoids (cortisol and aldosterone) secreted from adrenal gland (cortex region) leads to Addison's disease. Cortisol regulates the body's reaction to stressful situations. Aldosterone helps with sodium and potassium regulation. The adrenal cortex also produces sex hormones (androgens).
Acromegaly is an abnormal growth of the hands, feet, and face, caused by overproduction of growth hormone by the pituitary gland.

NOTES
Glucocorticoids are steroid hormones that regulate multiple aspects of glucose homeostasis. Glucocorticoids promote gluconeogenesis in liver, whereas in skeletal muscle and white adipose tissue they decrease glucose uptake and utilization by antagonizing insulin response.

147. (d) The phenomenon in which female gamete develops into embryo without getting fused with male gamete (fertilisation) is called parthenogenesis.
Autogamy is a form of self-fertilisation in which fission of the cell nucleus occurs without division of the cell, the two pronuclei so formed reuniting to form the synkaryon. Parthenocarpy is the production of fruit without fertilisation of an egg in the ovary. Synkaryon is a nucleus formed by the fusion of two pre-existing nuclei.

148. (d) In flowering plants, out of the two male gametes discharged in synergids, one fuses with the egg and other fuses with the secondary or definitive nucleus present in central cell.
Egg (n) + 1^{st} male gamete (n) → Zygote (2n)
Secondary nucleus (2n) + 2^{nd} male gamete (n) → Endosperm Nucleus(3n)
(central cell nuclei)

NOTES
The synergid cells produce an attractant that guides the pollen tube to the female gametophyte and likely contain factors that control arrest of pollen tube growth, pollen tube discharge, and gamete fusion.

149. (d) Post-fertilisation is a series of events that takes place after fertilisation. Following are the post-fertilisation changes in flowering plants:
- Ovule → Seed
- Ovary → Fruit
- Zygote → Embryo
- Central cell → Endosperm

150. (b) In some seeds like black pepper and beet, the ramnents of nucellus are persistant, this persistant nucellus is called perisperm. It is present in the seeds in the form of a layer of nutritive tissue

151. (a) Extrusion of second polar body from egg nucleus occurs after entry of sperm into the secondary oocyte but before fertilisation. The entry of sperm into the ovum induces completion of the meiotic division of the secondary oocyte. Entry of sperm causes breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC).

NOTES

During gametogenesis, one cell becomes the secondary oocyte the other cell forms the first polar body. The secondary oocyte then commences meiosis 2 which arrests at metaphase and will not continue without fertilization. At fertilization meiosis 2 completes, forming a second polar body.

152. (b) The correct sequence for transport of sperm cells in male reproductive system is:
Seminiferous tubules → Rete testis → Vasa efferentia→ Epididymis →Vas deferens →Ejaculatory duct → Urethra → Urethral meatus

153. (a) In lactational amenorrhea, pills and emergency contraceptives methods, there is the involvement of hormones.
Lactational amenorrhea (absence of menstruration) is based on the fact that ovulation and of intense lactation following parturition. Prolactin is the major hormone responsible for milk production and is present in sufficient quantities in almost all women to allow the establishment of normal lactation.
Emergency contraception methods include emergency contraception pills (ECP), intrauterine device, e.g., LNG-20 (Levonor-gestrel) and ulipristal acetate.
CuT and barrier method do not involve any hormonal role.

154. (c) Progestasert and LNG-20 are hormone releasing IUDs (Intra Uterine Devices). These are the devices which are used in birth control by making uterus unsuitable for implantation and the cervix hostile to sperms.

155. (c) Genital herpes is caused by two types of viruses- herpes simplex virus type 1 (HSV-1) and herpes simplex virus type 2 (HSV-2). At present there is no cure for type-II-herpes simplex virus. Other non curable STIs are hepatitis-B and HIV.

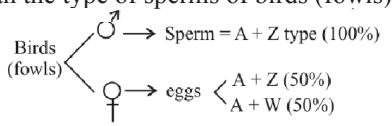
NOTES

Vaccines are available for the protection of STDs against infection with HPV, hepatitis A and hepatitis B. Other vaccines are under development, including those for HIV and herpes simplex virus (HSV).

