



SOLVED PAPER 2019

Time : 3 Hours

Max. Marks : 720

Important Instructions :

1. The test is of 3 hours duration and test contains 180 questions. Each question carries 4 marks. For each correct response, the candidate will get 4 marks.
2. For each incorrect response, one mark will be deducted from the total scores.

PHYSICS

1. 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) zero as r increases for $r < R$, decreases as r increases for $r > R$
 - (b) zero as r increases for $r < R$, increases as r increases for $r > R$
 - (c) decreases as r increases for $r < R$ and for $r > R$
 - (d) increases as r increases for $r < R$ and for $r > R$
2. 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) 5 J
 - (b) 25 J
 - (c) 20 J
 - (d) 30 J
3. 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) 9 : 4
 - (b) 1 : 2
 - (c) 2 : 1
 - (d) 4 : 9
4. 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/s², density of water = 10^3 kg/m³, the value of Z_0 is
 - (a) 10 cm
 - (b) 1 cm
 - (c) 0.5 cm
 - (d) 100 cm
5. Which colour of the light has the longest wavelength?
 - (a) blue
 - (b) green
 - (c) violet
 - (d) red
6. A body weight 200 N on the surface of earth. How much will it weight half way down to the centre of the earth?
 - (a) 200 N
 - (b) 250 N
 - (c) 100 N
 - (d) 150 N
7. A small hole of area of cross-section 2 mm^2 present near the bottom of a fully filled open tank of height 2 m. Taking $g = 10$ m/s², the rate of flow of water through the open hole would be nearly
 - (a) $8.9 \times 10^{-6} \text{ m}^3/\text{s}$
 - (b) $2.23 \times 10^{-6} \text{ m}^3/\text{s}$
 - (c) $6.4 \times 10^{-6} \text{ m}^3/\text{s}$
 - (d) $12.6 \times 10^{-6} \text{ m}^3/\text{s}$
8. 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) 30 kJ
 - (b) 2 J
 - (c) 1 J
 - (d) 3 J
9. 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 ($\mu = 1.5$) as that of glass) then the equivalent focal length is F_2 . The ratio $F_1 : F_2$ will be
 - (a) 1 : 2
 - (b) 2 : 3
 - (c) 3 : 4
 - (d) 2 : 1
10. In an experiment, the percentage of error occurred in the measurement of physical quantities A, B, C and 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) 16%
 - (b) - 10%
 - (c) 10%
 - (d) $\left(\frac{3}{13}\right)\%$
11. The unit of thermal conductivity is
 - (a) $\text{J m}^{-1} \text{K}^{-1}$
 - (b) W m K^{-1}
 - (c) $\text{W m}^{-1} \text{K}^{-1}$
 - (d) J m K^{-1}

12. 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) $2 mgR$ (b) $\frac{1}{2} mgR$
(c) $\frac{3}{2} mgR$ (d) mgR

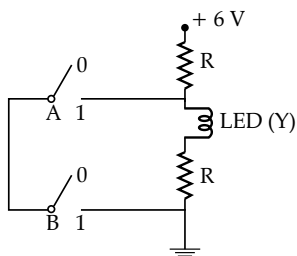
13. In which of the following processes, heat is neither absorbed nor released by a system?

(a) adiabatic (b) isobaric
(c) isochoric (d) isothermal

14. 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) $\frac{9F}{16}$ (b) $\frac{16F}{9}$
(c) $\frac{4F}{3}$ (d) F

15. The correct Boolean operation represented by the circuit diagram drawn is



(a) OR (b) NAND (c) NOR (d) AND

16. Which of the following acts as a circuit protection device?

(a) inductor (b) switch
(c) fuse (d) conductor

17. 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) 113.9 cm (b) 88 cm
(c) 68 cm (d) 6.8 cm

18. A parallel plate capacitor of capacitance $20 \mu F$ is being charged by a voltage source whose potential is changing at the rate of $3V/s$. The conduction current through the connecting wires, and the displacement current through the plates of the capacitor, would be, respectively

(a) $60 \mu A$, $60 \mu A$ (b) $60 \mu A$, zero
(c) zero, zero (d) zero, $60 \mu A$

19. α -particle consists of

(a) 2 electrons, 2 protons and 2 neutrons.
(b) 2 electrons and 4 protons only.
(c) 2 protons only.
(d) 2 protons and 2 neutrons only.

20. 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 ($g = 10 \text{ m/s}^2$)

(a) $\frac{10}{2\pi} \text{ rad/s}$ (b) 10 rad/s
(c) $10\pi \text{ rad/s}$ (d) $\sqrt{10} \text{ rad/s}$

21. Increase in temperature of a gas filled in a container would lead to

(a) increase in its kinetic energy.
(b) decrease in its pressure.
(c) decrease in intermolecular distance.
(d) increase in its mass.

22. A 800 turn coil of effective area 0.05 m^2 is kept perpendicular to a magnetic field $5 \times 10^{-5} \text{ T}$. 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) 0.2 V (b) $2 \times 10^{-3} \text{ V}$
(c) 0.02 V (d) 2 V

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

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

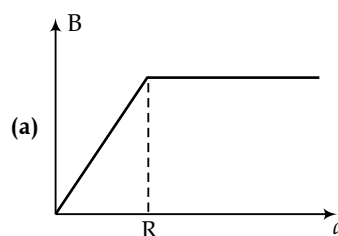
24. In total internal reflection when the angle of incidence is equal to the critical angle for the pair of media in contact, what will be angle of refraction?

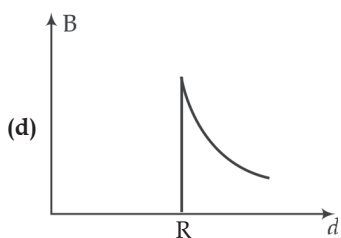
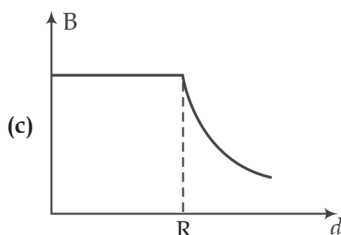
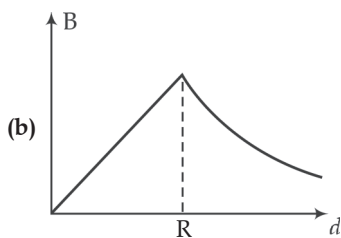
(a) 0°
(b) equal to angle of incidence
(c) 90°
(d) 180°

25. An electron is accelerated through a potential difference of $10,000 \text{ V}$. Its de-Broglie wavelength is (nearly): ($m_e = 9 \times 10^{-31} \text{ kg}$)

(a) $12.2 \times 10^{-12} \text{ m}$ (b) $12.2 \times 10^{-14} \text{ m}$
(c) 12.2 nm (d) $12.2 \times 10^{-13} \text{ m}$

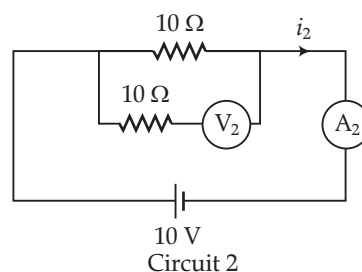
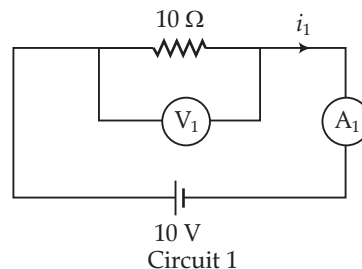
26. A cylindrical conductor of radius R is carrying a constant current. The plot of the magnitude of the magnetic field, B with the distance d from the centre of the conductor, is correctly represented by the figure



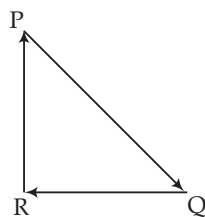


27. Pick the wrong answer in the context with rainbow.
- An observer can see a rainbow when his front is towards the sun.
 - Rainbow is a combined effect of dispersion refraction and reflection of sunlight.
 - When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.
 - The order of colours is reversed in the secondary rainbow.
28. The total energy of an electron in an atom in an orbit is -3.4 eV. Its kinetic and potential energies are, respectively.
- 3.4 eV, -6.8 eV
 - 3.4 eV, 3.4 eV
 - -3.4 eV, -3.4 eV
 - -3.4 eV, -6.8 eV
29. 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
- $\sqrt{A^2 + B^2}$
 - $\sqrt{A_0^2 + (A + B)^2}$
 - $A + B$
 - $A_0 + \sqrt{A^2 + B^2}$
30. For a p -type semiconductor, which of the following statements is true?
- Holes are the majority carriers and trivalent atoms are the dopants.
 - Holes are the majority carriers and pentavalent atoms are the dopants.
 - Electrons are the majority carriers and pentavalent atoms are the dopants.
 - Electrons are the majority carriers and trivalent atoms are the dopants.

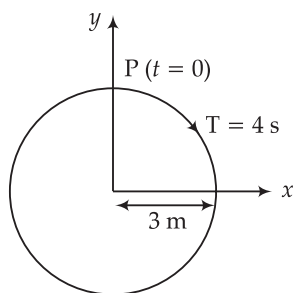
31. In which of the following devices, the eddy current effect is not used?
- magnetic braking in train
 - electromagnet
 - electric heater
 - induction furnace
32. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10 m/s and is flowing due east. If he is standing on the south 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
- 0°
 - 60° west
 - 45° west
 - 30° west
33. 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
- $\frac{1}{2}Mgl$
 - $\frac{1}{2}MgL$
 - Mgl
 - MgL
34. In the circuits shown below, the readings of voltmeters and the ammeters will be



- $V_1 = V_2$ and $i_1 = i_2$
 - $V_1 > V_2$ and $i_1 > i_2$
 - $V_1 > V_2$ and $i_1 = i_2$
 - $V_1 = V_2$ and $i_1 > i_2$
35. 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
- $\frac{4}{9}$
 - $\frac{5}{9}$
 - $\frac{1}{9}$
 - $\frac{8}{9}$
36. A particle moving with velocity \vec{v} is acted by three forces shown by the vector triangle PQR. The velocity of the particle will



- (a) decrease.
 (b) remain constant.
 (c) change according to the smallest force \overline{QR} .
 (d) increase.
37. The radius of circle, the period of revolution, initial position and sense of revolution are indicated in the figure.

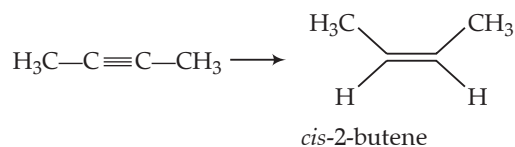


y -projection of the radius vector of rotating particle P is

- (a) $y(t) = 4 \sin\left(\frac{\pi t}{2}\right)$, where y in m
 (b) $y(t) = 3 \cos\left(\frac{3\pi t}{2}\right)$; where y in m
 (c) $y(t) = 3 \cos\left(\frac{\pi t}{2}\right)$, where y in m
 (d) $y(t) = -3 \cos 2\pi t$, where y in m
38. 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^{-3} N m (b) 12×10^{-4} N m
 (c) 2×10^6 N m (d) 2×10^{-6} N m
39. 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) $v_A : v_B$ (b) $r_B : r_A$ (c) 1 : 1 (d) $r_A : r_B$
40. Ionized hydrogen atoms and α -particles with same momentum enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be
 (a) 1 : 2 (b) 4 : 1 (c) 1 : 4 (d) 2 : 1
41. A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when
 (a) the wire is horizontal.
 (b) the mass is at the lowest point.
 (c) inclined at an angle of 60° from vertical.
 (d) the mass is at the highest point.
42. At a point A on the earth's surface the angle of dip, $\delta = +25^\circ$. At a point B on the earth's surface the angle of dip, $\delta = -25^\circ$. We can interpret that **Out of Syllabus**
 (a) A is located in the southern hemisphere and B is located in the northern hemisphere.
 (b) A is located in the northern hemisphere and B is located in the southern hemisphere.
 (c) A and B are both located in the southern hemisphere.
 (d) A and B are both located in the northern hemisphere.
43. 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 1m away, was found to be 0.2° . What will be the angular width of the first minima, ($\mu_{\text{water}} = 4/3$) if the entire experimental apparatus is immersed in water?
 (a) 0.15° (b) 0.05° (c) 0.1° (d) 0.266°
44. 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) $1 : \sqrt{2}$
45. Average velocity of a particle executing SHM in one complete vibration is
 (a) $A\omega$ (b) $\frac{A\omega^2}{2}$ (c) zero (d) $\frac{A\omega}{2}$

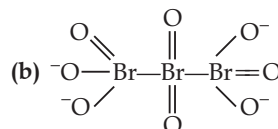
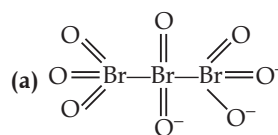
CHEMISTRY

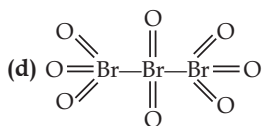
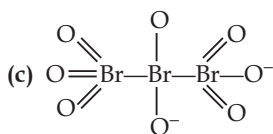
46. The most suitable reagent for the following conversion is



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

47. The correct structure of tribromo octaoxide is

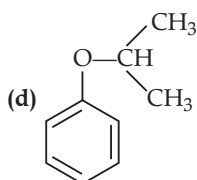
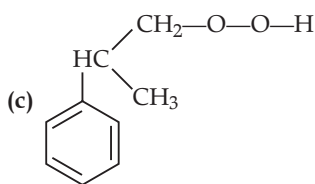
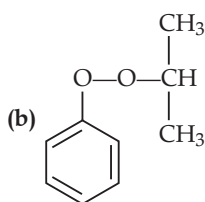
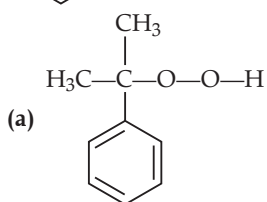
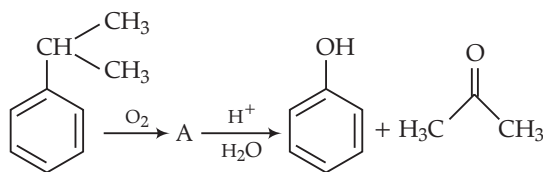




48. For a cell involving one electron $E_{\text{cell}}^{\circ} = 0.59 \text{ V}$ at 298 K, the equilibrium constant for the cell reaction is

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

- (a) 1.0×10^5 (b) 1.0×10^{10}
 (c) 1.0×10^{30} (d) 1.0×10^2
49. The structure of intermediate A in the following reaction is



50. The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is
 (a) 20 (b) 30 (c) 40 (d) 10
51. The non-essential amino acid among the following is
 (a) leucine. (b) alanine. (c) lysine. (d) valine.
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 Out of Syllabus

- (a) $Z > 1$ and repulsive forces and dominant.
 (b) $Z < 1$ and attractive forces and dominant.
 (c) $Z < 1$ and repulsive forces and dominant.
 (d) $Z > 1$ and attractive forces and dominant.
53. Which of the following reactions are disproportionation reaction?
 (i) $2\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}^0$
 (ii) $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
 (iii) $2\text{KMnO}_4 \xrightarrow{\Delta} \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
 (iv) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \longrightarrow 5\text{MnO}_2 + 4\text{H}^{\oplus}$

