SOLVED PAPER 2021

Time : 3 Hours **Max. Marks : 720**

Important Instructions :

The test is of 3 hours duration and test contains 200 questions. Each question carries 4 marks.

| Number of Questions to be attempted out of 200 Questions	180 Questions
Total Marks	720 Marks
Number of questions in each subject and section	• Physics: Section A – 35, Section B – 15 • Chemistry: Section A – 35, Section B – 15 • Zoology: Section A – 35, Section B – 15 • Botany: Section A – 35, Section B – 15
Internal Choice in NEET Question Paper	Yes; Section B in each subject attempt only 10 questions out of 15 questions
Marking Scheme	Each correct answer +4 marks. For each incorrect answer–1 mark

PHYSICS

Section A

1. In a potentiometer circuit a cell of EMF 1.5 V gives balance point at 36 cm length of wire. If another cell of EMF 2.5 V replaces the first cell, then at what length of the wire, the balance point occurs? `Out of Syllabus`
(a) 62 cm (b) 60 cm (c) 21.6 cm (d) 64 cm

2. Column-I gives certain physical terms associated with flow of current through a metallic conductor. Column-II gives some mathematical relations involving electrical quantities. Match Column-I and Column-II with appropriate relations.

Column-I		Column-II	
(A)	Drift Velocity	(P)	$\dfrac{m}{ne^2p}$
(B)	Electrical Resistivity	(Q)	neV_d
(C)	Relaxation Period	(R)	$\dfrac{eE}{m}\tau$
(D)	Current Density	(S)	$\dfrac{E}{J}$

(a) (A) - (R), (B) - (Q), (C) - (S), (D) - (P)
(b) (A) - (R), (B) - (S), (C) - (P), (D) - (Q)
(c) (A) - (R), (B) - (S), (C) - (Q), (D) - (P)
(d) (A) - (R), (B) - (P), (C) - (S), (D) - (Q)

3. An infinitely long straight conductor carries a current of 5A as shown. An electron is moving with a speed of 10^5 m/s parallel to the conductor. The perpendicular distance between the electron and the conductor is 20 cm at an instant. Calculate the magnitude of the force experienced by the electron at that instant.
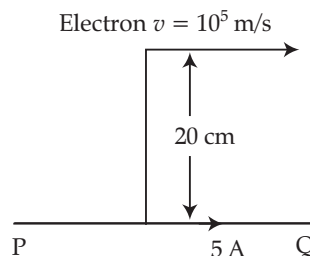
(a) 8×10^{-20} N (b) 4×10^{-20} N
(c) $8\pi \times 10^{-20}$ N (d) $4\pi \times 10^{-20}$ N

4. Polar molecules are the molecules
(a) Having a permanent electric dipole moment.
(b) Having zero dipole moment.
(c) Acquire a dipole moment only in the presence of electric field due to displacement of charges.
(d) Acquire a dipole moment only when magnetic field is absent.

5. A cup of coffee cools from 90°C to 80°C in t minutes, when the room temperature is 20°C. The time taken by a similar cup of coffee to cool from 80°C to 60°C at a room temperature same at 20°C is

Out of Syllabus

(a) $\dfrac{5}{13}t$ (b) $\dfrac{13}{10}t$ (c) $\dfrac{13}{5}t$ (d) $\dfrac{10}{13}t$

6. Consider the following statements (A) and (B) and identify the correct answer.
   (A) A zener diode is connected in reverse bias, when used as a voltage regulator.
   (B) The potential barrier of p-n junction lies between 0.1 V to 0.3 V.
   (a) (A) is incorrect but (B) is correct.
   (b) (A) and (B) both are correct.
   (c) (A) and (B) both are incorrect
   (d) (A) is correct and (B) is incorrect.

7. A nucleus with mass number 240 breaks into two fragments each of mass number 120, the binding energy per nucleon of unfragmented nuclei is 7.6 MeV while that of fragments is 8.5 MeV. The total gain in the Binding Energy in the process is
   (a) 216 MeV (b) 0.9 MeV (c) 9.4 MeV (d) 804 MeV

8. Two charged spherical conductors of radius R_1 and R_2 are connected by a wire. Then the ratio of surface charge densities of the spheres (σ_1/σ_2) is

(a) $\dfrac{R_1^2}{R_2^2}$ (b) $\dfrac{R_1}{R_2}$ (c) $\dfrac{R_2}{R_1}$ (d) $\sqrt{\left(\dfrac{R_1}{R_2}\right)}$

9. A body is executing simple harmonic motion with frequency 'n', the frequency of its potential energy is
   (a) $4n$ (b) n (c) $2n$ (d) $3n$

10. The half-life of a radioactive nuclide is 100 hours. The fraction of original activity that will remain after 150 hours would be

Out of Syllabus

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

11. For a plane electromagnetic wave propagating in x-direction, which one of the following combination gives the correct possible directions for electric field (E) and magnetic field (B) respectively ?
    (a) $-\hat{j}+\hat{k}, -\hat{j}+\hat{k}$ (b) $\hat{j}+\hat{k}, \hat{j}+\hat{k}$
    (c) $-\hat{j}+\hat{k}, -\hat{j}-\hat{k}$ (d) $\hat{j}+\hat{k}, -\hat{j}-\hat{k}$

12. A parallel plate capacitor has a uniform electric field 'E' in the space between the plates. If the distance between the plates is 'd' and the area of each plate is 'A', the energy stored in the capacitor is
    (ε_0 = permittivity of free space)

(a) $\dfrac{E^2 Ad}{\varepsilon_0}$ (b) $\dfrac{1}{2}\varepsilon_0 E^2$

(c) $\varepsilon_0 EAd$ (d) $\dfrac{1}{2}\varepsilon_0 E^2 Ad$

13. If force [F], acceleration [A] and time [T] are chosen as the fundamental physical quantities. Find the dimensions of energy.
    (a) $[F][A^{-1}][T]$ (b) $[F][A][T]$
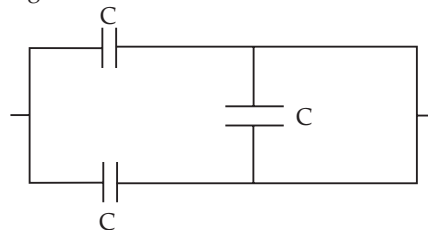   (c) $[F][A][T^2]$ (d) $[F][A][T^{-1}]$

14. A particle is released from height S from the surface of the Earth. At a certain height its kinetic energy is three times its potential energy. The height from the surface of earth and the speed of the particle at that instant are respectively

(a) $\dfrac{S}{4}, \sqrt{\dfrac{3gS}{2}}$ (b) $\dfrac{S}{4}, \dfrac{3gS}{2}$

(c) $\dfrac{S}{4}, \dfrac{\sqrt{3gS}}{2}$ (d) $\dfrac{S}{2}, \dfrac{\sqrt{3gS}}{2}$

15. The equivalent capacitance of the combination shown in the figure is

(a) $\dfrac{3C}{2}$ (b) $3C$ (c) $2C$ (d) $\dfrac{C}{2}$

16. If E and G respectively denote energy and gravitational constant, then $\dfrac{E}{G}$ has the dimensions of

(a) $[M^2][L^{-2}][T^{-1}]$ (b) $[M^2][L^{-1}][T^0]$
(c) $[M][L^{-1}][T^{-1}]$ (d) $[M][L^0][T^0]$

17. A lens of large focal length and large aperture is best suited as an objective of an astronomical telescope since
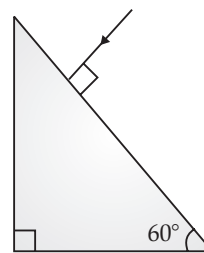   (a) a large aperture contributes to the quality and visibility of the images.
    (b) a large area of the objective ensures better light gathering power.
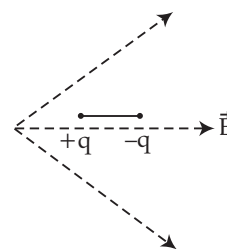   (c) a large aperture provides a better resolu-tion.
    (d) all of the above

18. Find the value of the angle of emergence from the prism. Refractive index of the glass is $\sqrt{3}$


(a) 90° (b) 60° (c) 30° (d) 45°

19. A dipole is placed in an electric field as shown. In which direction will it move ?

(a) Towards the right as its potential energy will increase.
(b) Towards the left as its potential energy will increase.
(c) Towards the right as its potential energy will decrease.
(d) Towards the left as its potential energy will decrease.

20. A screw gauge gives the following readings when used to measure the diameter of a wire
Main scale reading : 0 mm
Circular scale reading : 52 divisions
Given that 1 mm on main scale corresponds to 100 divisions on the circular scale. The diameter of the wire from the above data is
(a) 0.052 cm (b) 0.52 cm (c) 0.026 cm (d) 0.26 cm

21. A small block slides down on a smooth inclined plane, starting from rest at time $t = 0$. Let S_n be the distance travelled by the block in the interval $t = n - 1$ to $t = n$. Then, the ratio $\dfrac{S_n}{S_{n+1}}$

(a) $\dfrac{2n}{2n-1}$ (b) $\dfrac{2n-1}{2n}$ (c) $\dfrac{2n-1}{2n+1}$ (d) $\dfrac{2n+1}{2n+1}$

22. A convex lens 'A' of focal length 20 cm and a concave lens 'B' of focal length 5 cm are kept along the same axis with a distance 'd' between them. If a parallel beam of light falling on 'A' leaves 'B' as a parallel beam, then the distance 'd' in cm will be
(a) 30 (b) 25 (c) 15 (d) 50

23. The escape velocity from the Earth's surface is V. The escape velocity from the surface of another planet having a radius, four times that of Earth and same mass density is
(a) 4 V (b) V (c) 2 V (d) 3 V

24. An inductor of inductance L, a capacitor of capacitance C and a resistor of resistance 'R' are connected in series to an ac source of potential difference 'V' volts as shown in figure.
Potential difference across L, C and R is 40 V, 10 V and 40 V, respectively. The amplitude of current flowing through LCR series circuit is $10\sqrt{2}$ A. The impedance of the circuit is

(a) 5 Ω (b) $4\sqrt{2}$ Ω (c) $\dfrac{5}{\sqrt{2}}$ Ω (d) 4 Ω
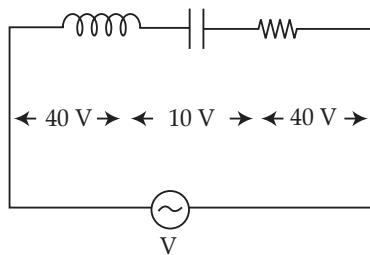
25. A spring is stretched by 5 cm by a force 10 N. The time period of the oscillations when a mass of 2 kg is suspended by it is
(a) 0.628 s (b) 0.0628 s (c) 6.28 s (d) 3.14 s