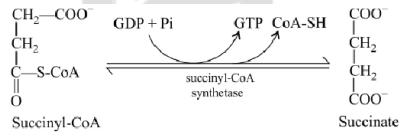
156. (d) Genes for flower colour in snapdragon shows incomplete dominance which is an exception of Mendel's first principle (*i.e.* Law of dominance), whereas Law of segregation is universally applicable. Incomplete dominance is a process when a dominant allele, or form of a gene, does not completely mask the effects of a recessive allele, and the organism's resulting physical appearance shows a blending of both alleles.

157. (c) 1 map unit represent 1% cross over. Map unit is used to measure genetic distance. This genetic distance is based on average number of cross over frequency.

158. (c) In birds female heterogamety is found thus sex of progeny depends on the types of egg rather than the type of sperms of birds (fowls).



159. (d) There will be no change in reading frame of m-RNA by deletion of GGU from 7^{th}, 8^{th}, and 9^{th} position.



160. (a) Expressed Sequence Tags (ESTs) are DNA sequences (genes) that are expressed as mRNA for protein synthesis. These are used in human Genome Project.

NOTES

Expressed Sequence Tags are small pieces of DNA sequence (usually 200 to 500 nucleotides long) that are generated by sequencing either one or both ends of an expressed gene. First, each gene (DNA) must be converted, or transcribed, into messenger RNA (mRNA)--RNA that serves as a template for protein synthesis.

161. (c) Lac operon consist of one regulatory genes (*i* gene) and three structural genes (*z, y*, and *a)*.
- *i* gene codes for Repressor.
- *z* gene codes for Beta-galactosidase.
- *y* gene codes for Permease.
- *a* gene codes for Transacetylase.

162. (d) Adaptive radiation occurs when a single or small group of ancestral species rapidly diversifies into a large number of descendant species. Therefore, when a population of a species invades a new area with many type of vacant habitats, they face different environmental pressures and eventually adapt exhibiting adaptive radiation.

163. (a) In Australia, marsupials and placental mammals have evolved to share many similar characteristics. This type of evolution may be referred to as convergent evolution.

NOTES

Many placental mammals resemble the marsupial mammals not only in structure but also in leading similar ways of life. These similarities in these two different types of mammals (Marsupials and placentals) w.r.t. ancestors are due to living in the similar ecological niches. Hence, when two different types of organisms converge towards functional similarity one can conclude that convergent evolution has occurred.

164. (b) Stabilising selection is a type of natural selection in which the population mean stabilises on a particular non-extreme trait value. This is thought to be the most common mechanism of action for natural selection because most traits do not appear to change drastically over time. The result of stabilising is the over-representation in a specific trait. For example, human birth weight, the number of eggs a bird lays, and the density of cactus spines.
The given data shows stabilising selection as most of the newborn having average weight between 3 to 3.3 kg survive and babies with less and more weight have low survival rate.

165. (a) Agriculture came around 10,000 years back and human settlements started.
The *Dryopithecus* and *Ramapithecus* primates existing 15 mya. They are hairy and walked like gorillas and chimpanzees.
Homo habilis probably did not eat meat. They were the first to make stone tools.

NOTES

Neanderthals are an extinct species or subspecies of archaic humans who lived in Eurasia until about 40,000 years ago. They probably went extinct due to competition with or extermination by immigrating European early modern humans or due to great climatic change, disease, or a combination of these factors.

166. (c) Frequency of dominant allele (p) = 0.4
Frequency of recessive allele (q) = 1 – 0.4 = 0.6
Frequency of homozygous dominant individuals (AA)
$= p^2 = (0.4)^2 =$ **0.16(AA)**
Frequency of heterozygous individuals (Aa)
$= 2pq = 2(0.4)(0.6) =$ **0.48(Aa)**
Frequency of homozygous recessive individuals (aa)
$= q^2 = (0.6)2 =$ **0.36(aa)**

167. (c) The correct match of the hominids and their brain sizes are:
Homo habilis – 650 - 800 c.c.
Homo neanderthalensis –1400 c.c.
Homo eractus –900 c.c.
Homo sapiens –1350 c.c.

168. (b) According to Hugo de Vries, mutations are random and directionless.
Hugo deVries believed that mutation caused speciation and hence called it saltation (single step large mutation).

169. (d) Typhoid is a bacterial infection that can lead to a high fever, diarrhoea, and vomiting. It is caused by the bacteria *Salmonella typhimurium (S. typhi)*.