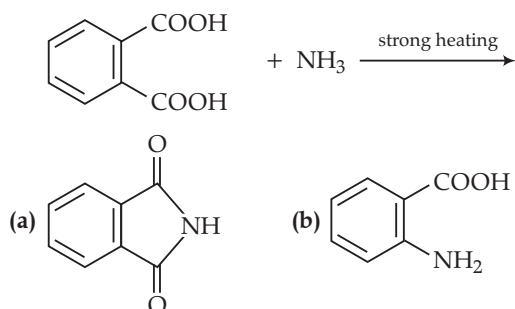
Select the correct option from the following

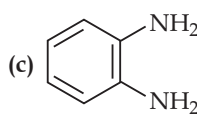
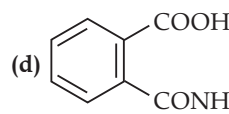
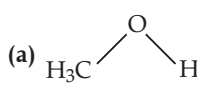
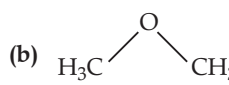
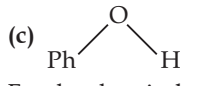
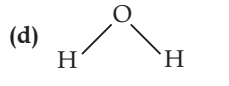
- (a) (i), (ii) and (iii) (b) (i), (iii) and (iv)
 (c) (i) and (iv) only (d) (i) and (ii) only
54. Which is the correct thermal stability order for H_2E (E = O, S, Se, Te and Po)?
 (a) $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{Po}$
 (b) $\text{H}_2\text{Po} < \text{H}_2\text{Te} < \text{H}_2\text{Se} < \text{H}_2\text{S} < \text{H}_2\text{O}$
 (c) $\text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{Po} < \text{H}_2\text{O} < \text{H}_2\text{S}$
 (d) $\text{H}_2\text{S} < \text{H}_2\text{O} < \text{H}_2\text{Se} < \text{H}_2\text{Te} < \text{H}_2\text{Po}$
55. 4d, 5p, 5f and 6p orbitals are arranged in the order of decreasing energy. The correct option is
 (a) $6p > 5f > 5p > 4d$ (b) $6p > 5f > 4d > 5p$
 (c) $5f > 6p > 4d > 5p$ (d) $5f > 6p > 5p > 4d$
56. 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
57. For the second period elements the correct increasing order of first ionisation enthalpy is
 (a) $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$
 (b) $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{N} < \text{O} < \text{F} < \text{Ne}$
 (c) $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$
 (d) $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{N} < \text{O} < \text{F} < \text{Ne}$
58. Identify the incorrect statement related to PCl_5 from the following
 (a) Two axial P—Cl bonds make an angle of 180° with each other.
 (b) Axial P—Cl bonds are longer than equatorial P—Cl bonds.
 (c) PCl_5 molecule is non-reactive.
 (d) Three equatorial P—Cl bonds make an angle of 120° with each other.

59. Which of the following diatomic molecular species has only π bonds according of Molecular Orbital Theory?
 (a) N_2 (b) C_2 (c) Be_2 (d) O_3
60. The number of sigma (σ) and pi (π) bonds in pent-2-en-4-yne is

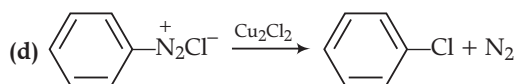
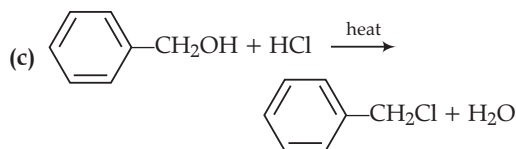
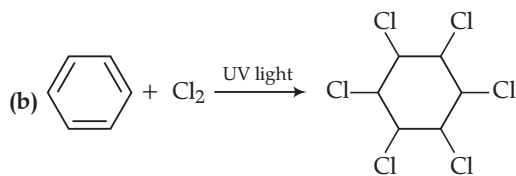
- (a) 8 σ bonds and 5 π bonds.
 (b) 11 σ bonds and 2 π bonds.
 (c) 13 σ bonds and no π bonds.
 (d) 10 σ bonds and 3 π bonds.
61. Among the following, the one that is not green house gas is Out of Syllabus
 (a) methane. (b) ozone.
 (c) sulphur dioxide. (d) nitrous oxide.
62. Under isothermal condition, a gas at 300 K expands from 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is
 (a) 5 kJ (b) 25 J (c) 30 J (d) -30 J
63. Which one is malachite from the following? Out of Syllabus

- (a) $\text{Cu}(\text{OH})_2$ (b) Fe_3O_4
 (c) $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ (d) CuFeS_2
64. The mixture that forms maximum boiling azeotrope is
 (a) Ethanol + Water
 (b) Acetone + Carbon disulphide
 (c) Heptane + Octane
 (d) Water + Nitric acid
65. The biodegradable polymer is Out of Syllabus
 (a) nylon-2-nylon 6 (b) nylon-6
 (c) Buna-S (d) nylon-6, 6
66. Which of the following series of transitions in the spectrum of hydrogen atom falls in visible region?
 (a) Balmer series (b) Paschen series
 (c) Brackett series (d) Lyman series
67. For an ideal solution, the correct option is
 (a) $\Delta_{\text{mix}} V \neq 0$ at constant T and P
 (b) $\Delta_{\text{mix}} H = 0$ at constant T and P
 (c) $\Delta_{\text{mix}} G = 0$ at constant T and P
 (d) $\Delta_{\text{mix}} S = 0$ at constant T and P
68. Which of the following is an amphoteric hydroxide?
 (a) $\text{Ca}(\text{OH})_2$ (b) $\text{Mg}(\text{OH})_2$ (c) $\text{Be}(\text{OH})_2$ (d) $\text{Sr}(\text{OH})_2$
69. 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) $t = 6.909/k$ (b) $t = 4.606/k$
 (c) $t = 2.303/k$ (d) $t = 0.693/k$
70. Conjugate base for Bronsted acids H_2O and HF are
 (a) H_3O^+ and F^- , respectively.
 (b) OH^- and F^- , respectively.
 (c) H_3O^+ and H_2F^+ , respectively.
 (d) OH^- and H_2F^+ , respectively.
71. The major product of the following reaction is



- (c)  (d) 
72. The compound that is most difficult to protonate is
 (a)  (b) 
 (c)  (d) 
73. For the chemical reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ the correct option is
 (a) $-\frac{d[\text{N}_2]}{dt} = 2\frac{d[\text{NH}_3]}{dt}$
 (b) $-\frac{d[\text{N}_2]}{dt} = \frac{1}{2}\frac{d[\text{NH}_3]}{dt}$
 (c) $3\frac{d[\text{H}_2]}{dt} = 2\frac{d[\text{NH}_3]}{dt}$
 (d) $-\frac{1}{3}\frac{d[\text{H}_2]}{dt} = -\frac{1}{2}\frac{d[\text{NH}_3]}{dt}$
74. In which case change in entropy is negative?
 (a) Expansion of a gas at constant temperature
 (b) Sublimation of solid to gas
 (c) $2\text{H}(\text{g}) \rightarrow \text{H}_2(\text{g})$
 (d) Evaporation of water
75. The correct order of the basic strength of methyl substituted amines in aqueous solution is
 (a) $(\text{CH}_3)_3\text{N} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH}$
 (b) $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2$
 (c) $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N}$
 (d) $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N}$
76. For the cell reaction $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightarrow 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{aq})$
 $E^{\circ}_{\text{cell}} = 0.24 \text{ V}$ at 298 K. The standard Gibbs energy ($\Delta_r G^{\circ}$) of the cell reaction is
 [Given that Faraday constant $F = 96500 \text{ C mol}^{-1}$]
 (a) $-23.16 \text{ kJ mol}^{-1}$ (b) $46.32 \text{ kJ mol}^{-1}$
 (c) $23.16 \text{ kJ mol}^{-1}$ (d) $-46.32 \text{ kJ mol}^{-1}$
77. What is the correct electronic configuration of the central atom in $\text{K}_4[\text{Fe}(\text{CN})_6]$ based on crystal field theory?
 (a) $t_{2g}^6 e_g^0$ (b) $e^3 t_2^3$ (c) $e^4 t_2^2$ (d) $t_{2g}^4 e_g^2$
78. 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 Out of Syllabus
 (a) C_3A_2 (b) C_3A_4 (c) C_4A_3 (d) C_2A_3
79. The method used to remove temporary hardness of water is Out of Syllabus
 (a) Clark's method.
 (b) Ion-exchange method.
 (c) Synthetic resins method.
 (d) Calgon's method.

80. The manganate and permanganate ions are tetrahedral, due to
 (a) there is no π -bonding.
 (b) the π -bonding involves overlap of p -orbitals of oxygen with p -orbitals of manganese.
 (c) the π -bonding involves overlap of d -orbitals of oxygen with d -orbitals of manganese.
 (d) the π -bonding involves overlap of p -orbitals of oxygen with d -orbitals of manganese.
81. Among the following, the reaction that proceeds through an electrophilic substitution, is

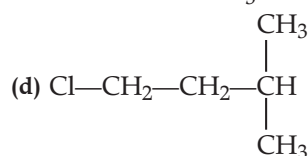
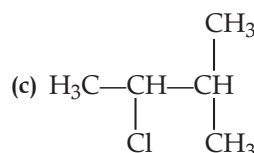
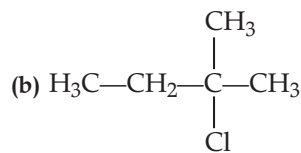
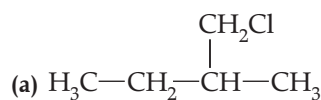


82. Match the Xenon compounds in Column-I with its structure in Column-II and assign the correct code

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) | (i) |
| (d) | (i) | (ii) | (iii) | (iv) |
83. Which of the following is incorrect statement?
 (a) SiCl₄ is easily hydrolysed.
 (b) GeX₄ (X = F, Cl, Br, I) is more stable than GeX₂.
 (c) SnF₄ is ionic in nature.
 (d) PbF₄ is covalent in nature.
84. An alkene 'A' on reaction with O₃ and Zn-H₂O 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



85. Which mixture of the solutions will lead to the formation of negatively charged colloidal [AgI]⁻ sol.?
 (a) 50 mL of 1 M AgNO₃ + 50 mL of 2 M KI
 (b) 50 mL of 2 M AgNO₃ + 50 mL of 1.5 M KI
 (c) 50 mL of 0.1 M AgNO₃ + 50 mL of 0.1 M I
 (d) 50 mL of 1 M AgNO₃ + 50 mL of 0.5 M KI
86. Match the following: Out of Syllabus

Column-I		Column-II	
(a)	Pure nitrogen	(i)	Chlorine
(b)	Haber process	(ii)	Sulphuric acid
(c)	Contact process	(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) | (ii) | (iv) | (i) | (iii) |
| (b) | (iii) | (iv) | (ii) | (i) |
| (c) | (iv) | (iii) | (ii) | (i) |
| (d) | (i) | (ii) | (iii) | (iv) |
87. Enzymes that utilize ATP in phosphate transfer require an alkaline earth metal (M) as the cofactor M is Out of Syllabus
- (a) Mg (b) Ca (c) Sr (d) Be
88. Among the following, the narrow spectrum antibiotic is Out of Syllabus
- (a) ampicillin (b) amoxycillin
 (c) chloramphenicol (d) penicillin G
89. Which of the following species is not stable?
 (a) [GeCl₆]²⁻ (b) [Sn(OH)₆]²⁻
 (c) [SiCl₆]²⁻ (d) [SiF₆]²⁻
90. pH of a saturated solution of Ca(OH)₂ is 9. The solubility product (k_{sp}) of Ca(OH)₂ is
 (a) 0.25×10^{-10} (b) 0.125×10^{-15}
 (c) 0.5×10^{-10} (d) 0.5×10^{-15}