26. A thick current carrying cable of radius 'R' carries current 'I' uniformly distributed across its cross section. The variation of magnetic field B(r) due to the cable with the distance 'r' from the axis of the cable is represented by
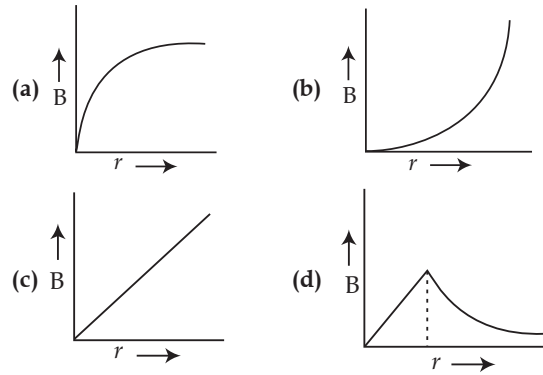
27. A radioactive nucleus $_Z^A X$ undergoes sponta-neous decay in the sequence [Out of Syllabus]
$_Z^A X \to_{z-1} B \to_{z-3} C \to_{z-2} D$, where Z is the atomic number of element X. The possible decay particles in the sequence are
(a) β⁻, α, β⁺ (b) α, β⁻, β⁺
(c) α, β⁺, β⁻ (d) β⁺, α, β⁻

28. The velocity of a small ball of mass M and density d, when dropped in a container filled with glycerine becomes constant after some time. If the density of glycerine is $\dfrac{d}{2}$, then the viscous force acting on the ball will be
(a) 2Mg (b) $\dfrac{Mg}{2}$ (c) Mg (d) $\dfrac{3}{2}$Mg

29. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of the input energy. How much power is generated by the turbine ?
($g = 10$ m/s²)
(a) 7.0 kW (b) 10.2 kW (c) 8.1 kW (d) 12.3 kW

30. A capacitor of capacitance 'C', is connected across an ac source of voltage V, given by V = V₀sinωt
The displacement current between the plates of the capacitor, would then be given by
(a) $I_d = V_0\omega C\sin\omega t$ (b) $I_d = V_0\omega C\cos\omega t$
(c) $I_d = \dfrac{V_0}{\omega C}\cos\omega t$ (d) $I_d = \dfrac{V_0}{\omega C}\sin\omega t$

31. The number of photons per second on an average emitted by the source of monochromatic light of wavelength 600 nm, when it delivers the power of 3.3×10^{-3} watt will be ($h = 6.6 \times 10^{-34}$ J s)
(a) 10^{15} (b) 10^{18} (c) 10^{17} (d) 10^{16}

32. The electron concentration in an n-type semiconductor is the same as hole concen-tration in a p-type semiconductor. An external field (electric) is applied across each of them. Compare the currents in them.
(a) No current will flow in p-type, current will only flow in n-type
(b) Current in n-type = current in p-type
(c) Current in p-type > current in n-type
(d) Current in n-type > current in p-type.

33. The effective resistance of a parallel connection that consists of four wires of equal length, equal area of cross-section and same material is 0.25 Ω. What will

be the effective resistance if they are connected in series ?

(a) $4\,\Omega$　　　(b) $0.25\,\Omega$　　(c) $0.5\,\Omega$　　(d) $1\,\Omega$

34. Match Column - I and Column - II and choose the correct match from the given choices.

Column - I		Column - II
(A)	Root mean square speed of gas molecules	(P)	$\dfrac{1}{3}nmv^{-2}$
(B)	Pressure exerted by ideal gas	(Q)	$\sqrt{\dfrac{3RT}{M}}$
(C)	Average kinetic energy of a molecule	(R)	$\dfrac{5}{2}RT$
(D)	Total internal energy of 1 mole of a diatomic gas	(S)	$\dfrac{3}{2}k_{B}T$

(a) (A) - (R), (B) - (Q), (C) - (P), (D) - (S)
(b) (A) - (R), (B) - (P), (C) - (S), (D) - (Q)
(c) (A) - (Q), (B) - (R), (C) - (S), (D) - (P)
(d) (A) - (Q), (B) - (P), (C) - (S), (D) - (R)

35. An electromagnetic wave of wavelength 'l' is incident on a photosensitive surface of negligible work function. If 'm' mass is of photoelectron emitted from the surface has de-Broglie wavelength ld, then

(a) $\lambda = \left(\dfrac{2h}{mc}\right)\lambda_d^2$　　　(b) $\lambda = \left(\dfrac{2m}{hc}\right)\lambda_d^2$

(c) $\lambda_d = \left(\dfrac{2mc}{h}\right)\lambda^2$　　　(d) $\lambda = \left(\dfrac{2mc}{h}\right)\lambda_d^2$

Section B

36. From a circular ring of mass 'M' and radius 'R' an arc corresponding to a 90° sector is removed. The moment of inertia of the remaining part of the ring about an axis passing through the centre of the ring and perpendicular to the plane of the ring is 'K' times 'MR²'. Then the value of 'K' is

(a) $\dfrac{1}{8}$　　(b) $\dfrac{3}{4}$　　(c) $\dfrac{7}{8}$　　(d) $\dfrac{1}{4}$

37. A point object is placed at a distance of 60 cm from a convex lens of focal length 30 cm. If a plane mirror were put perpendicular to the principal axis of the lens and at a distance of 40 cm from it, the final image would be formed at a distance of
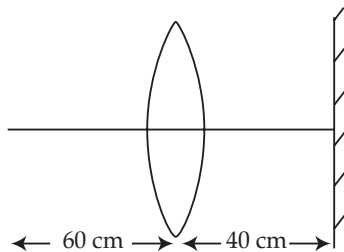
(a) 20 cm from the plane mirror, it would be a virtual image

(b) 20 cm from the lens, it would be a real image
(c) 30 cm from the lens, it would be a real image
(d) 30 cm from the plane mirror, it would be a virtual image

38. For the given circuit, the input digital signals are applied at the terminals A, B and C. What would be the output at the terminal y ?
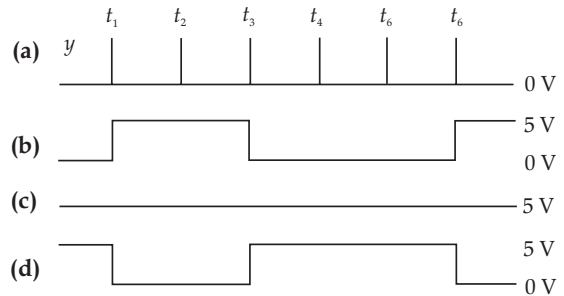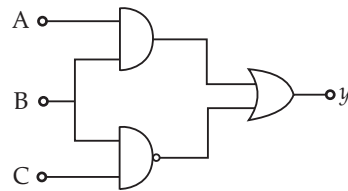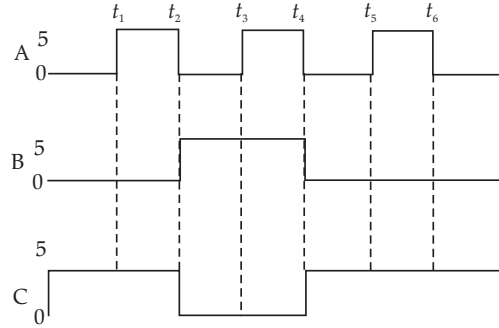
39. A car starts from rest and accelerates at 5 m/s². At $t = 4$ s, a ball is dropped out of a window by a person sitting in the car. What is the velocity and acceleration of the ball at $t = 6$ s ?
(Take $g = 10$ m/s²)

(a) $20\sqrt{2}$ m/s, 10 m/s²　　(b) 20 m/s, 5 m/s²
(c) 20 m/s, 0　　　　　　　　(d) $20\sqrt{2}$ m/s, 0

40. A uniform rod of length 200 cm and mass 500 g is balanced on a wedge placed at 40 cm mark. A mass of 2 kg is suspended from the rod at 20 cm and another unknown mass 'm' is suspended from the rod at 160 cm mark as shown in the figure. Find the value of 'm' such that the rod is in equilibrium. ($g = 10$ m/s²)
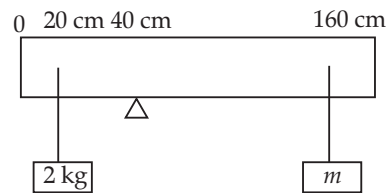

(a) $\dfrac{1}{12}$ kg　(b) $\dfrac{1}{2}$ kg　(c) $\dfrac{1}{3}$ kg　(d) $\dfrac{1}{6}$ kg

41. Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 >> R_2$, the mutual inductance M between them will be directly proportional to

(a) $\dfrac{R_2^2}{R_1}$ (b) $\dfrac{R_1}{R_2}$ (c) $\dfrac{R_2}{R_1}$ (d) $\dfrac{R_1^2}{R_2}$

42. Three resistors having resistances r_1, r_2 and r_3 are connected as shown in the given circuit. The ratio $\dfrac{i_3}{i_1}$ of currents in terms of resistances used in the circuit is
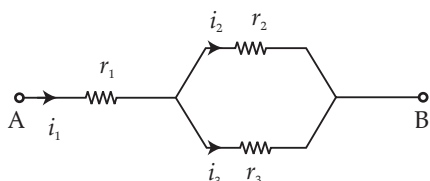
(a) $\dfrac{r_2}{r_1 + r_3}$ (b) $\dfrac{r_1}{r_2 + r_3}$ (c) $\dfrac{r_2}{r_2 + r_3}$ (d) $\dfrac{r_1}{r_1 + r_2}$

43. A particle of mass 'm' is projected with a velocity $v = kV_e$ ($k < 1$) from the surface of the earth.

(V_e = escape velocity)

The maximum height above the surface reached by the particle is

(a) $\dfrac{Rk^2}{1 - k^2}$ (b) $R\left(\dfrac{k}{1-k}\right)^2$

(c) $R\left(\dfrac{k}{1+k}\right)^2$ (d) $\dfrac{R^2k}{1+k}$

44. A uniform conducting wire of length $12a$ and resistance 'R' is wound up as a current carrying coil in the shape of,

(i) an equilateral triangle of side 'a'.

(ii) a square of side 'a'.

The magnetic dipole moments of the coil in each case respectively are

(a) $4\,Ia^2$ and $3\,Ia^2$ (b) $\sqrt{3}\,Ia^2$ and $3\,Ia^2$

(c) $3\,Ia^2$ and Ia^2 (d) $3\,Ia^2$ and $4\,Ia^2$

45. A step down transformer connected to an ac mains supply of 220 V is made to operate at 11 V, 44 W lamp. Ignoring power losses in the transformer, what is the current in the primary circuit ?

(a) 4 A   (b) 0.2 A   (c) 0.4 A   (d) 2 A

46. A series LCR circuit containing 5.0 H inductor, 80 µF capacitor and 40 Ω resistor is connected to 230 V variable frequency ac source. The angular frequencies of the source at which power transferred to the circuit is half the power at the resonant angular frequency are likely to be

(a) 42 rad/s and 58 rad/s   (b) 25 rad/s and 75 rad/s

(c) 50 rad/s and 25 rad/s   (d) 46 rad/s and 54 rad/s

47. Twenty seven drops of same size are charged at 200 V each. They combine to form a bigger drop. Calculate the potential of the bigger drop.

(a) 1980 V   (b) 660 V   (c) 1320 V   (d) 1520 V

48. A ball of mass 0.15 kg is dropped from a height 10 m, strikes the ground and rebounds to the same height. The magnitude of impulse imparted to the ball is ($g = 10$ m/s^2) nearly

(a) 1.4 kg m/s   (b) 0 kg m/s

(c) 4.2 kg m/s   (d) 2.1 kg m/s

49. In the product

$$\vec{F} = q\left(\vec{v} \times \vec{B}\right)$$

$$= q\vec{v} \times \left(B\hat{i} + B\hat{j} + B_0\hat{k}\right)$$

For $q = 1$ and $\vec{v} = 2\hat{i} + 4\hat{j} + 6\hat{k}$ and

$$\vec{F} = 4\hat{i} - 20\hat{j} + 12\hat{k}$$

What will be the complete expression for $\vec{B}$?