NOTES

Typhoid is diagnosed by Widal test. Widal test was developed by Georges Ferdinand Widal in 1896 and helps to detect presence of salmonella antibodies in a patient's serum.

170. (d) Colostrum, as a thin yellowish milk, is the first secretion for a few days after childbirth. Colostrum serves as an immune system enhancer to the new born infants. It contains immune cells, high protein and protective antibody (such as IgA) content. IgA help protect the mucous membranes in the throat, lungs, and intestines of the infant.

171. (a) Inbreeding depression, the reduction of fitness caused by inbreeding, is a universal phenomenon that depends on past mutation, selection, and genetic drift. Inbreeding depression can be overcome by the following ways:

- Out breeding: The breeding of animals which are unrelated to each other and do not have come ancestors for 4-6 generations.
- Out crossing: Mating done with the animals of same breed but after 4-6 generations.
- Cross breeding: Superior male mated with superior female of another breed.
- Interspecific hybridisations: Male and female animal of two different related species.

NOTES

Inbreeding depression is the reduced biological fitness in a given population as a result of inbreeding, or breeding of related individuals. Population biological fitness refers to an organism's ability to survive and perpetuate its genetic material. Signs of inbreeding depression:

- Reduced fertility both in litter size and sperm viability.
- Increased genetic disorders.
- Fluctuating facial asymmetry.
- Lower birth rate.
- Higher infant mortality and child mortality.
- Smaller adult size.
- Loss of immune system function.
- Increased cardiovascular risks.

172. (c) Inbreeding exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes. Therefore this is selection at each step & which increase the productivity of inbred population. Close and continued inbreeding usually reduces fertility and even productivity.

173. (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.

174. (b) Microbes are used in production of several household and industrial products –

- *Lactobacillus* – Production of curd
- *Saccharomyces cerevisiae* – Bread making
- *Aspergillus niger* – Citric acid production
- *Acetobacter aceti* – Acetic acid

175. (b) Statins are drugs that can lower blood cholesterol.
It is obtained from a yeast (Fungi) called *Monascus purpureus.*
They work by blocking a substance, body needs to make cholesterol.

176. (b) Biocontrol agents are those natural organisms like parasitism, predation and other mechanisms which play an important role in controlling the plant pests like nematodes weeds, insects, and mites and helps in maintaining and balancing the plant species along with their natural enemies. Fungus *Trichoderma*, Baculoviruses (NPV) and *Bacillus thuringiensis* are used as biocontrol agents.
Rhizobium, Nostoc, Azospirillum and *Oscillatoria* are used as biofertilisers, whereas TMV is a pathogen and aphids are pests that harm crop plants.

NOTES

The most common species of fungi used in this type of biocontrol is Trichoderma harzianum.

177. (a) *Trichoderma* is a very effective biological mean for plant disease management especially the soil born. It is a free-living fungus which is common in soil and root ecosystems. It reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion.

178. (d) To produce enzyme in large quantity, equipment required are bioreactors. Large scale production involves use of bioreactors.
Note: In 1990, Anderson and Schwarz licensed patents for the rotating wall bioreactor technology and founded Synthecon Inc. in Houston, Texas, to commercialize the device.

179. (b) A restriction enzyme or restriction endonuclease is an enzyme that cleaves DNA into fragments at or near specific recognition sites within molecules known as restriction sites. Restriction enzymes are one class of the broader endonuclease group of enzymes.

Each restriction endonuclease functions by inspecting the length of a DNA sequence. Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar phosphate backbone. These enzymes predictably cut both strands because the sequences they recognize are palindromic. That is the recognition sequences of identical bases on both DNA strands.

180. (b) During the isolation of desired gene, chilled ethanol is used for the precipitation of DNA. Ethanol is used in DNA extraction to force the DNA to precipitate in a solution. In order to collect a DNA sample, cells are broken down through agitation, and then mixed with water, salt and ethanol to create an aqueous solution. Ethanol along with salt work to prevent the DNA from dissolving into the water, instead causing it to precipitate out so it can be separated and extracted using a centrifuge.

NOTES

Since DNA is insoluble in ethanol and isopropanol, the addition of alcohol, followed by centrifugation, will cause the DNA proteins to come out of the solution. When DNA concentration in the sample is heavy, the addition of ethanol will cause a white precipitate to form immediately.