BIOLOGY

91. What map unit (Cenimorgan) is adopted in the construction of genetic maps ?
 (a) A unit of distance between two expressed genes, representing 100% cross over
 (b) A unit of distance between genes on chromosomes, representing 1% cross over
 (c) A unit of distance between genes on chromosomes, representing 50% cross over
 (d) A unit of distance between two expressed genes, representing 10% cross over
92. Select the correct group of biocontrol agents
 (a) *Trichoderma*, *Baculovirus*, *Bacillus thuringiensis*
 (b) *Oscillatoria*, *Rhizobium*, *Trichoderma*
 (c) *Nostoc*, *Azospirillum*, *Nucleopolyhe-drovirus*
 (d) *Bacillus thuringiensis*, Tobacco mosaic virus, Aphids
93. The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in
 (a) fallopian tubes and pancreatic duct.
 (b) eustachian and salivary duct.
 (c) bronchioles and fallopian tubes.
 (d) bile duct and bronchioles.
94. 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) 0.16 (AA); 0.24 (Aa); 0.36 (aa)
 (b) 0.16 (AA); 0.48 (Aa); 0.36 (aa)
 (c) 0.16 (AA); 0.36 (Aa); 0.48 (aa)
 (d) 0.36 (AA); 0.48 (Aa); 0.16 (aa)
95. Select the incorrect statement
 (a) Inbreeding is essential to evolve purelines in any animal.
 (b) Inbreeding selects harmful recessive genes that reduce fertility and productivity.
 (c) Inbreeding helps in accumulation of superior genes and elimination of undesirable genes.
 (d) Inbreeding increases homozygosity.
96. Which of the following factors is responsible for the formation of concentrated urine ?
 (a) Maintaining hyperosmolarity towards inner medullary interstitium in the kidneys
 (b) Selection of erythropoetin by Juxttaglo-merular complex
 (c) Hydrostatic pressure during glomerular filtration
 (d) Low levels of antidiuretic hormone
97. 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) (iii) (ii) (i) (iv)
 (b) (ii) (i) (iii) (iv)
 (c) (ii) (iii) (iv) (i)
 (d) (i) (ii) (iii) (iv)
98. Which of the following glucose transporters is insulin-dependent ?
 (a) GLUT II (b) GLUT III (c) GLUT IV (d) GLUT I
99. Grass leaves curl inwards during every dry weather. Select the most appropriate reason from the following
 (a) Flaccidity of bulliform cells
 (b) Shrinkage of air spaces in spongy mesophyll
 (c) Tyloses in vessels
 (d) Closure of stomata
100. Concanavalin A is
 (a) an essential oil. (b) a lectin.
 (c) a pigment. (d) an alkaloid.
101. Select the incorrect statement :
 (a) In male grasshoppers, 50% of sperms have no sex-chromosome.
 (b) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.
 (c) Human males have one of their sex-chromosome much shorter than the other.
 (d) Male fruit fly is heterogametic.
102. Which one of the following is not a method of *in situ* conservation of biodiversity?
 (a) Wildlife Sanctuary (b) Botanical Garden
 (c) Sacred Grove (d) Biosphere Reserve
103. Which of the following statements is incorrect ?
 (a) *Claviceps* is source of many alkaloids and LSD.
 (b) Conidia are produced exogenously and ascospores endogenously.
 (c) Yeasts have filamentous bodies with long thread-like hyphae.
 (d) Morels and truffles are edible delicacies.
104. Which of the following contraceptive methods do involve a role of hormone ?
 (a) Barrier method, Lactational amenorrhoea, Pills
 (b) CuT, Pills, Emergency contraceptives
 (c) Pills, Emergency contraceptives, Barrier methods
 (d) Lactational amenorrhoea, Pills, Emergency contraceptives
105. 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) | (iv) | (ii) | (i) |
| (b) | (ii) | (iv) | (iii) | (i) |
| (c) | (iii) | (ii) | (iv) | (i) |
| (d) | (iii) | (ii) | (i) | (iv) |
106. Drug called 'Heroin' is synthesised by
(a) acetylation of morphine.
(b) glycosylation of morphine.
(c) nitration of morphine.
(d) methylation of morphine.
107. Match the following organisms with the products they produce:
- | | |
|-------------------------------------|-------------------------------|
| (a) <i>Lactobacillus</i> | (i) Cheese |
| (b) <i>Saccharomyces cerevisiae</i> | (ii) Curd |
| (c) <i>Aspergillus niger</i> | (iii) Citric Acid |
| (d) <i>Acetobacter aceti</i> | (iv) Bread
(v) Acetic Acid |
- Select the correct option from the following
- | | | | | |
|-----|-------|------|-------|-------|
| | (a) | (b) | (c) | (d) |
| (a) | (ii) | (iv) | (iii) | (v) |
| (b) | (iii) | (iv) | (v) | (i) |
| (c) | (ii) | (i) | (iii) | (v) |
| (d) | (ii) | (iv) | (v) | (iii) |
108. What is the site of perception of photoperiod necessary for induction of flowering in plants?
(a) Pulvinus (b) Shoot apex
(c) Leaves (d) Lateral buds
109. 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) 1700 mL (b) 2200 mL (c) 2700 mL (d) 1500 mL
110. *Thiobacillus* is a group of bacteria helpful in carrying out
(a) chemoautotrophic fixation.
(b) nitrification.
(c) denitrification.
(d) nitrogen fixation.
111. 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) Stabilizing Selection (b) Disruptive Selection
(c) Cyclical Selection (d) Directional Selection
112. 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) Pink colour in F_1 is due to incomplete dominance.
(b) Ratio of F_2 is $\frac{1}{4}$ (Red) : $\frac{2}{4}$ (Pink) : $\frac{1}{4}$ (White).
(c) Law of Segregation does not apply in this experiment.
(d) This experiment does not following the Principle of Dominance.
113. Expressed Sequence Tags (ESTs) refers to
(a) polypeptide expression.
(b) DNA polymorphism.
(c) Novel DNA sequences.
(d) genes expressed as RNA.
114. Identify the cells whose secretion protects the lining of gastro-intestinal tract from various enzymes. Out of Syllabus
- | | |
|--------------------|-------------------|
| (a) Goblet cells | (b) Oxyntic cells |
| (c) Duodenal cells | (d) Chief cells |
115. Extrusion of second polar body from egg nucleus occurs
(a) after fertilisation.
(b) before entry of sperm into ovum.
(c) simultaneously with first cleavage.
(d) after entry of sperm but before fertilisation.
116. Match the hominids with their correct brain size:
- | | |
|----------------------------------|------------------|
| (a) <i>Homo habilis</i> | (i) 900 cc |
| (b) <i>Homo neanderthalensis</i> | (ii) 1350 cc |
| (c) <i>Homo erectus</i> | (iii) 650-800 cc |
| (d) <i>Homo sapiens</i> | (iv) 1400 cc |
- Select the correct option from the following
- | | | | | |
|-----|-------|-------|------|------|
| | (a) | (b) | (c) | (d) |
| (a) | (iii) | (ii) | (i) | (iv) |
| (b) | (iii) | (iv) | (i) | (ii) |
| (c) | (iv) | (iii) | (i) | (ii) |
| (d) | (iii) | (i) | (iv) | (ii) |
117. Which of the following statements is not correct?
(a) The hydrolytic enzymes of lysosomes are active under acidic pH.
(b) Lysosomes are membrane bound structures.
(c) Lysosomes are formed by the process of packaging in the endoplasmic reticulum.
(d) Lysosomes have numerous hydrolytic enzymes.
118. Select the hormone-releasing Intra-Uterine Devices.
(a) Multiload 375, Progestasert
(b) Progestasert, LNG-20
(c) Lippes Loop, Multiload 375
(d) Vaults, LNG-20
119. Respiratory Quotient (RQ) value of tripalmitin is
(a) 0.7 (b) 0.07 (c) 0.09 (d) 0.9
120. Pinus seed cannot germinate and establish without fungal association. This is because
(a) it has obligate association with mycorrhizae.
(b) it has very hard seed coat.
(c) its seeds contain inhibitors that prevent germination.
(d) its embryo is immature.
121. Sequence of organs in the alimentary canal of cockroach starting from mouth Out of Syllabus
(a) Pharynx → Oesophagus → Gizzard → Crop → Ileum → Colon → Rectum
(b) Pharynx → Oesophagus → Gizzard → Ileum → Crop → Colon → Rectum
(c) Pharynx → Oesophagus → Ileum → Crop → Gizzard → Colon → Rectum
(d) Pharynx → Oesophagus → Crop → Gizzard → Ileum → Colon → Rectum
122. Under which of the following conditions will there be no change in the reading frame of following mRNA ?
5' AACAGCGGUGCUAAU 3'

- (a) Deletion of G from 5th position
 (b) Insertion of A and G at 4th and 5th positions respectively
 (c) Deletion of GGU from 7th, 8th and 9th positions
 (d) Insertion of G at 5th position
123. From evolutionary point of view, retention of the female gametophyte with developing young embryo on the parent sporophyte for some time, is first observed in
 (a) mosses. (b) pteridophytes.
 (c) gymnosperms. (d) liverworts.
124. Match the following hormones with the respective disease:
 (a) Insulin (i) Addison's disease
 (b) Thyroxin (ii) Diabetes insipidus
 (c) Corticoids (iii) Acromegaly
 (d) Growth Hormone (iv) Goitre
 (v) Diabetes mellitus
- Select the correct option from the following:
- | | | | | |
|-----|------|------|-------|-------|
| | (a) | (b) | (c) | (d) |
| (a) | (ii) | (iv) | (iii) | (i) |
| (b) | (v) | (iv) | (i) | (iii) |
| (c) | (ii) | (iv) | (i) | (iii) |
| (d) | (v) | (i) | (ii) | (iii) |
125. The concept of "Omnis cellula-e cellula" regarding cell division was first proposed by
 (a) Theodore Schwann. (b) Schleiden.
 (c) Aristotle. (d) Rudolf Virchow.
126. Colostrum, the yellowish fluid, secreted by mother during the initial days of lactation is very essential to impart immunity to the newborn infants because it contains
 (a) monocytes. (b) macrophages.
 (c) immunoglobulin A. (d) natural killer cells.
127. Polyblend, a fine powder of recycled modified plastic, has proved to be a good material for
 (a) use as a fertilizer.
 (b) construction of roads.
 (c) making tubes and pipes.
 (d) making plastic sacks.
128. It takes very long time for pineapple plant to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield?
 (a) Gibberellin and Cytokinin
 (b) Gibberellin and Abscisic acid
 (c) Cytokinin and Abscisic acid
 (d) Auxin and Ethylene
129. Which part of the brain is responsible for thermoregulation?
 (a) Hypothalamus (b) Corpus callosum
 (c) Medulla oblongata (d) Cerebrum
130. Which of the following pairs of gases is mainly responsible for green house effect?
 (a) Oxygen and Nitrogen
 (b) Nitrogen and Sulphur dioxide
 (c) Carbon dioxide and Methane
 (d) Ozone and Ammonia
131. 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 from the following
- | | | | | |
|-----|-------|-------|------|------|
| | (a) | (b) | (c) | (d) |
| (a) | (iii) | (i) | (ii) | (iv) |
| (b) | (iii) | (i) | (iv) | (ii) |
| (c) | (iii) | (iv) | (i) | (ii) |
| (d) | (i) | (iii) | (ii) | (iv) |
132. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with
 (a) chilled ethanol.
 (b) methanol at room temperature.
 (c) chilled chloroform.
 (d) isopropanol.
133. The correct sequence of phases of cell cycle is
 (a) $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$ (b) $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$
 (c) $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$ (d) $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$
134. Which of the following statements regarding mitochondria is incorrect?
 (a) Enzymes of electron transport are embedded in outer membrane.
 (b) Inner membrane is convoluted with infoldings.
 (c) Mitochondrial matrix contains single circular DNA molecule and ribosomes.
 (d) Outer membrane is permeable to monomers of carbohydrates fats and proteins.
135. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was explained by
 (a) Gregor J. Mendel. (b) Alfred Sturtevant.
 (c) Sutton Boveri. (d) T.H. Morgan.
136. Identify the correct pairs representing the causative agent of typhoid fever and the confirmatory test for typhoid.
 (a) *Streptococcus pneumoniae* / Widal test
 (b) *Salmonella typhi* / Anthrone test
 (c) *Salmonella typhi* / Widal test
 (d) *Plasmodium vivax* / UTI test
137. The Earth Summit held in Rio de Janeiro in 1992 was called
 (a) for conservation of biodiversity and sustainable utilisation of its benefits.
 (b) to assess threat posed to native species by invasive weed species.
 (c) for immediate steps to discontinue use of CFCs that were damaging the ozone layer.
 (d) to reduce CO₂ emissions and global warming.
138. Variations caused by mutation, as proposed by Hugo de Vries, are
 (a) random and direction less.
 (b) small and directional.
 (c) small and direction less.
 (d) random and directional.
139. Which of the following can be used as a biocontrol agent in the treatment of plant disease?
 (a) *Chlorella* (b) *Anabaena*
 (c) *Lactobacillus* (d) *Trichoderma*

140. Which of the following immune responses is responsible for rejection of kidney graft ?
 (a) Humoral immune response
 (b) Inflammatory immune response
 (c) Cell-mediated immune response
 (d) Auto-immune response
141. Cells in G_0 phase
 (a) enter the cells cycle.
 (b) suspend the cell cycle.
 (c) terminate the cell cycle.
 (d) exit the cell cycle.
142. Which of the following is a commercial blood cholesterol lowering agents ?
 (a) Statin (b) Streptokinase
 (c) Lipases (d) Cyclosporin A
143. Which of the following muscular disorders is inherited ?
 (a) Muscular dystrophy (b) Myasthenia gravis
 (c) Botulism (d) Tetany
144. Select the correct option. Out of Syllabus
 (a) 11th and 12th pairs of ribs are connected to the sternum with the help of hyaline cartilage.
 (b) Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum.
 (c) There are seven pairs of vertebrosteral, three pairs of vertebrochondral and two pairs of vertebral ribs.
 (d) 8th, 9th and 10th pairs of ribs articulate directly with the sternum.
145. Which of the following statements is correct ?
Out of Syllabus
 (a) Cornea consists of dense connective tissue of elastin and can repair itself.
 (b) Cornea is convex, transparent layer which is highly vascularised.
 (c) Cornea consists of dense matrix of collagen and is the most sensitive portion of the eye.
 (d) Cornea is an external, transparent and protective proteinacious covering of the eye-ball.
146. Following statements describe the characteristics of the enzyme restriction endonuclease. Identify the incorrect statement.
 (a) The enzyme binds DNA at specific sites and cuts only one of the two strands.
 (b) The enzyme cuts the sugar-phosphate backbone at specific sites on each strand.
 (c) The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.
 (d) The enzyme cuts DNA molecule at identified position with the DNA.
147. Phloem in gymnosperms lacks
 (a) sieve tubes only.
 (b) companion cells only.
 (c) both sieve tubes and companion cells.
 (d) albuminous cells and sieve cells.
148. Use of an artificial kidney during haemodialysis may result in:
 1. Nitrogenous waste build-up in the body
 2. Non-elimination of excess potassium ions
 3. Reduced absorption of calcium ions from gastrointestinal tract
 4. Reduced RBC production
 Which of the following options is the most appropriate ?
 (a) (2) and (3) are correct (b) (3) and (4) are correct
 (c) (1) and (4) are correct (d) (1) and (2) are correct
149. Which of the following statements is incorrect ?
 (a) Viruses are obligate parasites.
 (b) Infective constituent in viruses is the protein coat.
 (c) Prions consist of abnormally folded proteins.
 (d) Viroids lack a protein coat.
150. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to
 (a) inflammation of bronchi and bronchioles.
 (b) proliferation of fibrous tissues and damage of the alveolar walls.
 (c) reduction in the secretion of surfactants by pneumocytes.
 (d) benign growth on mucous lining of nasal cavity.
151. Which of the following sexually transmitted diseases is not completely curable ?
 (a) Genital warts (b) Genital herpes
 (c) Chlamydiae (d) Gonorrhoea
152. How does steroid hormone influence the cellular activities ?
 (a) Binding to DNA and forming a genehormone complex
 (b) Activating cyclic AMP located on the cell membrane
 (c) Using aquaporin channels as second messenger
 (d) Changing the permeability of the cell membrane
153. Which of the statements given below is not true about formation of annual rings in trees ?
 (a) Differential activity of cambium causes light and dark bands of tissue-early and late wood respectively.
 (b) Activity of cambium depends upon variation in climate.
 (c) Annual rings are not prominent in trees of temperate region.
 (d) Annual ring is a combination of spring wood and autumn wood produced in a year.
154. What is the direction of movement of sugars in phloem ? Out of Syllabus
 (a) Upward (b) Downward
 (c) Bi-directional (d) Non-multidirectional
155. The shorter and longer arms of a submetacentric chromosome are referred to as
 (a) *p*-arm and *q*-arm respectively.
 (b) *q*-arm and *p*-arm respectively.
 (c) *m*-arm and *n*-arm respectively.
 (d) *s*-arm and *l*-arm respectively.
156. Which of these following methods is the most suitable for disposal of nuclear waste ?
 (a) Bury the waste under Antarctic ice-cover
 (b) Dump the waste within rocks under deep ocean
 (c) Bury the waste within rocks deep below the Earth's surface
 (d) Shoot the waste into space

157. Match the Column-I with Column-II

Column-I		Column-II	
(a)	P-wave	(i)	Depolarization of ventricles
(b)	QRS complex	(ii)	Repolarization of ventricles
(c)	T-wave	(iii)	Coronary ischemia
(d)	Reduction in the size of T-wave	(iv)	Depolarization of atria
		(v)	Repolarization of atria

Select the correct option.