(a) $6\hat{i} + 6\hat{j} - 8\hat{k}$ (b) $-8\hat{i} - 8\hat{j} - 6\hat{k}$

(c) $-6\hat{i} - 6\hat{j} - 8\hat{k}$ (d) $8\hat{i} + 8\hat{j} - 6\hat{k}$

50. A particle moving in a circle of radius R with a uniform speed takes a time T to complete one revolution. If this particle were projected with the same speed at an angle 'θ' to the horizontal, the maximum height attained by it equals 4R. The angle of projection, θ, is then given by

(a) $\theta = \sin^{-1}\left(\dfrac{2gT^2}{\pi^2 R}\right)^{1/2}$ (b) $\theta = \cos^{-1}\left(\dfrac{gT^2}{\pi^2 R}\right)^{1/2}$

(c) $\theta = \cos^{-1}\left(\dfrac{\pi^2 R}{gT^2}\right)^{1/2}$ (d) $\theta = \sin^{-1}\left(\dfrac{\pi^2 R}{gT^2}\right)^{1/2}$

CHEMISTRY

Section A

51. The molar conductance of NaCl, HCl and CH$_3$COONa at infinite dilution are 126.45, 426.16 and 91.0 S cm^2 mol^{-1} respectively. The molar conductance of CH$_3$COOH at infinite dilution is.
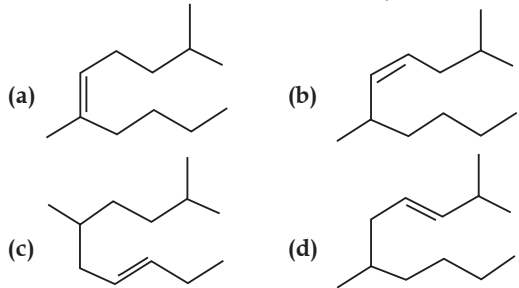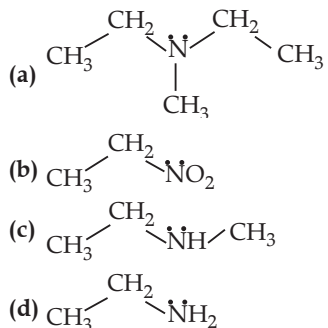
Choose the right option for your answer.

(a) 540.48 S cm^2 mol^{-1} (b) 201.28 S cm^2 mol^{-1}

(c) 390.71 S cm^2 mol^{-1} (d) 698.28 S cm^2 mol^{-1}

52. What is the IUPAC name of the organic compound formed in the following chemical reaction ?

Acetone $\xrightarrow[(ii)\,H_2O,H^+]{(i)\,C_2H_5MgBr,dry\ Ether}$ Product
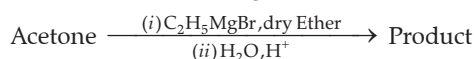
(a) 2-methylbutan-2-ol   (b) 2-methylpropan-2-ol

(c) pentan-2-ol   (d) pentan-3-ol

53. The following solutions were prepared by dissolving 10 g of glucose (C$_6$H$_{12}$O$_6$) in 250 ml of water (P$_1$), 10 g of urea (CH$_4$N$_2$O) in 250 ml of water (P$_2$) and 10 g of

sucrose ($C_{12}H_{22}O_{11}$) in 250 ml of water (P_3).

The right option for the decreasing order of osmotic pressure of these solutions is

(a) $P_3 > P_1 > P_2$ (b) $P_2 > P_1 > P_3$

(c) $P_1 > P_2 > P_3$ (d) $P_2 > P_3 > P_1$
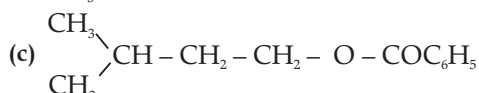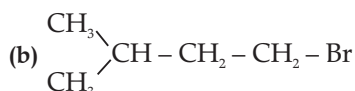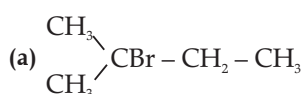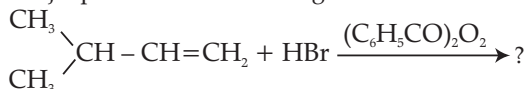
54. The right option for the statement "Tyndall effect is exhibited by", is   Out of Syllabus

(a) urea solution.   (b) NaCl solution.

(c) glucose solution.   (d) starch solution.

55. The maximum temperature that can be achieved in blast furnace is   Out of Syllabus

(a) Upto 5000 K   (b) Upto 1200 K

(c) Upto 2200 K   (d) Upto 1900 K

56. The correct option for the number of body centred unit cells in all 14 types of Bravais lattice unit cells is   Out of Syllabus

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

57. An organic compound contains 78% (by wt.) carbon and remaining percentage of hydrogen. The right option for the empirical formula of this compound is [Atomic wt. of C is 12, H is 1]

(a) CH_4 (b) CH   (c) CH_2 (d) CH_3

58. Zr (Z = 40) and Hf (Z = 72) have similar atomic and ionic radii because of

(a) having similar chemical properties.

(b) belonging to same group.

(c) diagonal relationship.

(d) lanthanoid contraction.

59. Ethylene diaminetetraacetate (EDTA) ion is

(a) tridentate ligand with three "N"donor atoms.

(b) hexadentate ligand with four "O" and two "N" donor atoms.

(c) unidentate ligand.

(d) bidentate ligand with two "N" donor atoms.

60. The correct structure of 2, 6-Dimethyl-dec-4 ene is

(a)   (b)

(c)   (d)

61. The RBC deficiency is deficiency disease of

(a) Vitamin B_2 (b) Vitamin B_{12}

(c) Vitamin B_6 (d) Vitamin B_1

62. BF_3 is planar and electron deficient compound. Hybridization and number of electrons around the central atom, respectively are

(a) sp^2 and 8   (b) sp^3 and 4

(c) sp^3 and 6   (d) sp^2 and 6

63. Dihedral angle of least stable conformer of ethane is

(a) 0°   (b) 120°   (c) 180°   (d) 60°

64. Among the following alkaline earth metal halides, one which is covalent and soluble in organic solvents is

(a) beryllium chloride.   (b) calcium chloride.

(c) strontium chloride.   (d) magnesium chloride.

65. Which one of the following polymers is prepared by addition polymerisation ?   Out of Syllabus

(a) Dacron   (b) Teflon

(c) Nylon-66   (d) Novolac

66. The structures of beryllium chloride in solid state and vapour phase, are

(a) chain in both.

(b) chain and dimer, respectively.

(c) linear in both.

(d) dimer and Linear, respectively.

67. Which one of the following methods can be used to obtain highly pure metal which is liquid at room temperature ?   Out of Syllabus

(a) Zone refining   (b) Electrolysis

(c) Chromatography   (d) Distillation

68. Which one among the following is the correct option for right relationship between C_P and C_V for one mole of ideal gas ?

(a) $C_V = RC_P$ (b) $C_P + C_V = R$

(c) $C_P - C_V = R$ (d) $C_P = RC_V$

69. Tritium, a radioactive isotope of hydrogen, emits which of the following particles?   Out of Syllabus

(a) Neutron (n)   (b) Beta (β)

(c) Alpha (α)   (d) Gamma (γ)

70. The major product formed in dehydroha logenation reaction of 2-Bromo pentane is Pent-2-ene. This product formation is based on ?

(a) Huckel's Rule   (b) Saytzeff's Rule

(c) Hund's Rule   (d) Hofmann Rule

71. A particular station of All India Radio, New Delhi broadcasts on a frequency of 1,368 kHz (kilohertz). The wavelength of the electro-magnetic radiation emitted by the transmitter is [speed of light $c = 3.0 \times 10^8$ ms^{-1}]

(a) 21.92 cm   (b) 219.3 m

(c) 219.2 m   (d) 2192 m

72. Right option for the number of tetrahedral and octahedral voids in hexagonal primitive unit cell are   Out of Syllabus

(a) 12, 6   (b) 8, 4   (c) 6, 12   (d) 2, 1

73. Identify the compound that will react with Hinsberg's reagent to give a solid which dissolves in alkali.

(a) CH_3—N(—CH_2—CH_3)(CH_2—CH_3) with CH_3

(b) CH_3—CH_2—NO_2

(c) CH_3—CH_2—NH—CH_3

(d) CH_3—CH_2—NH_2

74. The pK_b of dimethylamine and pK_a of acetic acid are 3.27 and 4.77 respectively at T (K). The correct option for the pH of dimethylammonium acetate solution is

(a) 6.25   (b) 8.50   (c) 5.50   (d) 7.75

75. The major product of the following chemical reaction is

$$\begin{array}{c} CH_3 \\ \diagdown \\ CH_3 \diagup \end{array} CH - CH = CH_2 + HBr \xrightarrow{(C_6H_5CO)_2O_2} ?$$

(a) $\begin{array}{c} CH_3 \\ \diagdown \\ CH_3 \diagup \end{array} CBr - CH_2 - CH_3$

(b) $\begin{array}{c} CH_3 \\ \diagdown \\ CH_3 \diagup \end{array} CH - CH_2 - CH_2 - Br$

(c) $\begin{array}{c} CH_3 \\ \diagdown \\ CH_3 \diagup \end{array} CH - CH_2 - CH_2 - O - COC_6H_5$

(d) $\begin{array}{c} CH_3 \\ \diagdown \\ CH_3 \diagup \end{array} CH - \underset{\underset{Br}{|}}{CH} - CH_3$
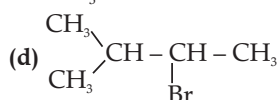
76. Match List-I with List-II.

	List-I		List-II
(a)	PCl_5	(i)	Square pyramidal
(b)	SF_6	(ii)	Trigonal planar
(c)	BrF_5	(iii)	Octahedral
(d)	BF_3	(iv)	Trigonal bipyramidal

Choose the correct answer from the options given below.
(a) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
(b) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
(c) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
(d) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

77. The incorrect statement among the following is
(a) actinoids are highly reactive metals, especially when finely divided.
(b) actinoid contraction is greater than lanthanoid contraction.
(c) most of the trivalent Lanthanoid ions are colorless in the solid state.
(d) lanthanoids are good conductors of heat and electricity.

78. **Statement I :** Acid strength increases in the order given as HF << HCl << HBr << HI.
Statement II : As the size of the elements F, Cl, Br, I increases down the group, the bond strength of HF, HCl, HBr and HI decreases and so the acid strength increases.
In the light of the above statements, choose the correct answer from the options given below.
(a) Statement I is incorrect but Statement II is true.
(b) Both statement I and Statement II are true.
(c) Both Statement I and Statement II are false.
(d) Statement I is correct but statement II is false.

79. Noble gases are named because of their inertness towards reactivity. Identify an incorrect statement about them.
(a) Noble gases have large positive values of electron gain enthalpy.
(b) Noble gases are sparingly soluble in water.
(c) Noble gases have very high melting and boiling points.
(d) Noble gases have weak dispersion forces.

80. The compound which shows metamerism is

(a) $C_4H_{10}O$ (b) C_5H_{12} (c) C_3H_8O (d) C_3H_6O

81. Choose the correct option for graphical representation of Boyle's law, which shows a graph of pressure vs. volume of a gas at different temperatures   `Out of Syllabus`


(a)

(b)

(c)

(d)
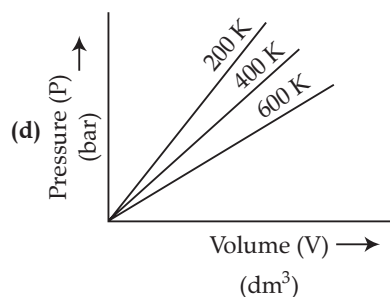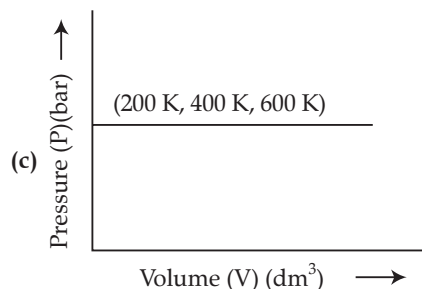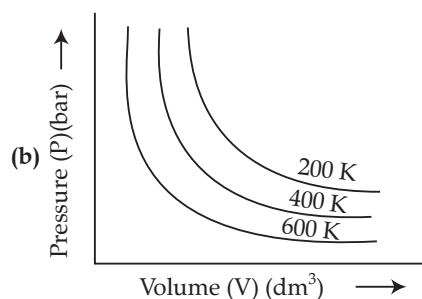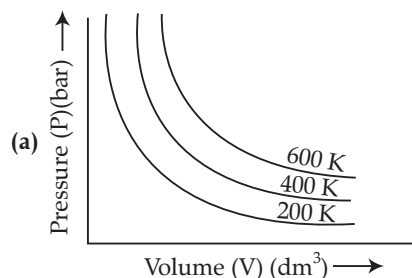
82. The correct sequence of bond enthalpy of 'C—X' bond is
(a) $CH_3 - Cl > CH_3 - F > CH_3 - Br > CH_3 - I$
(b) $CH_3 - F < CH_3 - Cl < CH_3 - Br < CH_3 - I$
(c) $CH_3 - F > CH_3 - Cl > CH_3 - Br > CH_3 - I$
(d) $CH_3 - F < CH_3 - Cl > CH_3 - Br > CH_3 - I$

83. Given below are two statements :   `Out of Syllabus`
Statement I :
Aspirin and Paracetamol belong to the class of narcotic analgesics.
Statement II :
Morphine and Heroin are non-narcotic analgesics.
In the light of the above statements, choose the correct answer from the options given below.
(a) Statement I is incorrect but Statement II is true.
(b) Both Statement I and Statement II are true.

(c) Both Statement I and Statement II are false.

(d) Statement I is correct but Statement II is false.
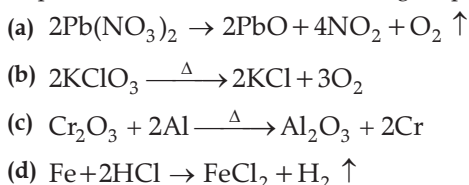
84. For a reaction A → B, enthalpy of reaction is −4.2 kJ mol⁻¹ and enthalpy of activation is 9.6 kJ mol⁻¹. The correct potential energy profile for the reaction is shown in option.

(a)

(b)

(c)

(d)
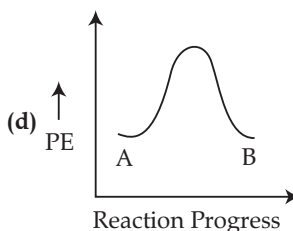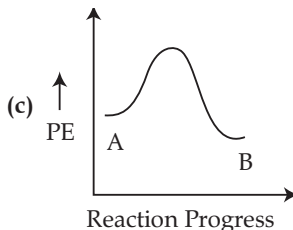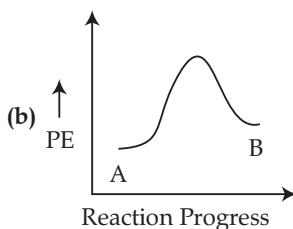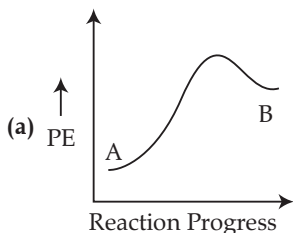
85. Which of the following reactions is the metal displacement reaction? Choose the right option.

(a) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2 \uparrow$

(b) $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

(c) $Cr_2O_3 + 2Al \xrightarrow{\Delta} Al_2O_3 + 2Cr$

(d) $Fe + 2HCl \rightarrow FeCl_2 + H_2 \uparrow$

Section B

86. The slope of Arrhenius plot $\left(\ln k \text{ v/s} \dfrac{1}{T} \right)$ of first order reaction is −5 × 10³ K. The value of E_a of the reaction is. Choose the correct option for your answer. [Given R = 8.314 JK⁻¹mol⁻¹]

(a) −83 kJ mol⁻¹   (b) 41.5 kJ mol⁻¹

(c) 83.0 kJ mol⁻¹   (d) 166 kJ mol⁻¹

87. Match List-I with List-II.

List-I		List-II	
(a)	$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	(i)	Acid rain
(b)	$HOCl(g) \xrightarrow{h\nu} \dot{O}H + \dot{C}l$	(ii)	Smog
(c)	$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$	(iii)	Ozone depletion
(d)	$NO_2(g) \xrightarrow{h\nu} NO(g) + O(g)$	(iv)	Tropospheric pollution

Choose the correct answer from the options given below.

(a) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

(b) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(c) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

(d) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

88. Match List-I with List-II

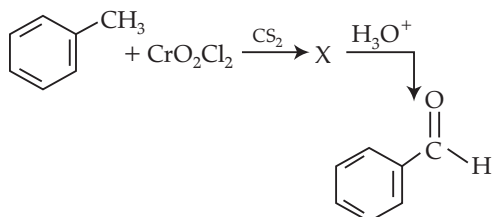| List-I		List-II	
(a)	$\bigcirc \xrightarrow[\text{Anhyd.AlCl}_3/\text{CuCl}]{\text{CO,HCl}}$	(i)	Hell-Volhard-Zelinsky reaction
(b)	$R - \overset{O}{\overset{\|}{C}} - CH_3 + NaOX \longrightarrow$	(ii)	Gattermann Koch reaction
(c)	$R - CH_2 - OH + R\,COOH \xrightarrow{\text{Conc.H}_2\text{SO}_4}$	(iii)	Haloform reaction
(d)	$R - CH_2COOH \xrightarrow[(ii)\,H_2O]{(i)\,X_2/\text{Red P}}$	(iv)	Esterification

Choose the correct answer from the options given below.

(a) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

(b) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

(c) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

(d) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)

89. From the following pairs of ions which one is not an iso-electronic pair ?

(a) Fe^{2+}, Mn^{2+} (b) O^{2-}, F^-

(c) Na^+, Mg^{2+} (d) Mn^{2+}, Fe^{3+}

90. The molar conductivity of 0.007 M acetic acid is 20 S cm² mol⁻¹. What is the dissociation constant of acetic acid? Choose the correct option.

$$\left[\begin{array}{l} \Lambda^o_{H^+} = 350\,S\,cm^2mol^{-1} \\ \Lambda^o_{CH_3COO^-} = 50\,Scm^2mol^{-1} \end{array} \right]$$

(a) 2.50×10^{-5} mol L⁻¹   (b) 1.75×10^{-4} mol L⁻¹

(c) 2.50×10^{-4} mol L⁻¹   (d) 1.75×10^{-5} mol L⁻¹

91. In which one of the following arrangements the given sequence is not strictly according to the properties indicated against it ?

(a) $CO_2 < SiO_2$:   Increasing
$< SnO_2 < PbO_2$ oxidizing power

(b) $HF < HCl$:   Increasing
$< HBr < HI$ acidic strength

(c) $H_2O < H_2S$:   Increasing pK_a
$< H_2Se < H_2Te$ values

(d) $NH_3 < PH_3$:   Increasing
$< AsH_3 < SbH_3$ acidic character

92. The intermediate compound 'X' in the following chemical reaction is

(a)

(b) $CH(OCrOHCl_2)_2$

(c) $CH(OCOCH_3)_2$

(d)

93. Which of the following molecules is non-polar in nature ?

(a) NO_2 **(b)** $POCl_3$ **(c)** CH_2O **(d)** $SbCl_5$

94. Match List-I with List-II.

|	List-I		List-II
(a)	$[Fe(CN)_6]^{3-}$	**(i)**	5.92 BM
(b)	$[Fe(H_2O)_6]^{3+}$	**(ii)**	0 BM
(c)	$[Fe(CN)_6]^{4-}$	**(iii)**	4.90 BM
(d)	$[Fe(H_2O)_6]^{2+}$	**(iv)**	1.73 BM

Choose the correct answer from the options given below.

(a) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
(b) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
(c) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
(d) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

95. $CH_3CH_2COO^-Na^+ \xrightarrow[\text{Heat}]{\text{NaOH, + ?}} CH_3CH_3 +$
 Na_2CO_3

Consider the above reaction and identify the missing reagent/chemical.

(a) DIBAL-H   **(b)** B_2H_6
(c) Red Phosphorus   **(d)** CaO

96. The product formed in the following chemical reaction is
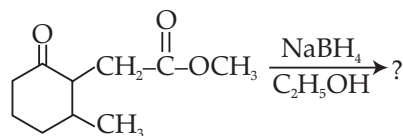
(a)

(b)

(c)

(d)

97. The correct option for the value of vapour pressure of a solution at 45°C with benzene to octane in molar ratio 3 : 2 is
[At 45°C vapour pressure of benzene is 280 mm of Hg and that of octane is 420 mm of Hg. Assume Ideal gas]

(a) 350 mm of Hg   **(b)** 160 mm of Hg
(c) 168 mm of Hg   **(d)** 336 mm of Hg

98. For irreversible expansion of an ideal gas under isothermal condition, the correct option is

(a) $\Delta U \neq 0, \Delta S_{total} = 0$ **(b)** $\Delta U = 0, \Delta S_{total} = 0$
(c) $\Delta U \neq 0, \Delta S_{total} \neq 0$ **(d)** $\Delta U = 0, \Delta S_{total} \neq 0$

99. Choose the correct option for the total pressure (in atm.) in a mixture of 4 g O_2 and 2 g H_2 confined in a total volume of one litre at 0°C is
[Given R = 0.082 L atm $mol^{-1}K^{-1}$, T = 273 K]

(a) 26.02   **(b)** 2.518   **(c)** 2.602   **(d)** 25.18

100. The reagent 'R' in the given sequence of chemical reaction is
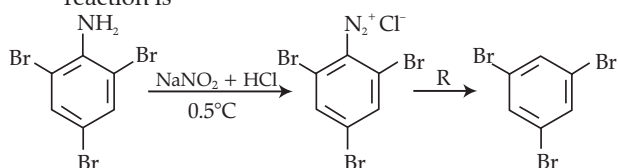
(a) CuCN/KCN   **(b)** H_2O
(c) CH_3CH_2OH **(d)** HI

BOTANY

Section A

101. The production of gametes by the parents, formation of zygotes, the F_1 and F_2 plants, can be understood from a diagram called
   (a) Net square.   (b) Bullet square.
   (c) Punch square.   (d) Punnett square.

102. Gemmae are present in
   (a) some Liverworts.   (b) mosses.
   (c) pteridophytes.   (d) some Gymnosperms.

103. The factor that leads to Founder effect in a population is
   (a) genetic drift.   (b) natural selection.
   (c) genetic recombination. (d) mutation.