- | | | | | |
|-----|------|-------|------|-------|
| | (a) | (b) | (c) | (d) |
| (a) | (iv) | (i) | (ii) | (i) |
| (b) | (ii) | (i) | (v) | (iii) |
| (c) | (ii) | (iii) | (v) | (iv) |
| (d) | (iv) | (i) | (ii) | (iii) |
158. Which one of the following statements regarding post-fertilization development in flowering plants is incorrect ?
- (a) Zygote develops into embryo.
 (b) Central cell develops into endosperm.
 (c) Ovules develop into embryo sac.
 (d) Ovary develops into fruit.
159. Select the correctly written scientific name of Mango which was first described by Carolus Linnaeus :
- (a) *Mangifera indica* Linn
 (b) *Mangifera indica*
 (c) *Mangifera Indica*
 (d) *Mangifera indica* Car. Linn.
160. What is the fate of the male gametes discharged in the synergid ?
- (a) All fuse with the egg
 (b) One fuses with the egg, other(s) fuse(s) with synergid nucleus
 (c) One fuses with the egg and other fuses with central cell nuclei
 (d) One fuses with the egg, other(s) degenerate(s) in the synergid
161. Which of the following features of genetic code does allow bacteria to produce human insulin by recombinant DNA technology ?
- (a) Genetic code is redundant
 (b) Genetic code is nearly universal
 (c) Genetic code is specific
 (d) Genetic code is not ambiguous
162. What of the following pair of organelles does not contain DNA ?
- (a) Chloroplast and Vacuoles
 (b) Lysosomes and Vacuoles
 (c) Nuclear envelope and Mitochondria
 (d) Mitochondria and Lysosomes
163. In some plants, the female gamete develops into embryo without fertilisation. This phenomenon is known as
- (a) parthenocarpy. (b) syngamy.
 (c) parthenogenesis. (d) autogamy.
164. 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) (A) is true but (B) is false
 (b) Both (A) and (B) are false
 (c) (A) is false but (B) is true
 (d) Both (A) and (B) are true
165. Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalysed by
- (a) hexokinase. (b) enolase.
 (c) phosphofructokinase. (d) aldolase.
166. Which of the following ecological pyramids is generally inverted ?
- (a) Pyramid of energy
 (b) Pyramid of biomass in a forest
 (c) Pyramid of biomass in a sea
 (d) Pyramid of numbers in grassland
167. Consider following features :
1. Organ system level of organisation
 2. Bilateral symmetry
 3. True coelomates with segmentation of body
- Select the correct option of animal groups which possess all the above characteristics.
- (a) Annelida, Arthropoda and Mollusca
 (b) Arthropoda, Mollusca and Chordata
 (c) Annelida, Mollusca and Chordata
 (d) Annelida, Arthropoda and Chordata
168. What is genetic disorder in which an individual has an overall masculine development, gynaecomastia and is sterile ?
- (a) Klinefelter's syndrome (b) Edward syndrome
 (c) Down's syndrome (d) Turner's syndrome
169. Which of the following is the most important cause for animals and plants being driven to extinction ?
- (a) Drought and floods
 (b) Economic exploitation
 (c) Alien species invasion
 (d) Habitat loss and fragmentation
170. What triggers activation of protoxin to active. Bt toxin of *Bacillus thuringiensis* in boll worm ?
- (a) Moist surface of midgut
 (b) Alkaline pH of gut
 (c) Acidic pH of stomach
 (d) Body temperature
171. Select the correct sequence for transport of sperm cells in male reproductive system.
- (a) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
 (b) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra
 (c) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal → Urethra → Urethral meatus
 (d) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra
172. Persistent nucellus in the seed is known as
- (a) perisperm. (b) hilum.
 (c) tegmen. (d) chalaza.

173. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes ?
 (a) Sludge digester (b) Industrial oven
 (c) Bioreactor (d) BOD incubator
174. Match the following structures with their respective location in organs: Out of Syllabus
- | | |
|--------------------------|-----------------------|
| (a) Crypts of Lieberkühn | (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.
- | | | | |
|-----------|----------|----------|-----------|
| (a) | (b) | (c) | (d) |
| (a) (ii) | (b) (iv) | (c) (i) | (d) (iii) |
| (b) (iii) | (b) (iv) | (c) (i) | (d) (ii) |
| (c) (iii) | (b) (ii) | (c) (i) | (d) (iv) |
| (d) (iii) | (b) (i) | (c) (ii) | (d) (iv) |
175. 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) 75 beats per minute (b) 100 beats per minute
 (c) 125 beats per minute (d) 50 beats per minute
176. Xylem translocates
 (a) water and mineral salts only.
 (b) water, mineral salts and some organic nitrogen only.
 (c) water, mineral salts, some organic nitrogen and hormones.
 (d) water only.
177. Which of the following is true for Golden rice ?
 (a) It is pest resistant, with a gene from *Bacillus thuringiensis*.
 (b) It is drought tolerant, developed using *Agrobacterium* vector.
 (c) It has yellow grains, because of a gene introduced from primitive variety of rice.
 (d) It is Vitamin A enriched, with a gene from daffodil.
178. Purines found in the DNA and RNA are
 (a) adenine and guanine. (b) guanine and cytosine.
 (c) cytosine and thymine. (d) adenine and thymine.
179. Which of the following protocols did aim for reducing emission of chlorofluorocarbons into the atmosphere ?
 (a) Kyoto Protocol (b) Gothenburg Protocol
 (c) Geneva Protocol (d) Montreal Protocol
180. Placentation, in which ovules develop on the inner wall of the ovary or in peripheral part, is
 (a) axile. (b) parietal.
 (c) free central. (d) basal.

Booklet	Batch	RollNumber
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>
(A) 10+1 (S)		0 0 0 0 0 0 0 0 0 0
(B) 10-2 (V)		1 1 1 1 1 1 1 1 1 1
(C) 10-3 (A)		2 2 2 2 2 2 2 2 2 2
(D) Crash (C)		3 3 3 3 3 3 3 3 3 3
(E)		4 4 4 4 4 4 4 4 4 4
(F) Paper		5 5 5 5 5 5 5 5 5 5
(G)	<input type="checkbox"/>	6 6 6 6 6 6 6 6 6 6
(H) Paper 1 (1)		7 7 7 7 7 7 7 7 7 7
(I) Paper 2 (2)		8 8 8 8 8 8 8 8 8 8
(J)		9 9 9 9 9 9 9 9 9 9

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries in this section have been properly filled by the student

The OMR Sheet will be computer checked. Fill the circles completely and dark enough for proper detection. Use ballpen (black or blue) for marking.

Avoid Improper Marking



Test Center Code

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

1 (a) (b) (c) (d)	6 (a) (b) (c) (d)	11 (a) (b) (c) (d)	16 (a) (b) (c) (d)	21 (a) (b) (c) (d)	26 (a) (b) (c) (d)
2 (a) (b) (c) (d)	7 (a) (b) (c) (d)	12 (a) (b) (c) (d)	17 (a) (b) (c) (d)	22 (a) (b) (c) (d)	27 (a) (b) (c) (d)
3 (a) (b) (c) (d)	8 (a) (b) (c) (d)	13 (a) (b) (c) (d)	18 (a) (b) (c) (d)	23 (a) (b) (c) (d)	28 (a) (b) (c) (d)
4 (a) (b) (c) (d)	9 (a) (b) (c) (d)	14 (a) (b) (c) (d)	19 (a) (b) (c) (d)	24 (a) (b) (c) (d)	29 (a) (b) (c) (d)
5 (a) (b) (c) (d)	10 (a) (b) (c) (d)	15 (a) (b) (c) (d)	20 (a) (b) (c) (d)	25 (a) (b) (c) (d)	30 (a) (b) (c) (d)
31 (a) (b) (c) (d)	36 (a) (b) (c) (d)	41 (a) (b) (c) (d)	46 (a) (b) (c) (d)	51 (a) (b) (c) (d)	56 (a) (b) (c) (d)
32 (a) (b) (c) (d)	37 (a) (b) (c) (d)	42 (a) (b) (c) (d)	47 (a) (b) (c) (d)	52 (a) (b) (c) (d)	57 (a) (b) (c) (d)
33 (a) (b) (c) (d)	38 (a) (b) (c) (d)	43 (a) (b) (c) (d)	48 (a) (b) (c) (d)	53 (a) (b) (c) (d)	58 (a) (b) (c) (d)
34 (a) (b) (c) (d)	39 (a) (b) (c) (d)	44 (a) (b) (c) (d)	49 (a) (b) (c) (d)	54 (a) (b) (c) (d)	59 (a) (b) (c) (d)
35 (a) (b) (c) (d)	40 (a) (b) (c) (d)	45 (a) (b) (c) (d)	50 (a) (b) (c) (d)	55 (a) (b) (c) (d)	60 (a) (b) (c) (d)
61 (a) (b) (c) (d)	66 (a) (b) (c) (d)	71 (a) (b) (c) (d)	76 (a) (b) (c) (d)	81 (a) (b) (c) (d)	86 (a) (b) (c) (d)
62 (a) (b) (c) (d)	67 (a) (b) (c) (d)	72 (a) (b) (c) (d)	77 (a) (b) (c) (d)	82 (a) (b) (c) (d)	87 (a) (b) (c) (d)
63 (a) (b) (c) (d)	68 (a) (b) (c) (d)	73 (a) (b) (c) (d)	78 (a) (b) (c) (d)	83 (a) (b) (c) (d)	88 (a) (b) (c) (d)
64 (a) (b) (c) (d)	69 (a) (b) (c) (d)	74 (a) (b) (c) (d)	79 (a) (b) (c) (d)	84 (a) (b) (c) (d)	89 (a) (b) (c) (d)
65 (a) (b) (c) (d)	70 (a) (b) (c) (d)	75 (a) (b) (c) (d)	80 (a) (b) (c) (d)	85 (a) (b) (c) (d)	90 (a) (b) (c) (d)
91 (a) (b) (c) (d)	96 (a) (b) (c) (d)	101 (a) (b) (c) (d)	106 (a) (b) (c) (d)	111 (a) (b) (c) (d)	116 (a) (b) (c) (d)
92 (a) (b) (c) (d)	97 (a) (b) (c) (d)	102 (a) (b) (c) (d)	107 (a) (b) (c) (d)	112 (a) (b) (c) (d)	117 (a) (b) (c) (d)
93 (a) (b) (c) (d)	98 (a) (b) (c) (d)	103 (a) (b) (c) (d)	108 (a) (b) (c) (d)	113 (a) (b) (c) (d)	118 (a) (b) (c) (d)
94 (a) (b) (c) (d)	99 (a) (b) (c) (d)	104 (a) (b) (c) (d)	109 (a) (b) (c) (d)	114 (a) (b) (c) (d)	119 (a) (b) (c) (d)
95 (a) (b) (c) (d)	100 (a) (b) (c) (d)	105 (a) (b) (c) (d)	110 (a) (b) (c) (d)	115 (a) (b) (c) (d)	120 (a) (b) (c) (d)
121 (a) (b) (c) (d)	126 (a) (b) (c) (d)	131 (a) (b) (c) (d)	136 (a) (b) (c) (d)	141 (a) (b) (c) (d)	146 (a) (b) (c) (d)
122 (a) (b) (c) (d)	127 (a) (b) (c) (d)	132 (a) (b) (c) (d)	137 (a) (b) (c) (d)	142 (a) (b) (c) (d)	147 (a) (b) (c) (d)
123 (a) (b) (c) (d)	128 (a) (b) (c) (d)	133 (a) (b) (c) (d)	138 (a) (b) (c) (d)	143 (a) (b) (c) (d)	148 (a) (b) (c) (d)
124 (a) (b) (c) (d)	129 (a) (b) (c) (d)	134 (a) (b) (c) (d)	139 (a) (b) (c) (d)	144 (a) (b) (c) (d)	149 (a) (b) (c) (d)
125 (a) (b) (c) (d)	130 (a) (b) (c) (d)	135 (a) (b) (c) (d)	140 (a) (b) (c) (d)	145 (a) (b) (c) (d)	150 (a) (b) (c) (d)
151 (a) (b) (c) (d)	156 (a) (b) (c) (d)	161 (a) (b) (c) (d)	166 (a) (b) (c) (d)	171 (a) (b) (c) (d)	176 (a) (b) (c) (d)
152 (a) (b) (c) (d)	157 (a) (b) (c) (d)	162 (a) (b) (c) (d)	167 (a) (b) (c) (d)	172 (a) (b) (c) (d)	177 (a) (b) (c) (d)
153 (a) (b) (c) (d)	158 (a) (b) (c) (d)	163 (a) (b) (c) (d)	168 (a) (b) (c) (d)	173 (a) (b) (c) (d)	178 (a) (b) (c) (d)
154 (a) (b) (c) (d)	159 (a) (b) (c) (d)	164 (a) (b) (c) (d)	169 (a) (b) (c) (d)	174 (a) (b) (c) (d)	179 (a) (b) (c) (d)
155 (a) (b) (c) (d)	160 (a) (b) (c) (d)	165 (a) (b) (c) (d)	170 (a) (b) (c) (d)	175 (a) (b) (c) (d)	180 (a) (b) (c) (d)

ANSWER KEY

1	(a)	31	(c)	61	(c)	91	(b)	121	(d)	151	(b)
2	(b)	32	(d)	62	(d)	92	(a)	122	(c)	152	(a)
3	(a)	33	(a)	63	(c)	93	(c)	123	(b)	153	(c)
4	(b)	34	(a)	64	(d)	94	(b)	124	(b)	154	(c)
5	(d)	35	(d)	65	(a)	95	(b)	125	(d)	155	(a)
6	(c)	36	(b)	66	(a)	96	(a)	126	(c)	156	(c)
7	(d)	37	(c)	67	(b)	97	(c)	127	(b)	157	(d)
8	(d)	38	(d)	68	(c)	98	(c)	128	(d)	158	(c)
9	(a)	39	(c)	69	(b)	99	(a)	129	(a)	159	(a)
10	(a)	40	(d)	70	(b)	100	(b)	130	(c)	160	(c)
11	(c)	41	(b)	71	(a)	101	(b)	131	(b)	161	(b)
12	(b)	42	(b)	72	(c)	102	(b)	132	(a)	162	(b)
13	(a)	43	(a)	73	(b)	103	(c)	133	(c)	163	(c)
14	(a)	44	(b)	74	(c)	104	(d)	134	(a)	164	(a)
15	(b)	45	(c)	75	(d)	105	(a)	135	(b)	165	(a)
16	(c)	46	(a)	76	(d)	106	(a)	136	(c)	166	(c)
17	(c)	47	(d)	77	(a)	107	(a)	137	(a)	167	(d)
18	(a)	48	(b)	78	(b)	108	(c)	138	(a)	168	(a)
19	(d)	49	(a)	79	(a)	109	(d)	139	(d)	169	(d)
20	(b)	50	(b)	80	(d)	110	(c)	140	(c)	170	(b)
21	(a)	51	(b)	81	(a)	111	(a)	141	(d)	171	(a)
22	(c)	52	(b)	82	(a)	112	(c)	142	(a)	172	(a)
23	(b)	53	(d)	83	(d)	113	(d)	143	(a)	173	(c)
24	(c)	54	(b)	84	(b)	114	(a)	144	(c)	174	(b)
25	(a)	55	(d)	85	(a)	115	(d)	145	(c)	175	(b)
26	(b)	56	(b)	86	(c)	116	(b)	146	(a)	176	(c)
27	(a)	57	(a)	87	(a)	117	(c)	147	(c)	177	(d)
28	(a)	58	(c)	88	(d)	118	(b)	148	(b)	178	(a)
29	(a)	59	(b)	89	(c)	119	(a)	149	(b)	179	(d)
30	(a)	60	(d)	90	(d)	120	(a)	150	(a)	180	(b)



SOLVED PAPER 2019

ANSWERS WITH EXPLANATIONS

PHYSICS

1. Option (a) is correct.

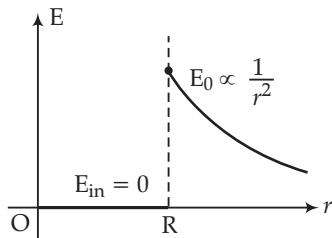
Since, the charge Q will be distributed over the surface of hollow metal sphere.