104. Plants follow different pathways in response to environment or phases of life to form different kinds of structures. This ability is called
   (a) maturity.   (b) elasticity.
   (c) flexibility.   (d) plasticity.

105. Match List-I with List-II.

	List-I		List-II
(a)	Cells with active cell division capacity	(i)	Vascular tissues
(b)	Tissues having all cells similar in structure and function	(ii)	Meristematic tissues
(c)	Tissue having different types of cells	(iii)	Scleritis
(d)	Dead cells with highly thickened walls and narrow lumen	(iv)	Simple tissue

Select the correct answer from the options given below.
	(a)	(b)	(c)	(d)
(a)	(iii)	(ii)	(iv)	(i)
(b)	(ii)	(iv)	(i)	(iii)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(i)	(ii)	(iii)	(iv)

106. The term used for transfer of pollen grains from anthers of one plant to stigma of a different plant which, during pollination, brings genetically different types of pollen grains to stigma, is
   (a) Cleistogamy   (b) Xenogamy
   (c) Geitonogamy   (d) Chasmogamy

107. Which of the following is a correct sequence of steps in a PCR (Polymerase Chain Reaction)
   (a) Annealing, Denaturation, Extension
   (b) Denaturation, Annealing, Extension
   (c) Denaturation, Extension, Annealing
   (d) Extension, Denaturation, Annealing

108. Match List-I with List-II.   Out of Syllabus

	List-I		List-II
(a)	Lenticels	(i)	Phellogen
(b)	Cork cambium	(ii)	Suberin deposition
(c)	Secondary cortex	(iii)	Exchange of gases
(d)	Cork	(iv)	Phelloderm

Choose the correct answer from the options given below.
	(a)	(b)	(c)	(d)
(a)	(iv)	(ii)	(i)	(iii)
(b)	(iv)	(i)	(iii)	(ii)
(c)	(iii)	(i)	(iv)	(ii)
(d)	(ii)	(iii)	(iv)	(i)

109. Inspite of interspecific competition in nature, which mechanism the competing species might have evolved for their survival ?
   (a) Predation   (b) Resource partitioning
   (c) Competitive release (d) Mutualism

110. DNA strands on a gel stained with ethidium bromide when viewed under UV radiation, appear as
   (a) bright blue bands.   (b) yellow bands.
   (c) bright orange bands. (d) dark red bands.

111. Which of the following algae produce Carrageen ?
   (a) Blue-green algae   (b) Green algae
   (c) Brown algae   (d) Red algae

112. Diadelphous stamens are found in
   (a) China rose and citrus. (b) China rose.
   (c) Citrus.   (d) Pea.

113. The plant hormone used to destroy weeds in a field
   (a) IBA   (b) IAA   (c) NAA   (d) 2, 4-D

114. Which of the following plants is monoecious ?
   (a) *Cycas circinalis*   (b) *Carica papaya*
   (c) *Chara*   (d) *Marchantia polymorpha*

115. Which of the following are not secondary metabolites in plants ?
   (a) Rubber, gums   (b) Morphine, codeine
   (c) Amino acids, glucose (d) Vinblastin, curcumin

116. Complete the flow chart on central dogma.

(a) DNA $\xrightarrow{\text{(b)}}$ mRNA $\xrightarrow{\text{(c)}}$ (d)

(a) (a)-Transduction; (b)-Translation; (c)-Replication; (d)-Protein
(b) (a)-Replication; (b)-Transcription; (c)-Transduction; (d)-Protein
(c) (a)-Translation; (b)-Replication; (c)-Transcription; (d)-Transduction
(d) (a)-Replication; (b)-Transcription; (c)-Translation; (d)-Protein

117. The site of perception of light in plants during photoperiodism is
    (a) leaf.
    (b) shoot apex.
    (c) stem.
    (d) axillary bud.

118. In the equation GPP – R = NPP R represents
    (a) Respiration losses
    (b) Radiant energy
    (c) Retardation factor
    (d) Environmental factor

119. Match List-I with List-II.

	List-I		List-II
(a)	Cristae	(i)	Primary construction in chromosome
(b)	Thylakoids	(ii)	Disc-shaped sacs in Golgi apparatus
(c)	Centromere	(iii)	Infoldings in mitochondria
(d)	Cistemae	(iv)	Flattened membranous sacs in stroma of plastids

Choose the correct answer from the options given below.

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

120. Which of the following algae contains mannitol as reserve food material ?
    (a) *Ulothrix*
    (b) *Ectocarpus*
    (c) *Gracilaria*
    (d) *Volvox*

121. Which of the following is an incorrect statement ?
    (a) Nuclear pores act as passages for proteins and RNA molecules in both directions between nucleus and cytoplasm.
    (b) Mature sieve tube elements possess a conspicuous nucleus and usual cytoplasmic organelles.
    (c) Microbodies are present both in plant and animal cells.
    (d) The perinuclear space forms a barrier between the materials present inside the nucleus and that of the cytoplasm.

122. Mutations in plant cells can be induced by
    (a) zeatin.
    (b) kinetin.
    (c) infrared rays.
    (d) gamma rays.

123. The first stable product of CO_2 fixation in Sorghum is
    (a) phosphoglyceric acid.
    (b) pyruvic acid.
    (c) oxaloacetic acid.
    (d) succinic acid.

124. Match List-I with List-II.

	List-I		List-II
(a)	Cohesion	(i)	More attraction in liquid phase
(b)	Adhesion	(ii)	Mutual attractor among water molecules
(c)	Surface tension	(iii)	Water loss in liquid phase
(d)	Guttation	(iv)	Attraction towards polar surfaces

Choose the correct answer from the options given below.

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

125. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out
    (a) Polysaccharides
    (b) RNA
    (c) DNA
    (d) Histones

126. Amensalism can be represented as
    (a) Species A (+); Species B (0)
    (b) Species A (–); Species B (0)
    (c) Species A (+); Species B (+)
    (d) Species A (–); Species B (–)

127. Which of the following stages of meiosis involves division of centromere ?
    (a) Telophase II
    (b) Metaphase I
    (c) Metaphase II
    (d) Anaphase II

128. When gene targeting involving gene amplification is attempted in an individual's tissue to treat disease, it is known as
    (a) safety testing.
    (b) biopiracy.
    (c) gene therapy.
    (d) molecular diagnosis.

129. The amount of nutrients, such as carbon, nitrogen, phosphorus and calcium present in the soil at any given time, is referred as
    (a) standing crop.
    (b) climax.
    (c) climax community.
    (d) standing state.

130. Which of the following statements is not correct ?
    (a) Pyramid of numbers in a grassland ecosystem is upright.
    (b) Pyramid of biomass in sea is generally inverted.
    (c) Pyramid of biomass in sea is generally upright.
    (d) Pyramid of energy is always upright.

131. A typical angiosperm embryo sac at maturity is
    (a) 8-nucleate and 8-celled
    (b) 8-nucleate and 7-celled
    (c) 7-nucleate and 8-celled
    (d) 7-nucleate and 7-celled

132. When the centromere is situated in the middle of two equal arms of chromosomes, the chromosome is referred as
    (a) acrocentric.
    (b) metacentric.
    (c) telocentric.
    (d) sub-metacentric.

133. Genera like *Selaginella* and *Salvinia* produce two kinds of spores. Such plants are known as
    (a) Heterosporous
    (b) Homosorus
    (c) Heterosorus
    (d) Homosporous

134. Match List-I with List-II

	List-I		List-II
(a)	Protoplast fusion	(i)	Totipotency
(b)	Plant tissue culture	(ii)	Pomato
(c)	Meristem culture	(iii)	Somaclones
(d)	Micro-propagation	(iv)	Virus free plants

Choose the correct answer from the options given below.

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

135. Which of the following is not an application of PCR (Polymerase Chain Reaction) ?
(a) Detection of gene mutation
(b) Molecular diagnosis
(c) Gene amplification
(d) Purification of isolated protein

Section B

136. Identify the correct statement.
(a) Split gene arrangement is characteristic of prokaryotes.
(b) In capping, methyl guanosine triphosphate is added to the 3' end of hnRNA.
(c) RNA polymerase binds with Rho factor to terminate the process of transcription in bacteria.
(d) The coding strand in a transcription unit is copied to an *m*RNA.

137. Now a days it is possible to detect the mutated gene causing cancer by allowing radioactive probe to hybridise its complimentary DNA in a clone of cells, followed by its detection using autoradiography because
(a) mutated gene does not appear on photographic film as the probe has complementarity with it.
(b) mutated gene partially appears on a photographic film.
(c) mutated gene completely and clearly appears on a photographic film.
(d) mutated gene does not appear on a photographic film as the probe has no complementarity with it.

138. What is the role of RNA polymerase III in the process of transcription in eukaryotes ?
(a) Transcribes only snRNAs
(b) Transcribes *r*RNAs (28S, 18S and 5.8S)
(c) Transcribes *t*RNA, 5s *r*RNA and snRNA
(d) Transcribes precursor of *m*RNA

139. Select the correct pair.
(a) Loose parenchyma   – Spongy
cell rupturing the   parenchyma
epidermis and
forming a lens
shaped opening
in bark

(b) Large colorless   – Subsidiary cells
empty cells in
the epidermis
of grass leaves
(c) In dicot leaves,   – Conjunctive
vascular bundles   tissue
are surrounded
by large thick-
walled cells
(d) Cells of   – Interfascicular
medullary rays   cambium
that form part
of cambial ring

140. In the exponential growth equation $N_t = N_0 e^{rt}$, e represents
(a) The base of geometric logarithms
(b) The base of number logarithms
(c) The base of exponential logarithms
(d) The base of natural logarithms

141. Which of the following statements is incorrect ?
(a) Oxidation-reduction reactions produce proton gradient in respiration.
(b) During aerobic respiration, role of oxygen is limited to the terminal stage.
(c) In ETC (Electron Transport Chain), one molecule of $NADH + H^+$ gives rise to 2 ATP molecules, and one $FADH_2$ gives rise to 3 ATP molecules.
(d) ATP is synthesized through complex V.

142. Which of the following statements is incorrect ?
(a) Cyclic photophosphorylation involves both PS I and PS II.
(b) Both ATP and $NADPH + H^+$ are synthesized during non-cyclic photophosphorylation.
(c) Stroma lamellae have PS I only and lack NADP reductase.
(d) Grana lamellae have both PS I and PS II.

143. Which of the following statements is correct ?
(a) Some of the organisms can fix atmospheric nitrogen in specialized cells called sheath cells.
(b) Fusion of two cells is called Karyogamy.
(c) Fusion of protoplasms between two motile or non-motile gametes is called plasmogamy.
(d) Organisms that depend on living plants are called saprophytes.

144. DNA fingerprinting involves identifying differences in some specific regions in DNA sequence, called as
(a) Polymorphic DNA.   (b) Satellite DNA.
(c) Repetitive DNA.   (d) Single nucleotides.

145. Match List-I with List-II.

	List-I		List-II
(a)	Protein	(i)	C = C double bonds
(b)	Unsaturated fatty acid	(ii)	Phosphodiester bonds
(c)	Nucleic acid	(iii)	Glycosidic bonds
(d)	Polysaccharide	(iv)	Peptide bonds

Choose the correct answer from the options given below.

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

146. Match Column - I with Column - II:

Column - I		Column- II	
(a)	*Nitrococcus*	(i)	Denitrification
(b)	*Rhizobium*	(ii)	Conversion of ammonia to nitrite
(c)	*Thiobacillus*	(iii)	Conversion of nitrite to nitrate
(d)	*Nitrobacter*	(iv)	Conversion of atmospheric nitrogen to ammonia

Choose the correct answer from options given below.

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

147. In some members of which of the following pairs of families, pollen grains retain their viability for months after release ?
(a) Rosaceae ; Leguminosae
(b) Poaceae ; Rosaceae
(c) Poaceae ; Leguminosae
(d) Poaceae ; Solanaceae

148. Plasmid pBR322 has Pstl restriction enzyme site within gene amp^R that confers ampicillin resistance.
If this enzyme is used for inserting a gene for β-galactoside production and the recombinant plasmid is inserted in an *E. coli* strain

(a) It will be able to produce a novel protein with dual ability.

(b) It will not be able to confer ampicillin resistance to the host cell.
(c) The transformed cells will have the ability to resist ampicillin as well as produce β-galactoside.
(d) It will lead to lysis of host cell.

149. Match Column-I with Column-II

Column-I		Column-II
(a) $\% \; \mathcal{Q} \; K_{(5)} C_{1+2+(2)} A_{(3)+1} \underline{G}_1$	(i)	Brassicaceae
(b) $\oplus \mathcal{Q} \; K_{(5)} \widehat{C_{(5)}} A_5 \underline{G}_{(2)}$	(ii)	Liliaceae
(c) $\oplus \mathcal{Q} \; \widehat{P_{(3+3)}} A_{3+3} \underline{G}_{(3)}$	(iii)	Fabaceae
(d) $\oplus \mathcal{Q} K_{2+2} C_4 A_{2-4} \underline{G}_{(2)}$	(iv)	Solanaceae

Select the correct answer from the options given below.

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

150. Match List-I with List-II.

List-I		List-II	
(a)	S phase	(i)	Proteins are synthesized
(b)	G_2 phase	(ii)	Inactive phase
(c)	Quiescent stage	(iii)	Interval between mitos is and initiation of DNA replication
(d)	G_1 phase	(iv)	DNA replication

Choose the correct answer from the options given below.

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

ZOOLOGY

Section A

151. Which of the following RNAs is not required for the synthesis of protein ?
(a) siRNA   (b) *m*RNA
(c) *t*RNA   (d) *r*RNA

152. Succus entericus is referred to as   Out of Syllabus
(a) chyme.   (b) pancreatic juice.
(c) intestinal juice.   (d) gastric juice.

153. Which is the "Only enzyme" that has "Capability" to catalyse Initiation, Elongation and Termination in the process of transcription in prokaryotes ?
(a) DNase

(b) DNA dependent DNA polymerase
(c) DNA dependent RNA polymerase
(d) DNA Ligase

154. Which of the following characteristics is incorrect with respect to cockroach?   Out of Syllabus
(a) 10th abdominal segment in both sexes, bears a pair of anal cerci.

(b) A ring of gastric caeca is present at the junction of midgut and hind gut.
(c) Hypopharynx lies within the cavity enclosed by the mouth parts.
(d) In females, 7th-9th sterna together form a genital pouch.

155. Match List - I with List - II

	List-I		List-II
(a)	Metamerism	(i)	Coelenterata
(b)	Canal system	(ii)	Ctenophora
(c)	Comb plates	(iii)	Annelida
(d)	Cnidoblasts	(iv)	Porifera

Choose the correct answer from the options given below.

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

156. Which of the following is not an objective of Biofortification in crops ?
(a) Improve micronutrient and mineral content
(b) Improve protein content
(c) Improve resistance to diseases
(d) Improve vitamin content

157. Identify the incorrect pair
(a) Drugs   –   Ricin
(b) Alkaloids   –   Codeine
(c) Toxin   –   Abrin
(d) Lectins   –   Concanavalin A

158. Match List-I with List-II

	List-I		List-II
(a)	*Aspergillus niger*	(i)	Acetic Acid
(b)	*Acetobacter aceti*	(ii)	Lactic Acid
(c)	*Clostridium butylicum*	(iii)	Citric Acid
(d)	*Lactobacillus*	(iv)	Butyric Acid

Choose the correct answer from the options given below.

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

159. With regard to insulin choose correct options.
(a) C-peptide is not present in mature insulin.
(b) The insulin produced by *r*DNA technology has cpeptide.
(c) The pro-insulin has C-peptide
(d) A-peptide and B-peptide of insulin are interconnected by disulphide bridges.
Choose the correct answer from the options given below.
(a) (b), (d) only   (b) (a), (d) only
(c) (b), (c) only   (d) (a), (c), (d) only

160. Select the favourable conditions required for the formation of oxyhaemoglobin at the alveoli.
(a) Low pO_2, low pCO_2, more H^+, higher temperature
(b) High pO_2, low pCO_2, less H^+, lower temperature
(c) Low pO_2, high pCO_2, more H^+, higher temperature
(d) High pO_2, high pCO_2, less H^+, higher temperature

161. Match the following:

	List-I		List-II
(a)	*Physalia*	(i)	Pearl oyster
(b)	*Limulus*	(ii)	Portuguese Man of War
(c)	*Ancylostoma*	(iii)	Living fossil
(d)	*Pinctada*	(iv)	Hookworm

Choose the correct answer from the options given below.

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

162. The fruit fly has 8 chromosomes (2n) in each cell. During interphase of Mitosis if the number of chromosomes at G_1 phase is 8, what would be the number of chromosomes after S phase ?
(a) 32   (b) 8   (c) 16   (d) 4

163. Which one of the following organisms bears hollow and pneumatic long bones ?
(a) *Ornithorhynchus*   (b) *Neophron*
(c) *Hemidactylus*   (d) *Macropus*

164. Dobson units are used to measure thickness of
(a) Troposphere.   (b) CFCs.
(c) Stratosphere.   (d) Ozone.

165. Which enzyme is responsible for the conversion of inactive fibrinogens to fibrins ?
(a) Thrombokinase   (b) Thrombin
(c) Renin   (d) Epinephrine

166. For effective treatment of the disease, early diagnosis and understanding its pathophysiology is very important. Which of the following molecular diagnostic techniques is very useful for early detection ?
(a) Hybridization Technique
(b) Western Blotting Technique
(c) Southern Blotting Technique
(d) ELISA Technique

167. The organelles that are included in the endomembrane system are
(a) Golgi complex, Endoplasmic reticulum, Mitochondria and Lysosomes.
(b) Endoplasmic reticulum, Mitochondria, Ribosomes and Lysosomes.
(c) Endoplasmic reticulum, Golgi complex, Lysosomes and Vacuoles.
(d) Golgi complex, Mitochondria, Ribo-somes and Lysosomes.

168. If Adenine makes 30% of the DNA molecule, what will be the percentage of Thymine, Guanine and Cytosine in it ?

(a) T : 20 ; G : 25 ; C : 25   (b) T : 20 ; G : 30 ; C : 20
(c) T : 20 ; G : 20 ; C : 30   (d) T : 30 ; G : 20 ; C : 20

169. A specific recognition sequence identified by endonucleases to make cuts at specific positions within the DNA is
(a) poly(A) tail sequences.
(b) degenerate primer sequence.
(c) okazaki sequences.
(d) palindromic nucleotide sequences.

170. Which of the following statements wrongly represents the nature of smooth muscle ?
(a) These muscles are present in the wall of blood vessels.
(b) These muscle have no striations.
(c) They are involuntary muscles.
(d) Communication among the cells is performed by intercalated discs.

171. Match List-I with List-II.

	List-I		List-II
(a)	Vaults	(i)	Entry of sperm through Cervix is blocked
(b)	IUDs	(ii)	Removal of Vas deferens
(c)	Vasectomy	(iii)	Phagocytosis of sperms within the Uterus
(d)	Tubectomy	(iv)	Removal of fallopian tube

Choose the correct answer from the options given below

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

172. During the process of gene amplification using PCR, if very high temperature is not maintained in the beginning, then which of the following steps of PCR will be affected first ?
(a) Ligation   (b) Annealing
(c) Extension   (d) Denaturation

173. In a cross between a male and female, both heterozygous for sickle cell anaemia gene, what percentage of the progeny will be diseased ?
(a) 100%   (b) 50%   (c) 75%   (d) 25%

174. Read the following statements.
(a) Metagenesis is observed in Helminths.
(b) Echinoderms are triploblastic and coelomate animals.
(c) Round worms have organ-system level of body organization.
(d) Comb plates present in ctenophores help in digestion.
(e) Water vascular system is characteristic of Echinoderms.
Choose the correct answer from the options given below.
(a) (b), (c) and (e) are correct
(b) (c), (d) and (e) are correct
(c) (a), (b) and (c) are correct
(d) (a), (d) and (e) are correct

175. Receptors for sperm binding in mammals are present on
(a) zona pellucida.   (b) corona radiata.
(c) vitelline membrane.   (d) perivitelline space.

176. Sphincter of oddi is present at
(a) junction of jejunum and duodenum.
(b) ileo-caecal junction.
(c) junction of hepato-pancreatic duct and duodenum.
(d) gastro-oesophageal junction.

177. Chronic auto immune disorder affecting neuro muscular junction leading to fatigue, weakening and paralysis of skeletal muscle is called as
(a) gout.   (b) arthritis.
(c) muscular dystrophy.   (d) myasthenia gravis.

178. Persons with 'AB' blood group are called as "Universal recipients". This is due to
(a) absence of antibodies, anti-A and anti-B, in plasma.
(b) absence of antigens A and B on the surface of RBCs.
(c) absence of antigens A and B in plasma.
(d) presence of antibodies, anti-A and anti-B, on RBCs.

179. The centriole undergoes duplication during
(a) G_2 phase   (b) S-phase
(c) Prophase   (d) Metaphase

180. Erythropoietin hormone which stimulates R.B.C. formation is produced by
(a) juxtaglomerular cells of the kidney.
(b) alpha cells of pancreas.
(c) the cells of rostral adenohypophysis.
(d) the cells of bone marrow.