(i) For inside ($r < R$)

Apply, Gauss law,

$$\oint \vec{E}_{in} \cdot d\vec{S} = \frac{q_{en}}{\epsilon_0} = 0 \text{ or, } E_{in} = 0 \quad (\because q_{en} = 0)$$

(ii) For outside ($r > R$)



$$\oint \vec{E}_0 \cdot d\vec{S} = \frac{q_{en}}{\epsilon_0}$$

Here, $q_{en} = Q$ ($\because q_{en} = Q$)

So, $E_0 4\pi r^2 = \frac{Q}{\epsilon_0}$

Hence, $E_0 \propto \frac{1}{r^2}$

2. Option (b) is correct.

Work done under the given variable force is :

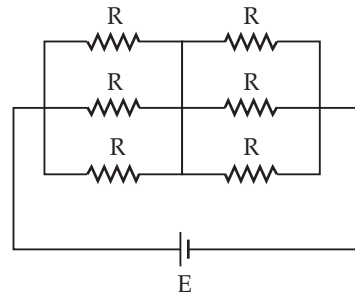
$$W = \int_{y_1}^{y_2} F dy$$

Here, $y_1 = 0, y_2 = 1$ m

$$\text{So, } W = \int_0^1 (20 + 10y) dy = \left[20y + \frac{10y^2}{2} \right]_0^1 = 25 \text{ J}$$

3. Option (a) is correct.

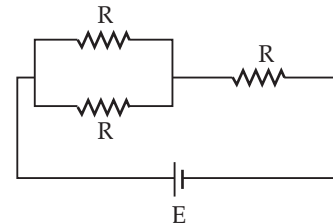
Apply the given condition, where all bulbs are glowing, from the given figure.



Equivalent resistance, $R_{eq} = \frac{R}{3} + \frac{R}{3} = \frac{2R}{3}$

Initial Power, $(P_i) = \frac{E^2}{R_{eq}} = \frac{3E^2}{2R}$... (i)

(ii) When two section A and one from section B are glowing.



Equivalent resistance, $R_{eq} = \frac{R}{2} + R = \frac{3R}{2}$

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

Now, $\frac{P_i}{P_f} = \frac{3E^2}{2R} \cdot \frac{3R}{2E^2} = 9 : 4$

4. Option (b) is correct.

For the soap, Excess pressure = $\frac{4T}{R}$,

Gauge pressure = $\rho g Z_0$

Apply the given condition,

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

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

or, $Z_0 = \frac{4 \times 2.5 \times 10^{-2}}{10^{-3} \times 1000 \times 10}$ m

or, $Z_0 = 1$ cm

5. Option (d) is correct.

Since, Red colour has least frequency. So, red has the longest wavelength among the given colour.

As, $v = \nu \lambda$

6. Option (c) is correct.

Acceleration due to gravity at a depth d from surface of Earth.

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

Here, g = acceleration due to gravity at earth's surface

Multiplying by mass ' m ' on both sides of equation (i)

$$\begin{aligned} mg' &= mg \left(1 - \frac{d}{R} \right) \\ &= 200 \left(1 - \frac{R}{2R} \right) \quad \left(d = \frac{R}{2} \right) \\ &= \frac{200}{2} = 100 \text{ N} \end{aligned}$$

7. Option (d) is correct.

Since, the rate of flow liquid is given as :

$$\begin{aligned} Q &= au = a\sqrt{2gh} \\ &= 2 \times 10^{-6} \text{ m}^2 \times \sqrt{2 \times 10 \times 2} \text{ m/s} \\ &= 2 \times 2 \times 3.14 \times 10^{-6} \text{ m}^3/\text{s} \\ &= 12.56 \times 10^{-6} \text{ m}^3/\text{s} \\ &= 12.6 \times 10^{-6} \text{ m}^3/\text{s} \end{aligned}$$

8. Option (d) is correct.

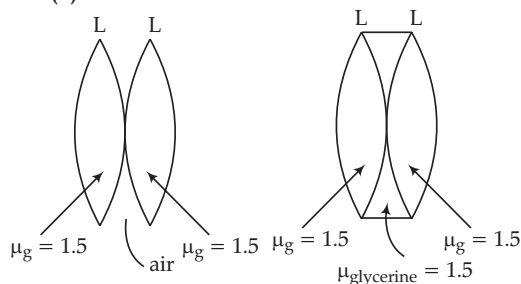
Apply the law of conservation of energy,
Work required = change in kinetic energy

Since, final KE = 0

$$\begin{aligned} \text{And, initial KE} &= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{3}{4}mv^2 \\ &= \frac{3}{4} \times 100 \times (20 \times 10^{-2})^2 = 3 \text{ J} \end{aligned}$$

Hence, change in KE, $|\Delta \text{KE}| = 3 \text{ J}$

9. Option (a) is correct.



Equivalent focal length (in air) $\frac{1}{F_1} = \frac{1}{f} + \frac{1}{f} = \frac{2}{f}$

When glycerin is filled inside, glycerin lens behaves like a diverging lens of focal length ($-f$)

$$\frac{1}{F_2} = \frac{1}{f} + \frac{1}{f} - \frac{1}{f} = \frac{1}{f}$$

Now, $\frac{F_1}{F_2} = \frac{1}{2}$

10. Option (a) is correct.

From the given equation :

$$X = \frac{A^2 B^{1/2}}{C^{1/3} D^3}$$

For the maximum percentage error,

$$\begin{aligned} \frac{\Delta X}{X} \times 100 &= 2 \frac{\Delta A}{A} \times 100 + \frac{1}{2} \frac{\Delta B}{B} \times 100 \\ &\quad + \frac{1}{3} \frac{\Delta C}{C} \times 100 + 3 \frac{\Delta D}{D} \times 100 \\ &= 2 \times 1\% + \frac{1}{2} \times 2\% + \frac{1}{3} \times 3\% + 3 \times 4\% \\ &= 2\% + 1\% + 1\% + 12\% \\ &= 16\% \end{aligned}$$

11. Option (c) is correct.

From the expression for the coefficient of thermal conductivity

$$\therefore K = \frac{dH}{A dt \Delta T}; \text{ Here, all alphabets are in their usual meaning.}$$

Unit of $K = \text{Wm}^{-1} \text{K}^{-1}$

12. Option (b) is correct.

Since, the initial potential energy at Earth's surface is

$$U_i = \frac{-GMm}{R}$$

And, the final potential energy at height, $h = R$:

$$U_f = \frac{-GMm}{2R}$$

Since, work done = change in PE

$$\begin{aligned} \therefore w &= U_f - U_i \\ &= \frac{GMm}{2R} \\ &= \frac{mgR}{2} \quad (\because GM = gR^2) \end{aligned}$$

13. Option (a) is correct.

From the characteristic property of adiabatic process, there is no exchange in heat.

14. Option (a) is correct.

Apply coulomb's law, $F = \frac{kQ^2}{r^2}$

If 25% of charge of A transferred to B then after the transformation of charge.

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

$$\text{New force, } F_1 = \frac{Kq_A q_B}{r^2}$$

$$\Rightarrow F_1 = \frac{k \left(\frac{3Q}{4} \right)^2}{r^2}$$

$$\Rightarrow F_1 = \frac{9}{16} \frac{KQ^2}{r^2}$$

$$\Rightarrow F_1 = \frac{9F}{16} \quad \left[\text{Here, } F = \frac{KQ^2}{r^2} \right]$$

15. Option (b) is correct.

From the given logic circuit LED will glow, when voltage across LED is high.

This can be verified by the given truth table.

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

This is output of NAND gate.

16. Option (c) is correct.

Fuse is the protective device because of low melting point of the wire that can save other device on heating.

17. Option (c) is correct.

From the given condition

$$\alpha_{CU} L_{CU} = \alpha_{AI} L_{AI}$$

$$1.7 \times 10^{-5} \times 88 \text{ cm} = 2.2 \times 10^{-5} \times L_{AI}$$

$$L_{AI} = \frac{1.7 \times 88}{2.2} = 68 \text{ cm}$$

18. Option (a) is correct.

Capacitance of parallel plate capacitor

$$(c) = 20 \mu\text{F} = 20 \times 10^{-6} \text{ F}$$

$$\text{Rate of change of potential } \left(\frac{dV}{dt} \right) = 3 \text{ V/s}$$

Since, $q = CV$

Differentiating above equation w.r.t. t

$$\frac{dq}{dt} = \frac{c dv}{dt}$$

$$i_c = 20 \times 10^{-6} \times 3 \quad \left[\text{Here, } i_c = \frac{dq}{dt} \right]$$

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

Since, $i_d = i_c = 60 \mu\text{A}$

19. Option (d) is correct.

Since, α -particle is equivalent to He-atom nucleus, hence it has two protons and two neutrons only.

20. Option (b) is correct.

The limiting friction of the block at the point of equilibrium,

$$F_L \geq mg$$

$$\Rightarrow \mu N \geq mg \quad [\text{Here, } F_L = \mu N]$$

$$\Rightarrow \mu mr\omega^2 \geq mg \quad [\text{Here, } N = mr\omega^2]$$

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

For minimum angular velocity

$$\omega_{\min} = \sqrt{\frac{g}{r\mu}}$$

$$\text{or, } \omega_{\min} = \sqrt{\frac{10}{0.1 \times 1}} = 10$$

21. Option (a) is correct.

Since, the increase of temperature will increase the kinetic energy for the given gas.

For the given ideal gas,

$$U = \frac{F}{2} nRT$$

$F \rightarrow$ no. of degree of freedom.

22. Option (c) is correct.

Given :

Magnetic field (b) = $5 \times 10^{-5} \text{ T}$

Number of turns in coil (N) = 800

Area of coil (a) = 0.05 m^2

Time taken to rotate (Δt) = 0.1 s

Initial angle, $\theta_1 = 0^\circ$

Final angle, $\theta_2 = 90^\circ$

Now the change in magnetic flux $\Delta\phi$ in given as $\Delta\phi = \phi_2 - \phi_1$

$$\Delta\phi = NBA \cos 90^\circ - NBA \cos 0^\circ$$

$$= -NBA \quad [\text{as } \cos 90^\circ = 0]$$

$$= -800 \times 5 \times 10^{-5} \times 0.05 \text{ Wb}$$

$$= -2 \times 10^{-3} \text{ Wb}$$

From Faraday's second law of electromagnetic induction,

$$e = \frac{\Delta\phi}{\Delta t} = \frac{-(-) 2 \times 10^{-3} \text{ Wb}}{0.1 \text{ s}} = 0.02 \text{ V}$$

23. Option (b) is correct.

Since, the electric field due to first line charge is given as

$$\vec{E}_1 = \frac{\lambda}{2\pi\epsilon_0 R} i \text{ N/C}$$

Electric field due to second line charge in given as

$$\vec{E}_2 = \frac{\lambda}{2\pi\epsilon_0 R} i \text{ N/C}$$

Now, the net electric field

$$\vec{E}_{\text{net}} = \vec{E}_1 + \vec{E}_2$$

$$= \frac{\lambda}{2\pi\epsilon_0 R} i + \frac{\lambda}{2\pi\epsilon_0 R} i$$

$$= \frac{\lambda}{\pi\epsilon_0 R} i \text{ N/C}$$

24. Option (c) is correct.

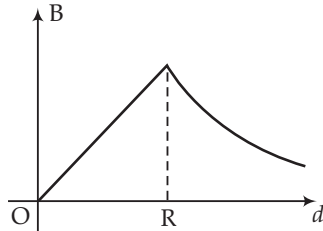
Let i_c be the critical angle,
Hence, at $i = i_c$, refracted ray grazes with the surface.
So, angle of refraction is 90° .

25. Option (a) is correct.

Expression for an electron accelerated through a potential V is given as

$$\lambda = \frac{12.27}{\sqrt{V}} \text{ \AA} = \frac{12.27 \times 10^{-10}}{\sqrt{10000}} = 12.27 \times 10^{-12} \text{ m}$$

26. Option (b) is correct.



Since, the magnetic field inside conductor is given as

$$B = \frac{\mu_0}{2\pi} \frac{i}{R^2} d$$

or, $B = Kd$... (i)

Here, $K = \frac{\mu_0}{2\pi} \frac{i}{R^2}$

If, straight line passing through origin, at surface ($d = R$)

$$B = \frac{\mu_0}{2\pi} \frac{i}{R} \text{ ... (ii)}$$

For the maximum B at outside surface ($d > R$)

$$B = \frac{\mu_0}{2\pi} \frac{i}{d}$$

or, $B \propto \frac{1}{d}$

27. Option (a) is correct.

When observer faces in front of Sun. He will not observe rainbow.

28. Option (a) is correct.

Apply Bohr's Atomic model for H-atom

$$\text{K.E} = |TE| = \frac{|U|}{2}$$

Here, K.E. = 3.4 eV

Hence, $U = -2KE = -2 \times 3.4 \text{ eV}$
 $= -6.8 \text{ eV}$

29. Option (a) is correct.

From the given displacement

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

Resultant amplitude of the particle

$$R = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

$$= \sqrt{A^2 + B^2}, \text{ Here, } \theta = 90^\circ$$

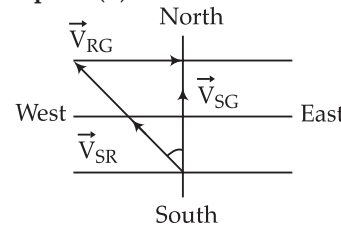
30. Option (a) is correct.

In p -type semiconductor, an intrinsic semi-conductor is doped with trivalent impurities, that creates deficiencies of valence electrons called holes which are majority charge carriers.

31. Option (c) is correct.

Eddy current effect is not used in case of electric heater because it works on Joule's heating effect.

32. Option (d) is correct.



$$V_{SR} = 20 \text{ m/s}$$

$$V_{RG} = 10 \text{ m/s}$$

$$\Rightarrow \vec{V}_{SG} = \vec{V}_{SR} + \vec{V}_{RG}$$

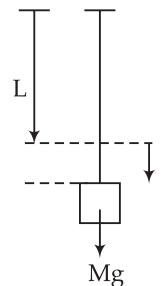
$$\Rightarrow \sin \theta = \frac{|\vec{V}_{RG}|}{|\vec{V}_{SR}|}$$

$$\Rightarrow \sin \theta = \frac{10 \text{ m/s}}{20 \text{ m/s}}$$

$$\Rightarrow \sin \theta = \frac{1}{2}$$

$$\Rightarrow \theta = 30^\circ \text{ west-side}$$

33. Option (a) is correct.



Since, the elastic potential energy is given as :

$$U = \frac{1}{2} \text{ (work done due to gravity)}$$

$$U = \frac{1}{2} Mgl$$

34. Option (a) is correct.

Since, the galvanometer resistance for an ideal ammeter is zero while for an ideal voltmeter is infinite, so

$$V_1 = i_1 \times 10 = \frac{10}{10} \times 10 = 10 \text{ V}$$

$$V_2 = i_2 \times 10 = \frac{10}{10} \times 10 = 10 \text{ V}$$

So, $V_1 = V_2$

$$\text{Hence, } i_1 = i_2 = \frac{10 \text{ V}}{10 \Omega} = 1 \text{ A}$$

35. Option (d) is correct.

Since, the fractional loss of KE of colliding body in given as

$$\begin{aligned} \frac{\Delta \text{KE}}{\text{KE}} &= \frac{4(m_1 m_2)}{(m_1 + m_2)^2} \\ &= \frac{4(4m)2m}{(4m + 2m)^2} && [\text{Here, } m_1 = 4m \\ &&& \text{\& } m_2 = 2m] \\ &= \frac{32m^2}{36m^2} = \frac{8}{9} \end{aligned}$$

36. Option (b) is correct.

From the given diagram, the forces are forming closed loop in same order.

$$\text{Hence, } \vec{F}_{\text{net}} = \vec{0}$$

$$\Rightarrow m \frac{dv}{dt} = \vec{0} \quad \left[\because \vec{F}_{\text{net}} = m \frac{d\vec{v}}{dt} \right]$$

Solving above, we get

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

37. Option (c) is correct.

Given,

Time periods, $T = 4 \text{ s}$

$$\text{Angular velocity, } (\omega) = \frac{2\pi}{T} = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad/s}$$

Since, at $t = 0$, displacement (y) is maximum, so equation will be cosine function.