181. Which one of the following belongs to the family Muscidae ?
(a) House fly   (b) Fire fly
(c) Grasshopper   (d) Cockroach

182. Veneral diseases can spread through
(a) Using sterile needles
(b) Transfusion of blood from infected person
(c) Infected mother to foetus
(d) Kissing
(e) Inheritance
Choose the correct answer from the option given below
(a) (a) and (c) only   (b) (a), (b) and (c) only
(c) (b), (c) and (d) only   (d) (b) and (c) only

183. The partial pressures (in mm Hg) of oxygen (O_2) and carbon dioxide (CO_2) at alveoli (the site of diffusion) are
(a) $pO_2 = 159$ and $pCO_2 = 0.3$
(b) $pO_2 = 104$ and $pCO_2 = 40$
(c) $pO_2 = 40$ and $pCO_2 = 45$
(d) $pO_2 = 95$ and $pCO_2 = 40$

184. Which one of the following is an example of hormone releasing IUD ?
(a) Multiload 375   (b) CuT
(c) LNG 20   (d) Cu 7

185. Which stage of meiotic prophase shows terminalisation of chiasmata as its distinctive feature ?
(a) Pachytene   (b) Leptotene
(c) Zygotene   (d) Diakinesis

Section B

186. Which of these is not an important component of initiation of parturition in humans ?
(a) Release of Prolactin
(b) Increase in estrogen and progesterone ratio
(c) Synthesis of prostaglandins
(d) Release of Oxytocin

187. Following are the statements about prostomium of earthworm.
(a) It serves as a covering for mouth.
(b) It helps to open cracks in the soil into which it can crawl.
(c) It is one of the sensory structures.
(d) It is the first body segment.
Choose the correct answer from the options given below.
(a) (b) and (c) are correct
(b) (a), (b) and (c) are correct
(c) (a), (b) and (d) are correct
(d) (a), (b), (c) and (d) are correct

188. The Adenosine deaminase deficiency results into
(a) Addison's disease
(b) Dysfunction of Immune system
(c) Parkinson's disease
(d) Digestive disorder

189. Match List-I with List-II

	List-I		List-II
(a)	Adaptive radiation	(i)	Selection of resistant varieties due to excessive use of herbicides and pesticides
(b)	Convergent evolution	(ii)	Bones of forelimbs in Man and Whale
(c)	Divergent evolution	(iii)	Wings of Butterfly and Bird
(d)	Evolution by anthropogenic action	(iv)	Darwin Finches

Choose the correct answer from the options given below.
	(a)	(b)	(c)	(d)
(a)	(i)	(iv)	(iii)	(ii)
(b)	(iv)	(iii)	(ii)	(i)
(c)	(iii)	(ii)	(i)	(iv)
(d)	(ii)	(i)	(iv)	(iii)

190. Match List-I with List-II

	List-I		List-II
(a)	Allen's Rule	(i)	Kangaroo rat
(b)	Physiological adaptation	(ii)	Desert lizard
(c)	Behavioural adaptation	(iii)	Marine fish at depth
(d)	Biochemical adaptation	(iv)	Polar seal

Choose the correct answer from the options given below.
	(a)	(b)	(c)	(d)
(a)	(iv)	(iii)	(ii)	(i)
(b)	(iv)	(ii)	(iii)	(i)
(c)	(iv)	(i)	(iii)	(ii)
(d)	(iv)	(i)	(ii)	(iii)

191. Which one of the following statements about Histones is wrong ?
(a) Histones carry positive charge in the side chain.
(b) Histones are organized to form a unit of 8 molecules.
(c) The pH of histones is slightly acidic.
(d) Histones are rich in amino acids - Lysine and Arginine.

192. **Assertion (A):** A person goes to high altitude and experiences 'altitude sickness' with symptoms like breathing difficulty and heart palpitations.
Reason (R): Due to low atmospheric pressure at high altitude, the body does not get sufficient oxygen.
In the light of the above statements, choose the correct answer from the options given below
(a) (A) is false but (R) is true
(b) Both (A) and (R) are true and (R) is the correct explanation of (A)
(c) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(d) (A) is true but (R) is false

193. Which of the following is not a step in Multiple Ovulation Embryo Transfer Technology (MOET) ?
(a) Fertilized eggs are transferred to surrogate mothers at 8-32 cell stage.
(b) Cow is administered hormone having LH like activity for super ovulation.
(c) Cow yields about 6-8 eggs at a time.
(d) Cow is fertilized by artificial insemination.

194. Match List-I with List-II

	List-I		List-II
(a)	Filariasis	(i)	*Haemophilus influenzae*
(b)	Amoebiasis	(ii)	*Trichophyton*
(c)	Pneumonia	(iii)	*Wuchereria bancrofti*
(d)	Ringworm	(iv)	*Entamoeba histolytica*

Choose the correct answer from the options given below
	(a)	(b)	(c)	(d)
(a)	(ii)	(iii)	(i)	(iv)
(b)	(iv)	(i)	(iii)	(ii)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(i)	(ii)	(iv)	(iii)

195. Following are the statements with reference to 'lipids'.
(a) Lipids having only single bonds are called unsaturated fatty acids.
(b) Lecithin is a phospholipid.
(c) Trihydroxy propane is glycerol.
(d) Palmitic acid has 20 carbon atoms including carboxyl carbon.

(e) Arachidonic acid has 16 carbon atoms.

Choose the correct answer from the options given below.

(a) (b) and (e) only   **(b)** (a) and (b) only

(c) (c) and (d) only   **(d)** (b) and (c) only

196. Which of the following secretes the hormone, relaxin, during the later phase of pregnancy ?

    (a) Uterus   **(b)** Graafian follicle

    (c) Corpus luteum   **(d)** Foetus

197. Identify the types of cell junctions that help to stop the leakage of the substances across a tissue and facilitation of communication with neighbouring cells via rapid transfer of ions and molecules.

    (a) Adhering junctions and Gap junctions, respectively.

    (b) Gap junctions and Adhering junctions, respectively.

    (c) Tight junctions and Gap junctions, respectively.

    (d) Adhering junctions and Tight junctions, respectively.

198. Match List-I with List-II

	List-I		List-II
(a)	Scapula	(i)	Cartilaginous joints
(b)	Cranium	(ii)	Flat bone
(c)	Sternum	(iii)	Fibrous joints
(d)	Vertebral column	(iv)	Triangular flat bone

Choose the correct answer from the options given below

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

199. During muscular contraction which of the following events occur ?

    (a) 'H' zone disappears

    (b) 'A' band widens

    (c) 'I' band reduces in width

    (d) Myosine hydrolyzes ATP, releasing the ADP and Pi.

    (e) Z-lines attached to actins are pulled inwards.

Choose the correct answer from the options given below

(a) (b), (d), (e), (a) only   **(b)** (a), (c), (d), (e) only

(c) (a), (b), (c), (d) only   **(d)** (b), (c), (d), (e) only

200. **Statement I:** The codon 'AUG' codes for methionine and phenylalanine.

Statement II: 'AAA' and 'AAG' both codons code for the amino acid lysine.

In the light of the above statements, choose the correct answer from the options given below.

    (a) Statement I is incorrect but Statement II is true.

    (b) Both Statement I and Statement II are true.

    (c) Both Statement I and Statement II are false.

    (d) Statement I is correct but Statement II is false.

☐☐☐

Booklet   Batch   RollNumber   Test Center Code

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

A   10+1 (S)
B   10-2 (V)
C   10-3 (A)
D   Crash (C)
E
F   Paper
G
H   Paper 1 (1)
I   Paper 2 (2)
J

Name

Test Date   Invigilator's Signature

Student's Signature

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

Avoid Improper Marking

Partially Filled

Lightly Filled

ANSWER KEY

1	(b)	41	(a)	81	(a)	121	(b)	161	(d)
2	(b)	42	(c)	82	(c)	122	(d)	162	(b)
3	(a)	43	(a)	83	(c)	123	(c)	163	(b)
4	(a)	44	(b)	84	(c)	124	(b)	164	(d)
5	(c)	45	(b)	85	(c)	125	(c)	165	(b)
6	(d)	46	(d)	86	(b)	126	(b)	166	(d)
7	(a)	47	(a)	87	(d)	127	(d)	167	(c)
8	(c)	48	(c)	88	(a)	128	(c)	168	(d)
9	(c)	49	(c)	89	(a)	129	(d)	169	(d)
10	(c)	50	(a)	90	(d)	130	(c)	170	(d)
11	(c)	51	(c)	91	(c)	131	(b)	171	(c)
12	(d)	52	(a)	92	(b)	132	(b)	172	(d)
13	(c)	53	(b)	93	(d)	133	(a)	173	(d)
14	(a)	54	(d)	94	(a)	134	(c)	174	(a)
15	(c)	55	(c)	95	(d)	135	(d)	175	(a)
16	(b)	56	(a)	96	(a)	136	(c)	176	(c)
17	(d)	57	(d)	97	(d)	137	(d)	177	(d)
18	(b)	58	(d)	98	(d)	138	(c)	178	(a)
19	(c)	59	(b)	99	(d)	139	(d)	179	(b)
20	(a)	60	(b)	100	(c)	140	(d)	180	(a)
21	(c)	61	(b)	101	(d)	141	(c)	181	(a)
22	(c)	62	(d)	102	(a)	142	(a)	182	(d)
23	(a)	63	(a)	103	(a)	143	(c)	183	(b)
24	(a)	64	(a)	104	(d)	144	(c)	184	(c)
25	(a)	65	(b)	105	(b)	145	(b)	185	(d)
26	(d)	66	(b)	106	(b)	146	(b)	186	(a)
27	(d)	67	(d)	107	(b)	147	(a)	187	(b)
28	(b)	68	(c)	108	(c)	148	(b)	188	(b)
29	(c)	69	(b)	109	(b)	149	(b)	189	(b)

30	(b)	70	(b)	110	(c)	150	(d)	190	(d)
31	(d)	71	(b)	111	(d)	151	(a)	191	(c)
32	(d)	72	(a)	112	(d)	152	(c)	192	(b)
33	(a)	73	(d)	113	(d)	153	(c)	193	(b)
34	(d)	74	(d)	114	(c)	154	(b)	194	(c)
35	(d)	75	(b)	115	(c)	155	(d)	195	(d)
36	(b)	76	(b)	116	(d)	156	(c)	196	(c)
37	(a)	77	(c)	117	(a)	157	(a)	197	(c)
38	(c)	78	(b)	118	(a)	158	(b)	198	(a)
39	(a)	79	(c)	119	(d)	159	(d)	199	(b)
40	(a)	80	(a)	120	(b)	160	(b)	200	(a)

ANSWERS WITH EXPLANATIONS

PHYSICS

1. Out of Syllabus

2. Option (b) is correct.

Drift velocity $(V_d) = ?$

Suppose, applied electric field at the two end of conductor is E

$$\xrightarrow{\quad} E$$
$$\overline{\rho}$$

Force on electron $= e$E

Acceleration $(a) = \dfrac{F}{m}$

$\Rightarrow \qquad a = \dfrac{e\text{E}}{m}$

Now, $\qquad V = u + a\tau$

Initial velocity, $u = 0$

$\Rightarrow \qquad V_d = a\tau$

$\Rightarrow \qquad V_d = \dfrac{e\text{E}}{m}\tau$

Electrical resistivity $= ?$

$$R = \rho \cdot \dfrac{l}{A}$$

$$V = IR$$

$\Rightarrow \qquad E = \dfrac{V}{l}$

$\Rightarrow \qquad E.l = I \times \rho \dfrac{l}{A}$

$\Rightarrow \qquad E \cdot \dfrac{l}{l} = \left(\dfrac{I}{A}\right)\rho \qquad \left(\because J = \dfrac{I}{A}\right)$

$\Rightarrow \qquad E = J\rho$

$\Rightarrow \qquad \rho = \dfrac{E}{J}$

Relaxation period

$$V_d = \dfrac{e\text{E}\tau}{m}$$

We know, $\qquad I = neAV_d$

$\Rightarrow \qquad I = neA\left(\dfrac{e\text{E}\tau}{m}\right)$

$\Rightarrow \qquad I = \dfrac{ne^2 A\text{E}\tau}{m}$

$\Rightarrow \qquad I = \dfrac{ne^2 A\tau}{m}\left(\dfrac{V}{l}\right) \qquad \left(\because E = \dfrac{V}{l}\right)$

$\Rightarrow \qquad \dfrac{m \cdot l}{ne^2 A\tau} = \dfrac{V}{I}$

$\Rightarrow \qquad \dfrac{ml}{ne^2 A\tau} = R \qquad (\because V = IR)$

$\Rightarrow \qquad \dfrac{ml}{ne^2 A\tau} = \rho \cdot \dfrac{l}{A} \qquad \left(\because R = \dfrac{\rho l}{A}\right)$

$\Rightarrow \qquad \rho = \dfrac{m}{ne^2 \tau}$

Current density $(J) = \dfrac{I}{A}$

$\Rightarrow \qquad J = \dfrac{ne\,A\,V_d}{A}$

$\Rightarrow \qquad J = neV_d$

Hence, the correct option will be option *b*.