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

$$y = 3 \cos \left(\frac{\pi t}{2} \right) \quad [\text{Here, } a = 3 \text{ m}]$$

38. Option (d) is correct.

Apply work energy theorem.

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

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

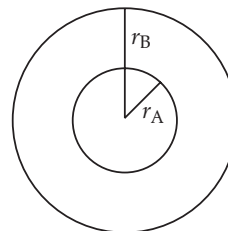
$$\begin{aligned} \theta &= 2\pi \text{ revolution} \\ &= 2\pi \times 2\pi = 4\pi^2 \text{ rad} \end{aligned}$$

$$\Rightarrow -\tau\theta = \frac{1}{2} \times \frac{1}{2} m r^2 (\omega^2 - \omega_i^2)$$

The required torque is given as :

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

$$\Rightarrow \tau = 2 \times 10^{-6} \text{ Nm}$$

39. Option (c) is correct.

Since, the time period for both the particle in same

$$\text{So, } T_A = T_B = T$$

$$\text{Angular velocity for A, } (\omega_A) = \frac{2\pi}{T_B}$$

$$\text{Angular velocity for B, } (\omega_B) = \frac{2\pi}{T_B}$$

$$\text{Now, the required ratio is } \frac{\omega_A}{\omega_B} = \frac{T_B}{T_A} = \frac{T}{T} = 1$$

40. Option (d) is correct.

$$\text{The radius for H-atom is given as } r_H = \frac{\rho}{eB}$$

$$\text{The radius for } \alpha\text{-particle is given as } r_\alpha = \frac{\rho}{2eB}$$

Now, we shall find the ratio

$$\frac{r_H}{r_\alpha} = \frac{\rho/eB}{\rho/2eB} = \frac{\rho}{eB} \times \frac{2eB}{\rho}$$

$$\frac{r_H}{r_\alpha} = \frac{2}{1}$$

41. Option (b) is correct.

Apply Newton's second law for equation of motion

$$T - mg = \frac{mu^2}{l}$$

$$T - mg + \frac{mu^2}{l}$$

The tension is maximum at the lowest position of mass, so the chance of breaking is maximum.

42. Out of Syllabus**43. Option (a) is correct.**

$$\text{Angular fringe width (in air), } \theta_{\text{air}} = \frac{B}{D}$$

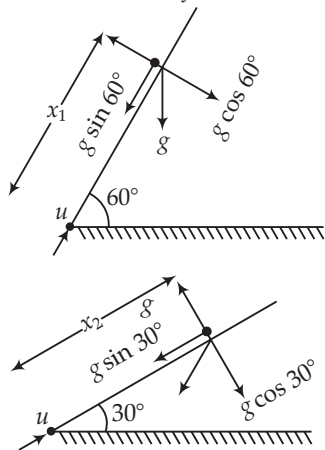
Here, all alphabets are in their usual meaning
Angular fringe width (in water)

$$\theta_{\text{water}} = \frac{B}{\mu D} = \frac{\theta_{\text{air}}}{\mu}$$

$$= \frac{0.2^\circ}{\left(\frac{4}{3}\right)} = 0.15$$

44. Option (b) is correct.

Let u be the initial velocity



$$\text{Moved distance, } (x_1) = \frac{u^2}{2g \sin 60^\circ}$$

$$\text{Moved distance, } (x_2) = \frac{u^2}{2g \sin 30^\circ}$$

$$\text{Now, } \frac{x_1}{x_2} = \frac{\sin 30^\circ}{\sin 60^\circ} = \frac{1 \times 2}{2 \times \sqrt{3}} = 1 : \sqrt{3}$$

45. Option (c) is correct.

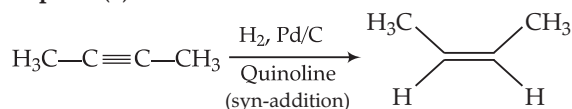
Since, net displacement in complete cycle $\Delta y = 0$

$$\text{So, Average velocity} = \frac{\text{Displacement}}{\text{Time interval}}$$

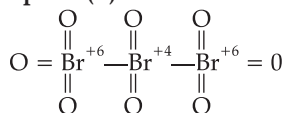
$$= \frac{y_f - y_i}{T} = \frac{\Delta y}{T} = \frac{0}{T} = 0$$

CHEMISTRY

46. Option (a) is correct.



47. Option (d) is correct.



Notice that the O, S or Br atom are +6, +4, +6 respectively.

48. Option (b) is correct.

Given,

$$E^\circ_{\text{cell}} = 0.59 \text{ V}$$

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{2.303 RT}{nF} \log Q$$

$$\Rightarrow E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.059}{n} \log Q$$

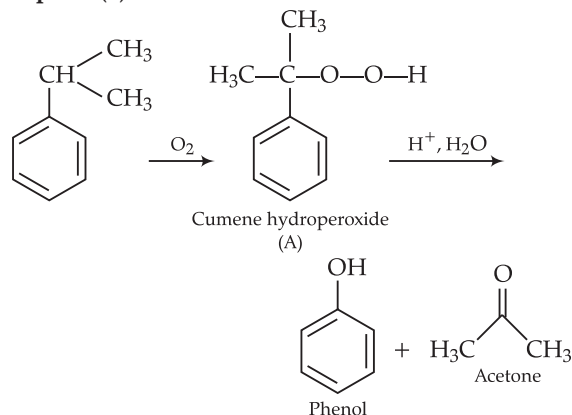
(At equilibrium, $E_{\text{cell}} = 0$ and $Q = K_{\text{eq}}$)

$$\Rightarrow 0 = E^\circ_{\text{cell}} - \frac{0.059}{1} \log K_{\text{eq}}$$

$$\Rightarrow \log K_{\text{eq}} = \frac{E^\circ_{\text{cell}}}{0.059} = \frac{0.59}{0.059} = 10$$

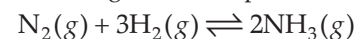
$$\Rightarrow K_{\text{eq}} = 10^{10} = 1.0 \times 10^{10}$$

49. Option (a) is correct.



50. Option (b) is correct.

According to Haber's process,



2 moles of NH_3 uses 3 moles of H_2

$$\begin{aligned} \text{So, 20 moles of } \text{NH}_3 \text{ will use } & \frac{3}{2} \times 20 \text{ moles of } \text{H}_2 \\ & = 30 \text{ moles of } \text{H}_2 \end{aligned}$$

51. Option (b) is correct.

The amino acids which are synthesised inside the human body are called non-essential amino acids.

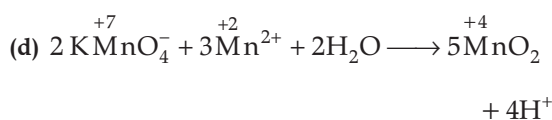
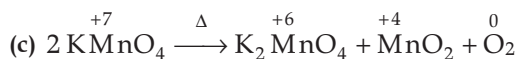
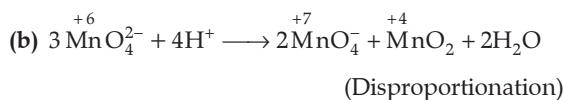
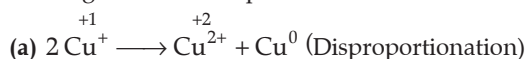
Example: Glycine, alanine, serine, cysteine, etc.

52. Out of Syllabus

53. Option (d) is correct.

In a disproportionation reaction, same substance undergoes oxidation (increase in oxidation number)

and reduction (decrease in oxidation number forming two different products).



54. Option (b) is correct.

The thermal stability of hydrides decreases down the group due to decrease in bond dissociation energy down the group. Therefore, thermal stability order will be : $\text{H}_2\text{Po} < \text{H}_2\text{Te} < \text{H}_2\text{Se} < \text{H}_2\text{S} < \text{H}_2\text{O}$.

55. Option (d) is correct.

As per Aufbau principle ($n + l$ rule), higher is the value of n , greater will be the energy.

$4d = 4 + 2 = 6$ } (Between these two subshell $4d$
 $5p = 5 + 1 = 6$ } have lower value of n , Hence it
 $5f = 5 + 3 = 8$ is lower energy sub shell

$$6p = 6 + 1 = 7$$

Hence, the correct order of decreasing energy will be : $5f > 6p > 5p > 4d$.

56. Option (b) is correct.

Basic buffer is defined as a mixture of weak base and salt of weak base with strong acid.



$$\begin{array}{ccc} \text{Before} & 100 \text{ ml} & 100 \text{ ml} & 0 \\ & \times 0.1 \text{ M} & \times 0.1 \text{ M} & \\ & = 10 \text{ m mol} & = 10 \text{ m mol} & \end{array}$$

$$\text{After} \quad 0 \quad 0 \quad 10 \text{ m mol}$$

Salt hydrolysis takes place so, this is not a basic buffer.



$$\begin{array}{ccc} \text{Before} & 100 \text{ ml} & 200 \text{ ml} & 0 \\ & \times 0.1 \text{ M} & \times 0.1 \text{ M} & \\ & = 10 \text{ m mol} & = 20 \text{ m mol} & \end{array}$$

$$\text{After} \quad 0 \quad 10 \text{ m mol} \quad 10 \text{ m mol}$$

It is a basic buffer.



$$\begin{array}{ccc} \text{Before} & 100 \text{ ml} & 100 \text{ ml} & 0 \\ & \times 0.1 \text{ M} & \times 0.1 \text{ M} & \\ & = 10 \text{ m mol} & = 10 \text{ m mol} & \end{array}$$

$$\text{After} \quad 0 \quad 0 \quad 10 \text{ m mol}$$

It is a neutral solution.



$$\begin{array}{ccc} \text{Before} & 25 \text{ ml} & 50 \text{ ml} & 0 \\ & \times 0.1 \text{ M} & \times 0.1 \text{ M} & \\ & = 2.5 \text{ m mol} & = 5 \text{ m mol} & \end{array}$$

$$\text{After} \quad 0 \quad 2.5 \text{ m mol} \quad 2.5 \text{ m mol}$$

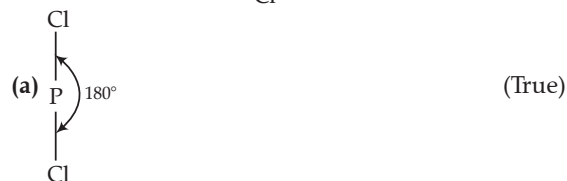
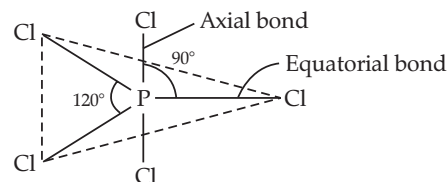
It is a basic solution (due to presence of NaOH) but not basic buffer.

57. Option (a) is correct.

Ionization enthalpy is dependent upon the stability. 'Be' and 'N' have comparatively more stable subshell than B and O. So, the correct increasing order of first ionization enthalpy will be :

$$\text{Li} < \text{B} < \text{Be} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$$

58. Option (c) is correct.



(b) Axial bond : 240 pm
Equatorial bond : 202 pm (True)

(c) PCl_5 is reactive molecule due to longer and weaker, axial bonds. (False)

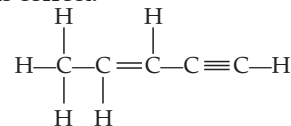
(d) True

59. Option (b) is correct.

Molecular orbital configuration C_2 is :

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

60. Option (d) is correct.



Number of sigma (σ) bonds = 10

Number of pi (π) bonds = 3

61. Out of Syllabus

62. Option (d) is correct.

For irreversible isothermal expansion,

$$\begin{aligned} W &= -P_{\text{ext}} \Delta V \\ &= -P_{\text{ext}} (V_2 - V_1) \\ &= -2 (0.25 - 0.1) \text{ L bar} \\ &= -2 (0.15) \text{ L bar} \\ &= -0.3 \text{ L bar} \\ &= -0.3 \times 100 \text{ J} \\ &= -30 \text{ J} \end{aligned}$$

63. Out of Syllabus

64. Option (d) is correct.

Maximum boiling azeotrope is shown by solution which shows negative deviation from Raoult's law. Except water + Nitric acid, all other mixtures show positive deviation.

65. Out of Syllabus**66. Option (a) is correct.**

Balmer series lies in visible region.
Paschen series lies in infra red region.
Brackett series lies in infra red region.
Lyman series lies in ultraviolet region.

67. Option (b) is correct.

For an ideal solution at constant T and P, $\Delta_{\text{mix}} H = 0$, $\Delta_{\text{mix}} S > 0$, $\Delta_{\text{mix}} G < 0$ and $\Delta_{\text{mix}} V = 0$.

68. Option (c) is correct.

$\text{Be}(\text{OH})_2$ is an amphoteric hydroxide as it reacts with acid as well as base while others are basic hydroxide.
 $\text{Be}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{BeCl}_2 + 2\text{H}_2\text{O}$
 $\text{Be}(\text{OH})_2 + 2\text{NaOH} \rightarrow \text{Na}_2[\text{Be}(\text{OH})_4]$

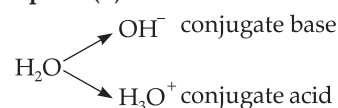
69. Option (b) is correct.

For first order reaction,

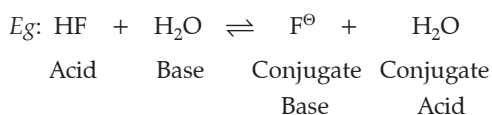
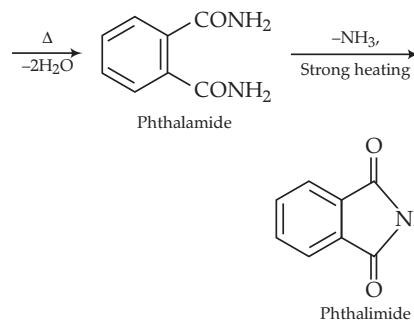
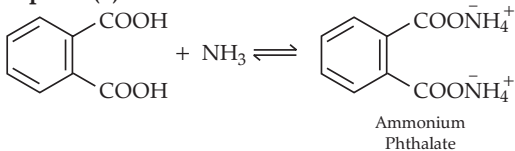
$$k = \frac{2.303}{t} \log \frac{[A_x]_0}{[A]_t}$$

(For 99% completion, $[A]_0 = 100$, $[A]_t = 1$)

$$\begin{aligned} k &= \frac{2.303}{t} \log \frac{100}{1} \\ &= \frac{2.303}{t} \log 10^2 \\ &= \frac{2.303}{t} \times 2 \log 10 \\ &= \frac{2.303}{t} \times 2 \\ t &= \frac{4.606}{k} \end{aligned}$$

70. Option (b) is correct.

HF on loss of H^+ ion becomes F^- is the conjugate base of HF.

**71. Option (a) is correct.****72. Option (c) is correct.**

The lone pair of electrons causes delocalization which makes it difficult to protonate due to less availability of electrons.

73. Option (b) is correct.

Rate of the reaction can be written as :

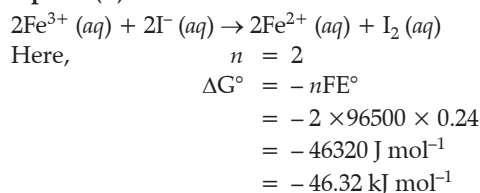
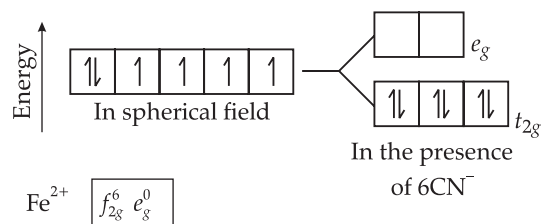
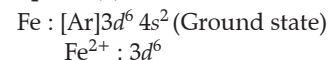
$$\begin{aligned} \text{Rate} &= \frac{\text{Decrease in the concentration of reactants or increase in the concentration of part}}{\text{Time taken}} \\ -\frac{d[\text{N}_2]}{dt} &= -\frac{1}{3} \frac{d[\text{H}_2]}{dt} = +\frac{1}{2} \frac{d[\text{NH}_3]}{dt} \end{aligned}$$

74. Option (c) is correct.

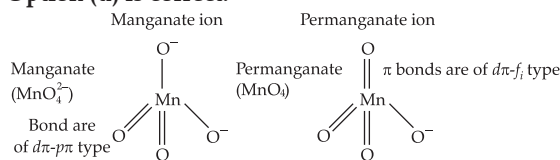
In option (a) $\Delta S > 0$.
In option (b) $\Delta S > 0$.
In option (c) $\Delta S < 0$ as $\Delta n_g < 0$.
In option (d) $\Delta S > 0$.

75. Option (d) is correct.

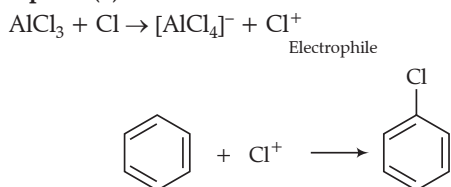
The basic strength of methyl substituted amines in aqueous form is together affected by inductive effect, solvation effect and steric hindrance. So, the correct order of basic strength will be :
 $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N}$

76. Option (d) is correct.**77. Option (a) is correct.****78. Out of Syllabus****79. Out of Syllabus**

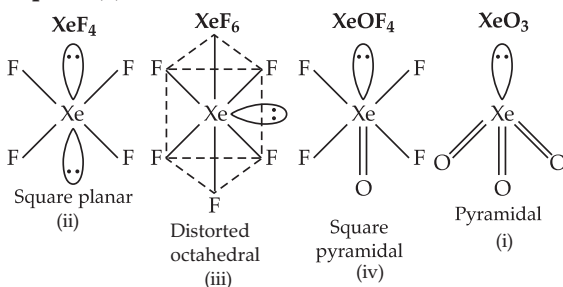
80. Option (d) is correct.



81. Option (a) is correct.



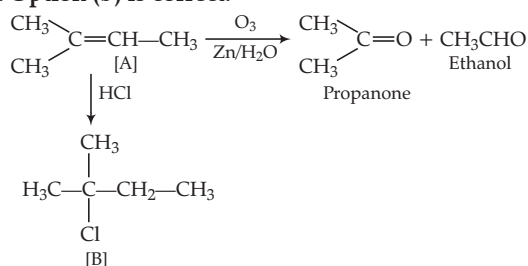
82. Option (a) is correct.



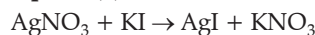
83. Option (d) is correct.

PbF_4 is ionic in nature.

84. Option (b) is correct.



85. Option (a) is correct.



If KI is in excess then negatively charged colloid, $[AgI]^-$ is formed. Whereas, if $AgNO_3$ is in excess positively charged colloid AgI/Ag^+ will form.

86. Out of Syllabus

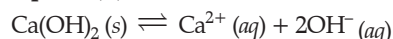
87. Out of Syllabus

88. Out of Syllabus

89. Option (c) is correct.

Due to presence of d-orbitals Si, Ge and Sn form species like SiF_6^{2-} , $[GeCl_6]^{2-}$, $[Sn(OH)_2]^{2-}$ respectively. Due to small size of Si^{4+} , six large chloride ions cannot be accommodated around Si^{4+} .

90. Option (d) is correct.



Given :

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

$$\text{or } [OH^-] = 10^{-5} M$$

$$s = \frac{10^{-5}}{2}$$

$$K_{sp} = [Ca^{2+}][OH^-]^2$$

$$= S \times (2s)^2 = 4s^3$$

$$= 4 \times \left(\frac{10^{-5}}{2}\right)^3$$

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

BIOLOGY

91. Option (b) is correct.

A centimorgan or map unit is a unit for measuring genetic linkage. It is defined as the distance between chromosome positions (also termed loci or markers) for which the expected average number of intervening chromosomal crossovers in a single generation is 1 percent.

92. Option (a) is correct.

Biocontrol refers to the use of biological methods for controlling plant diseases and pests. *Bacillus thuringiensis* (Bt), *Trichoderma* sp. and *Baculovirus* (sp.) genus *Nucleopolyhedrovirus* are used as biocontrol agents.

Rhizobium, *Nostoc*, *Azospirillum*, and *Oscillatoria* are used as biofertilisers, which helps in making the soil fertile while Tobacco Mosaic virus is a pathogen that infects a wide range of plants and aphids are pest that harms crop plants.

93. Option (c) is correct.

Some of the columnar or cuboidal cells are modified. They contain cilia on their surface. Such cells are called the ciliated epithelium. They help to move some particle or mucus in a specific direction. They are located on the inner surface of hollow organs like fallopian tubes and bronchioles.

94. Option (b) is correct.

Frequency of dominant allele (say p) = 0.4

Frequency of recessive allele (say q) = $1 - 0.4$
= 0.6

Frequency of homozygous dominant individuals

$$(AA) = p^2 = (0.4)^2 = 0.16$$

Frequency of heterozygous individuals (Aa)

$$= 2pq = 2(0.4)(0.6) = 0.48$$

Frequency of homozygous recessive individuals

$$(aa) = q^2 = (0.6)^2 = 0.36$$

95. Option (b) is correct.

Inbreeding exposes harmful recessive genes that are eliminated by selection. It helps in accumulation of superior genes and elimination of less desirable genes. This approach increases the productivity of the inbred population.

Continued inbreeding, especially close inbreeding, may reduce fertility and productivity. This is called inbreeding depression.

96. Option (a) is correct.

The loop of Henle and vasa recta play important role in making concentrated urine. The filtrate flow in the two limbs of Henle is in opposite direction. The two limbs of the vasa recta also show the counter current of blood flow. The counter flow near the area of Henle's loop and vasa recta increases the osmolarity towards the inner medullary interstitium. The osmolarity increases from 300 mOsmolL⁻¹ to 1200 mOsmolL⁻¹. Thus, hyperosmolarity help in the formation of concentrated urine.

97. Option (c) is correct.

Saprophytes are involved in the decomposition of dead organic materials, parasites are organisms that live on living organisms, and lichen is a symbiotic association between algae and fungi, while mycorrhiza is a symbiotic association between fungi and root of higher plants.

98. Option (c) is correct.

GLUT I and GLUT IV are glucose transport proteins that facilitate glucose transport into insulin-sensitive cells. GLUT-I is insulin- independent and is widely distributed in different tissues of the human body while GLUT IV is primarily expressed in adult tissues and exhibit insulin-dependent glucose transport, such as adipose tissue and skeletal and cardiac muscle.

99. Option (a) is correct.

Bulliform cells are modified cells into large, colourless, and empty cells. During the rainy season they absorb water and become turgid to expose the leaf surface. When the weather is dry, the leaves are flaccid because of water stress. The leaf becomes curl inward to reduce the loss of water.

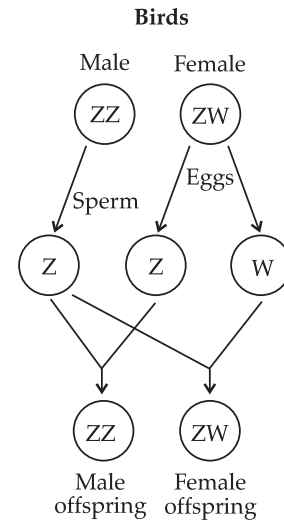
100. Option (b) is correct.

Alkaloids, rubber, flavonoids, essential oils, coloured pigments, scents, spices, and gums are called secondary metabolites. Concanavalin A is a kind of lectin that belongs to one of the secondary metabolites.

101. Option (b) is correct.

The type of sex determination in birds is called female heterogamety and male homogamety. Thus, the sex of the progeny depends on the type of egg rather than the type of sperm. The female birds have two different sex chromosomes designated as Z and W

while male birds have two similar sex chromosomes and are called ZZ.

**102. Option (b) is correct.**

Botanical garden is a method of *ex-situ* conservation of biodiversity. *Ex-situ* conservation (off site) is the conservation of organisms outside their habitats. e.g., genetic resource centres, zoological parks, botanical gardens, gene banks, etc.

103. Option (c) is correct.

Yeast is a unicellular sac fungus (ascomycetes). It lacks filamentous structure known as hyphae.

104. Option (d) is correct.

- **Lactational amenorrhea** is one of the natural contraceptive methods. The ovulation and menstrual cycles do not occur during intense lactation after parturition. As long as breastfeeding continued the chance of conception is almost nil.
- **Oral pills** contain hormones-either progestogens or progestogen-estrogen combinations used by the females.
- An **emergency contraceptive** is like the administration of progestogen-estrogen or the use of IUDs within 72 hours of coitus is effective in the prevention of conception.

105. Option (a) is correct.

Pila belongs to mollusca. It has an organ which is a file-like structure that helps in feeding called a radula.

Bombyx is an arthropod. Malpighian tubules are the excretory organ in *Bombyx*.

Pleurobrachia belong to ctenophores. It has Comb plates that bear eight external rows of cilia.

Taenia belongs to platyhelminthes. It has flame cells to regulate osmoregulation and excretion.

106. Option (a) is correct.

Heroin is commonly called smack, and chemically diacetylmorphine. It is the most dangerous, white,

odourless, bitter crystalline compound produced by the acetylation of morphine. It is used as a depressant because it reduces the function of the body. It is consumed by snorting or injection.

107. Option (a) is correct.

Lactobacillus is used for the production of curd, *Saccharomyces cerevisiae* is used for making bread, *Aspergillus niger* is used in citric acid production while *Acetobacter aceti* is used in acetic acid production.

108. Option (c) is correct.

Light stimulates certain responses in the plant. Such responses to day and night are called photoperiodism. Leaves are the site of the perception of light. Some of the shoot apices are modified to flowering apices before flowering due to photoperiodism.

109. Option (d) is correct.

Expiratory Capacity (EC) is the total volume of air a person can expire after a normal inspiration. This includes tidal volume and expiratory reserve volume.

Since, Tidal Volume = 500 ml

And Expiratory Reserve Volume = 1000 ml

So, Expiratory Capacity = TV + ERV

$$= 500 + 1000$$

$$= 1500 \text{ ml}$$

110. Option (c) is correct.

Thiobacillus denitrificans cause denitrification. Denitrification is the process of conversion of oxides of nitrogen to free nitrogen by bacteria present in the soil.

111. Option (a) is correct.

Stabilizing selection is a kind of natural selection. The population stabilizes on the non-extreme value of the trait. The newborn having an average body weight between 3 to 3.3 kg. The data shows that they have a chance of a low survival rate. Because newborn is lower than 3 kg and more than 3.3 kg. Hence, data shows stabilizing selection.

112. Option (c) is correct.

The intensity of the phenotype of the heterozygote is less compared to that of the concerned dominant allele. So, the phenotype of heterozygotes would be like the homozygotes of the two concerned alleles. Such a condition is called incomplete dominance.

Flower colour in Snapdragon is an example of incomplete dominance. A cross between red (RR) and white (rr) would produce a pink flower (Rr). Because it is intermediate between those two homozygotes (RR and rr). It is an example of the exception of Mendel's inheritance.

113. Option (d) is correct.

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

114. Out of Syllabus

115. Option (d) is correct.

Extrusion of 'second' polar body from 'egg' nucleus occurs after entry of sperm but before fertilisation.

116. Option (b) is correct.

Correct match of hominids with their brain sizes are as follows :

Homo habilis - 650-800 cc

Homo neanderthalensis -1400 cc

Homo erectus - 900 cc

Homo sapiens - 1350 cc

117. Option (c) is correct.

Lysosomes are produced by the rough ER and the Golgi. It contains powerful digestive enzymes (about 40 in number) that are capable of breaking down the organic material. Thus, the lysosome serves as an intracellular digestive system and is called digestive bags. The digestive enzymes contained in lysosome are synthesized by RER and are packed into lysosomes by Golgi bodies.

118. Option (b) is correct.

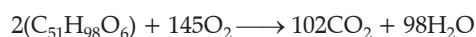
Progestasert and LNG-20 are hormone-releasing IUDs, which makes the uterus unsuitable for implantation and the cervix hostile to the sperms.

119. Option (a) is correct.

The respiratory quotient (RQ) is the ratio of CO₂ produced to O₂ consumed while food is being metabolized.

$$RQ = \frac{\text{CO}_2 \text{ eliminated}}{\text{O}_2 \text{ consumed}}$$

The respiratory quotient of tripalmitin is :



+ Energy

$$R.Q. = \frac{102\text{CO}_2}{145\text{O}_2} = 0.7$$

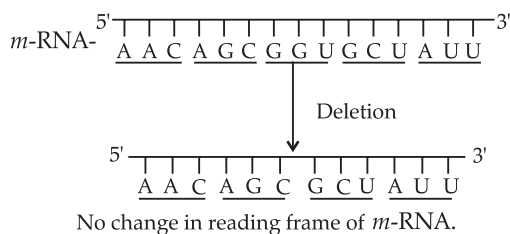
120. Option (a) is correct.

Mycorrhiza is a symbiotic association of fungi with the root systems of some plants. The fungal hyphae either form a dense network around the young root or they penetrate deep into the cells of the roots. The large surface area of the fungal hyphae helps to enhance the absorption of water and minerals from the soil. In return, they get sugar and nitrogenous compounds from the host plants. However, in some plants, the mycorrhizal association is obligate. For e.g., *Pinus* seeds do not germinate and cannot establish in the absence of mycorrhizal association.

121. Out of Syllabus

122. Option (c) is correct.

In case of deletion of GGU from 7th, 8th and 9th position, there will be no change in the reading frame of mRNA.

**123. Option (b) is correct.**

Retention of the female gametophyte with developing young embryo on the parent sporophyte for some time is first observed in pteridophytes. This phenomenon is known as Heterospory. Heterospory evolved first in pteridophytes such as *Selaginella* and *Salvinia* and is considered an important step in evolution as it is a precursor to the seed habit.

If two types of spores are formed by the same plant such a condition is called heterospory. These spores differ in size. The smaller one is known as the microspore and the larger one is known as the megaspore. The microspore germinates to form the male gametophyte and the megaspore germinates to form the female gametophyte. The male gametophyte releases the male gametes and these reach the female gametophyte to fuse with the egg. The development of the zygote takes place inside the female gametophyte.

This retention and germination of the megaspore within the megasporangium ensure proper development of the zygote. The zygote develops into the future sporophyte. The evolution of the seed habit is related to the retention of the megaspore.

124. Option (b) is correct.

Insulin deficiency leads to diabetes mellitus, hyposecretion of thyroxin can be associated with enlargement of the thyroid gland called goitre, deficiency of corticoids leads to Addison's disease while hypersecretion of growth hormone in adults leads to acromegaly.

125. Option (d) is correct.

Rudolf Carl Virchow in 1858, gave the concept of "*Omnis cellula-e cellula*" regarding cell division. This means that all cells arise from pre-existing cells by cell division.

126. Option (c) is correct.

The yellowish milk produced during the initial few days of lactation is called colostrum. It contains several antibodies especially immunoglobulin A, which imparts naturally acquired passive immunity to the newborn.

127. Option (b) is correct.

Polyblend is a fine powder of recycled modified plastic. It was developed by Ahmed Khan and his company. Polyblend is mixed with bitumen. It is good material to repel the water and used to lay roads.

128. Option (d) is correct.

Auxin and Ethylene, both these hormones are helpful for flowering and fruit synchronisation. They are responsible for growth and maturation as well.

129. Option (a) is correct.

Hypothalamus, a region of the forebrain is responsible for maintaining constant body temperature. It is the main thermoregulatory centre of the brain.

130. Option (c) is correct.

The greenhouse effect refers to an overall increase in the average temperature of the earth due to the presence of greenhouse gases. The gases that cause the greenhouse effect are:

- Carbon dioxide (60% effect)
- Vapour
- Methane (20% effect)
- Nitrogen oxide (6% effect)
- Ozone
- Chlorofluorocarbons (14% effect)

Thus, carbon dioxide and methane are the major greenhouse gases.

131. Option (b) is correct.

The *lac* operon consists of:

- One regulatory gene (*i*-gene), which codes for repressor.

Three structural genes (*z*, *y*, and *a*).

- ***z* gene** : Codes for *β-galactosidase*, which hydrolyze lactose to galactose and glucose.
- ***y* gene**: Codes for *Permease*, which increases the permeability of the cell to lactose.
- ***a*-gene** : Codes for a *transacetylase*

132. Option (a) is correct.

Chilled ethanol is used for the precipitation of DNA, during the isolation of the desire gene. Isopropanol is useful for large sample volumes.

133. Option (c) is correct.

The sequence of events by which a cell duplicates its genome, synthesizes other cell constituents, and eventually divides into two daughter cells is known as the cell cycle. The correct sequence of phases of cell cycle is: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.

- **G_1 (Gap 1) phase** : It is the first phase of the growth. It is the stage during which the cell grows and prepares its DNA for replication.
- **S phase (Synthetic phase)** : It is the stage during which DNA synthesis occurs.
- **G_2 phase** : In this phase, the cell continues to grow and prepares itself for division.
- **M Phase** : A cell reproduces during the mitotic phase. The mitotic phase has two stages : Karyokinesis and Cytokinesis.

134. Option (a) is correct.

In mitochondria, enzymes of electron transport are embedded in the inner membrane.

135. Option (b) is correct.

Alfred Sturtevant explained chromosomal mapping based on recombination frequency which is directly proportional to distance between two genes on the same chromosome.

Mendel is known as the father of genetics and proposed the laws of inheritance.

Theodore Boveri with Walter Sutton proposed the chromosomal theory of inheritance, while **Thomas Hunt Morgan** formulated the chromosomal theory of inheritance using fruit flies (*Drosophila melanogaster*).

136. Option (c) is correct.

Typhoid is caused by the bacteria *Salmonella typhi*, which is diagnosed by the widal test. This test is based on antigen-antibody reaction.

137. Option (a) is correct.

The Earth Summit held in Rio de Janeiro in 1992 had three main objectives:

- (a) Conservation of biodiversity
- (b) Sustainable use of biodiversity
- (c) Sharing of benefits in the utilization of genetic resources.

138. Option (a) is correct.

Hugo deVries proposed the Mutation Theory of evolution. De Vries worked on *Oenothera lamarckiana*. He proposed that mutation leads to evolution but a not minor variation. These mutations are random and directionless. According to Darwinian variations, the mutations are small and directional.

139. Option (d) is correct.

Fungus *Trichoderma* is a biological control agent being developed for use in the treatment of plant diseases. They live in the roots of higher plants and protect them from various pathogens.

140. Option (c) is correct.

Cell-mediated immune response (CMI) causes rejection of the graft. Immune response by T-lymphocytes (T-cells) is by activation of cytotoxic killer cells which detects and destroys the foreign cells and also a cancerous cell is called cell-mediated immune response.

If a kidney donated by another person will be treated as foreign material by cell-mediated immune in the recipient. This results in the rejection of kidney graft. Hence, HLA tissue matching and blood group matching are important before the transplantation of kidney.

141. Option (d) is correct.

G_0 or quiescent phase is the stage wherein cells remain metabolically active, but do not proliferate unless called to do so. These cells that do not divide

further exit the G_1 phase to enter an inactive stage. Such cells are used for replacing the cells lost during injury.

142. Option (a) is correct.

Statins are produced by *Monascus purpureus* yeast. It is used as blood-cholesterol lowering agents. It inhibits the enzymes responsible for the synthesis of cholesterol.

Streptokinase is used as a 'clot buster' to remove clots from the blood vessels of patients who have myocardial infarction.

Lipases are used in detergent formulations. It helps to remove oily stains from the laundry.

Cyclosporin A is produced by *Trichoderma polysporum* (fungus) and is used as an immuno-suppressive agent in organ transplant patients.

143. Option (a) is correct.

Muscular dystrophy is a genetic disorder. It is characterized by progressive degeneration of skeletal muscles, which are the muscles that control movement.

Myasthenia Gravis is a kind of autoimmune disease. It affects the neuromuscular junction. This can lead to fatigue. The skeletal muscles become weak and paralyzed.

Tetany is a rapid spasm in muscle due to low Ca^{2+} in body fluid.

Botulism is a rare and dangerous type of food poisoning caused by the bacterium *Clostridium botulinum*.

144. Out of Syllabus**145. Out of Syllabus****146. Option (a) is correct.**

Restriction endonucleases cut the strand a little away from the centre of the palindrome sites, but between the same two bases on the opposite strands. This leaves single-stranded overhanging stretches at the ends. They are called sticky ends. This stickiness facilitates the action of the enzyme DNA ligase.

147. Option (c) is correct.

Phloem in angiosperms is composed of sieve tube elements, companion cells, phloem parenchyma and phloem fibres. Gymnosperms have albuminous cells and sieve cells. They lack sieve tubes and companion cells.

148. Option (b) is correct.

Haemodialysis removes waste, salt, and extra water to prevent them from building up in the body. It keeps a safe level of certain chemicals in our blood such as potassium, sodium and bicarbonate helping to control blood pressure. Also, there will be reduced absorption of calcium ions from the gastrointestinal tract. It reduce the production of RBC due to the deficiency of erythropoietin.

149. Option (b) is correct.

Infective constituent in viruses is either DNA or RNA, not protein.

150. Option (a) is correct.

Asthma is an allergic disorder in which a wheezing sound is produced due to inflammation of bronchi and bronchioles.

151. Option (b) is correct.

Genital Herpes is not completely curable, as it is caused by type II herpes simplex virus. Another sexually transmitted disease that is not curable is HIV.

152. Option (a) is correct.

Steroid hormones directly enter into the cell and bind with intracellular receptors like nucleus to form hormone-receptor complex. The hormone-receptor complex interacts with the genome, increasing the production of proteins.

153. Option (c) is correct.

Annual rings are prominent only in the trees of the temperate region. Because the weather pattern is not uniform in temperate regions throughout the year. There would be differential activity in the cambium. So, annual rings are prominent in the trees of temperate region. In the tropics, climatic conditions are uniform throughout the year. Hence, there is no differential activity of the cambium.

154. Out of Syllabus**155. Option (a) is correct.**

In a sub-metacentric chromosome, the short arm is designated as 'p' arm while the long arm is designated as 'q' arm.

156. Option (c) is correct.

Safe disposal of radioactive wastes is a big challenge. It is recommended that nuclear wastes should be stored after pre-treatment in suitable containers, which should then be buried in rocks.

157. Option (d) is correct.

A typical human electrocardiogram has five waves: P, Q, R, S, and T.

- The P-wave indicates atrial depolarisation, which causes atrial systole. During this wave, the impulse of contraction is generated by the SA node.
- QRS-complex represents depolarisation of ventricles (Ventricular systole).
- The T-wave represents the repolarisation of ventricles.
- Reduction in the size of T-wave i.e. insufficient supply of oxygen in T-wave represents coronary ischemia.

158. Option (c) is correct.

Post-fertilisation changes that take place in flowering plants are :

Petal	Fall off
Sepal	Fall off
Stamen	Fall off
Zygote	Embryo (2n)
Primary endosperm nucleus	Endosperm (3n)
Synergid	Disintegrate
Antipodals	Disintegrate
Ovary	Fruit
Ovule	Seed

159. Option (a) is correct.

According to rules of binomial nomenclature, the correct scientific name of mango is *Mangifera indica* Linn. The first name *Mangifera* indicates genera, the second name *indica* indicates species name, and Linn indicates the species name first described by a scientist like Linnaeus.

160. Option (c) is correct.

In flowering plants,

- Out of the two male gametes, one gamete fuses with the nucleus of the egg cell and forms the zygote. The process is known as syngamy.
- The other male gamete fuses with the two polar nuclei located in the central cell to form a triploid primary endosperm nucleus (PEN). Since the process involves the fusion of three haploid nuclei, it is known as triple fusion.
- Since two kinds of fusions (syngamy and triple fusion) take place in an embryo sac it is known as double fertilisation.

161. Option (b) is correct.

In recombinant DNA technology, a bacterium can produce human insulin because genetic code is nearly universal. Human insulin is used to treat diabetes.

162. Option (b) is correct.

Lysosome and vacuoles do not contain DNA.

163. Option (c) is correct.

Parthenogenesis is the process, whereby the female gamete develops into a new organism without fertilisation. Seedless fruits are formed by parthenogenesis.

164. Option (a) is correct.

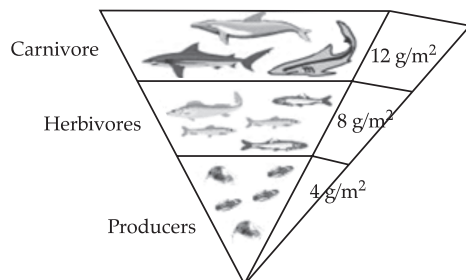
Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group while a complete catalytic active enzyme with its bound prosthetic group is called a holoenzyme.

165. Option (a) is correct.

Hexokinase catalyzes the conversion of Glucose to Glucose-6 phosphate. It is the first step of the activation phase of glycolysis.

166. Option (c) is correct.

The pyramid of biomass is inverted in an aquatic ecosystem as the biomass of fishes far exceeds the biomass of zooplankton (upon which they feed).



Inverted Pyramid in an Aquatic Ecosystem

167. Option (d) is correct.

Annelida, Arthropoda, and Chordata have all the given three features: Organ system level of organisation, bilateral symmetry, true coelomates with the segmentation of body.

168. Option (a) is correct.

Klinefelter's syndrome has an additional copy of X-chromosome in male. They have trisomy of sex chromosomes as 44 + XXY (47). They show overall masculine development, gynaecomastia, and are sterile.

169. Option (d) is correct.

Habitat loss and fragmentation is the major cause of biodiversity loss and extinction of plants and animals. Habitat of various organisms are altered or destroyed by uncontrolled and unsustainable human activities such as deforestation, slash and burn agriculture, mining, and urbanisation. This results in the breaking up of the habitat into small pieces, which affects the movement of migratory animals and also, decreases the genetic exchange between populations leading to a declination of species.

170. Option (b) is correct.

Some strains of *Bacillus thuringiensis* have proteins that kill insects like coleopterans (beetles), lepidopterans (tobacco budworm, armyworm) and dipterans (flies, mosquitoes, etc).

They form a crystalline protein during their growth. This crystal is called protoxin. It is an inactive form. When an insect consumes this inactive toxin, it is converted into an active form of toxin because of the alkaline pH of the gut. This toxin form pores, swelling, and lysis in the epithelial cells of the gut and kill the insect.

171. Option (a) is correct.

The correct sequence for transport of sperm cells in the male reproductive system is :

Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus.

172. Option (a) is correct.

Remnants of nucellus in the matured seed are known as **perisperm**. e.g., black pepper, beet, etc.

Hilum is the point where the body of the ovule is attached to the Funiculus.

Tegmen is the delicate inner protective layer of a seed.

Chalaza is the basal swollen part of the nucellus (opposite the micropylar end) from where the integuments originate.

173. Option (c) is correct.

Bioreactors are large vessels used for the large scale production of biotechnology products from the raw materials. Here, the raw materials are biologically converted into specific products, enzymes, etc., using microbial plant, animal, or human cells.

174. Out of Syllabus**175. Option (b) is correct.**

Given,

Cardiac output = 5L or 5000 mL

The Blood volume in ventricles at the end of diastole = 100 mL

The Blood volume in ventricles at the end of systole = 50 mL

Therefore, Stroke volume = 100 – 50 = 50 mL

As we know, Cardiac output = Stroke volume × Heart rate

On putting the values, we get

5000 mL = 50 mL × Heart rate

or Heart rate = 5000/50 = 100 beats per minute.

176. Option (c) is correct.

Xylem is associated with translocation of main water, mineral salts, some organic nitrogen, and hormones.

177. Option (d) is correct.

Golden rice is vitamin A enriched rice, with a gene from daffodil and is rich in carotene.

178. Option (a) is correct.

Purines (double carbon-nitrogen rings) include Adenine (A) and Guanine (G) while pyrimidines (single carbon-nitrogen ring) include Cytosine (C), Thymine (T-only in DNA) and Uracil (U-only in RNA).

179. Option (d) is correct.

The **Montreal Protocol** (an international treaty in Canada, 1987) was signed to control the emission of ozone-depleting substances into the atmosphere.

180. Option (b) is correct.

The pattern in which the ovules are arranged within the ovary is called placentation. Marginal, axile, parietal, free central, and basal are the types of placentation. In parietal placentation, the ovules develop on the inner wall of the ovary or in the peripheral part. e.g., Mustard, Argemone, etc.