$A \to R$
$B \to S$
$C \to P$
$D \to Q$

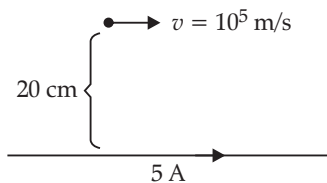**3. Option (a) is correct.**

Given,

Current in conductor $(I) = 5$ A

Speed of electron $(v) = 10^5$ m/s

Perpendicular distance between electron and conductor $= 20$ cm

Force on electron $= ?$

Magnetic field due to current carrying conductor

$$\mathbf{B} = \frac{\mu_0 i}{2\pi a}$$

So, force on charge

$$F = evB$$

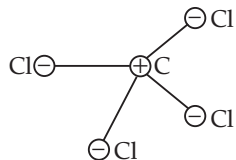$$\Rightarrow \quad F = 1.6 \times 10^{-19} \times 10^5 \times \frac{\mu_0 \times 5}{2\pi \times 0.2}$$

$$\Rightarrow \quad F = 1.6 \times 10^{-19} \times 10^5 \times \left(\frac{2\mu_0}{4\pi}\right) \times \frac{5}{0.2}$$

$$\Rightarrow \quad F = 1.6 \times 10^{-19} \times 10^{-7} \times 10^5 \times 5 \times 10 N$$

$$\Rightarrow \quad F = 8.0 \times 10^{-20} N$$

4. Option (a) is correct.

It is a kind of molecule, in which, the one end of the molecule is slightly positive, while other end of the molecule is slightly negative.

Hence, molecules have a permanent electric dipole moment of their own.

5. Out of Syllabus

6. Option (d) is correct.

When we are connecting zener diode in reverse bias, and after the breakdown, voltage across the zener diode becomes constant.

Hence, zener diode works as a voltage regulator.

Hence, statement A is correct.

We know that the potential barrier across silicon diode is 0.7 V.

Hence, statement B is incorrect.

7. Option (a) is correct.

Given,

Mass number of nucleus $(m) = 240$

The masses of two fragments are

$$m_1 = m_2 = 120$$

Binding energy per nucleon of unfragmented nuclei $= 7.6$ MeV
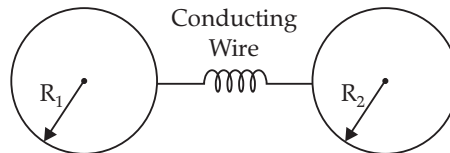
BE of fragmented nuclei $= 8.5$ MeV

Total gain in Binding energy $= ?$

Total gain in Binding energy = BE of products
                              $-$ BE of reactants

$$= (120 + 120) \times 8.5 - 240 \times 7.6$$

$$= 240 \times 8.5 - 240 \times 7.6$$

$$= 216 \text{ MeV}$$

Hence, gain in binding energy $= 216$ MeV

8. Option (c) is correct.

After connecting through the conducting wire, the potential on both the sphere will become same.

$$\frac{Q_1}{4\pi\varepsilon_0 R_1} = \frac{Q_2}{4\pi\varepsilon_0 R_2}$$

$$\frac{Q_1 R_1}{4\pi\varepsilon_0 R_1^2} = \frac{Q_2 R_2}{4\pi\varepsilon_0 R_2^2}$$

$$\Rightarrow \quad \frac{\sigma_1 R_1}{\varepsilon_0} = \sigma_2 \cdot \frac{R_2}{\varepsilon_0}$$

So, $$\frac{\sigma_1}{\sigma_2} = \frac{R_2}{R_1}$$

9. Option (c) is correct.

Given,

Frequency of simple hormonic motion $= n$

The frequency of it's potential energy $= ?$

The equation of displacement of SHM

$$x = A \sin(\omega t + \phi) \qquad \text{...(i)}$$

The potential energy of the particle executing SHM(u)

$$= \frac{1}{2} K x^2$$

$$\Rightarrow \quad u = \frac{1}{2} K \left[\left(A \sin(\omega t + \phi) \right) \right]^2 \qquad \text{...(ii)}$$

From equation (i) and (ii)

$$\omega = 2\pi n$$

$$n = \omega/2\pi \qquad \text{...(iii)}$$

And $$u = \frac{K}{2} A^2 \sin^2(\omega t + \phi)$$

$$\Rightarrow \quad \sin^2\theta = \frac{1 - \cos\theta}{2} = \frac{1}{2} - \frac{1}{2}\cos\theta$$

$$\Rightarrow \quad u = \frac{KA^2}{2 \times 2}(1 - \cos 2(\omega t + \phi))$$

Hence, frequency of potential energy

$$f_1 = \frac{2\omega}{2\pi} \qquad \text{...(iv)}$$

Now, divide equation (iv) from equation (iii)

$$\frac{f_1}{n} = \frac{\dfrac{2\omega}{2\pi}}{\dfrac{\omega}{2\pi}}$$
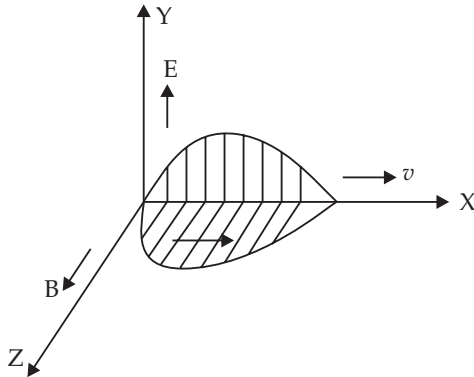
$$= \frac{f_1}{n} = 2$$

$\Rightarrow \qquad f_1 = 2n$

Hence, the required frequency of potential energy $= 2n$

10. Out of Syllabus

11. Option (c) is correct.

Given,

Direction of propagation of
electromagnetic wave $= +X -$ direction

From the given graph of the propagation of electromagnetic wave,

We can analyze that direction of propagation of wave, direction of electric field and direction of magnetic fields are perpendicular to each other.

$$\overline{E} \cdot \overline{B} = 0$$

So, $(-\hat{j} + \hat{k}) \cdot (-\hat{j} - \hat{k}) = 0$

$\Rightarrow \qquad + 1 - 1 = 0$
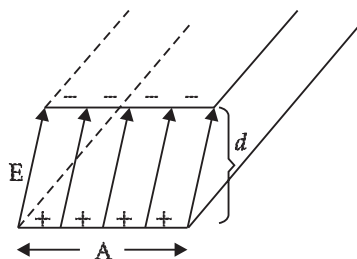
12. Option (d) is correct.

Given,

Electric field between the parallel plate capacitor $= E$

Distance between the plates $= d$

Area of each plate $= A$

Energy stored in the capacitor $= ?$

The developed potential between the plates $(V) = \overline{E} \cdot d$

Capacitance $= \dfrac{\varepsilon_0 A}{d}$

Hence, stored potential energy

$$u = \frac{1}{2} CV^2$$

$\Rightarrow \qquad u = \dfrac{1}{2} \left(\dfrac{\varepsilon_0 A}{d} \right) (\overline{E} \cdot d)^2$

$\Rightarrow \qquad u = \dfrac{1}{2} \dfrac{\varepsilon_0 A}{d} E^2 \cdot d^2$

$\Rightarrow \qquad u = \dfrac{1}{2} \varepsilon_0 A \, dE^2$

13. Option (c) is correct.

Given,

Choosen fundamental quantities are,

Force $= F$

Acceleration $= A$

Time $= T$

Dimensions of energy $= ?$

$$E \propto F^a A^b T^c$$

$\Rightarrow \qquad [E] = [F^a][A^b][T^c]$

Now,

$\Rightarrow \qquad [E] = [ML^2T^{-2}]$

$[A] = [M^0LT^{-2}]$

$[T] = [M^0L^0T^1]$

Substituting the values,

$[ML^2T^{-2}] = [MLT^{-2}]^a[T]^b[T]^c$

$[ML^2T^{-2}] = [M^a \, L^{a + b} \, T^{-2a - 2b + c}]$

Now, comparing the exponents,

$a = 1$ ...(i)

$a + b = 2$ ...(ii)

$-2a - 2b + c = -2$ ...(iii)

From equation (i), (ii) and (iii)

$b = 2 - 1$

$b = 1$

And, $\quad C = -2 + 2a + 2b$

$= -2 + 2 + 2$

$C = +2$

Hence, $\quad [E] = [FAT^2]$

14. Option (a) is correct.

Given,

Height from which particle released $= S$

Let at height h,

Kinetic energy $= 3$ Potential energy

Initially, potential energy $= mgS$.

At height h,

$$mgh + \frac{1}{2} mv^2 = mgS$$

$$gh + \frac{v^2}{2} = gS \qquad \text{...(i)}$$

From the given condition,

$$\frac{1}{2} mv^2 = 3 \, mgh$$

$$\Rightarrow \qquad v^2 = 6gh \qquad \qquad ...(ii)$$

From equation (i) and (ii)

$$gh + \frac{6gh}{2} = gS$$

$$\Rightarrow \qquad h + 3h = S$$
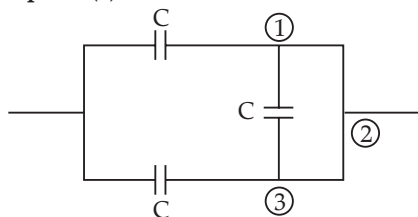
$$\Rightarrow \qquad 4h = S$$

$$\Rightarrow \qquad h = \frac{S}{4}$$

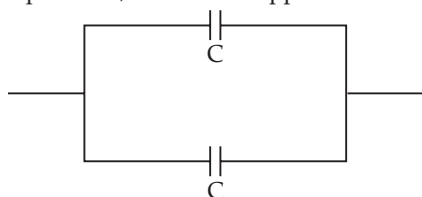Now, substituting the value of h in equation (ii)

$$v^2 = 6g \times \left(\frac{S}{4}\right)$$

$$\Rightarrow \qquad v = \sqrt{6g\frac{S}{4}} = \frac{\sqrt{3gS}}{2}$$

15. Option (c) is correct.

In the above circuit diagram, point (1) and (3) are at same potential, so it will disappear from circuit

$$\mathbf{C_{eq}} = C + C$$
$$= 2\,C$$

Hence, the required equivalent capacitance of the circuit = 2 C

16. Option (b) is correct.

Given,

$$E = \text{Energy}$$
$$G = \text{Gravitational constant}$$
$$\frac{E}{G} = ?$$

Dimensional formula of energy

$$(E) = [ML^2T^{-2}]$$

Dimensional formula of gravitational constant

$$= \frac{[MLT^{-2}L^2]}{[M^2]}$$

$$= [M^{-1}L^3T^{-2}]$$

Hence, $\qquad \dfrac{E}{G} = \dfrac{[ML^2T^{-2}]}{[M^{-1}L^3T^{-2}]}$

$$= [M^2\,L^{-1}\,T^0]$$

17. Option (d) is correct.

In the astronomical telescope, the focal length of the objective lense and aperture is quite large. Due to which the light gathering power of telescope used to increase, and the resolving power or the ability to observe two object distinctly gets increase.

By using larger diameters, the fainter objects can be observed so, the larger focal length of the objective lens contributes in the better quality and visibility of images.

18. Option (b) is correct.

As we know, when any ray of light incident normally on any surface, then it will not face any deviation.
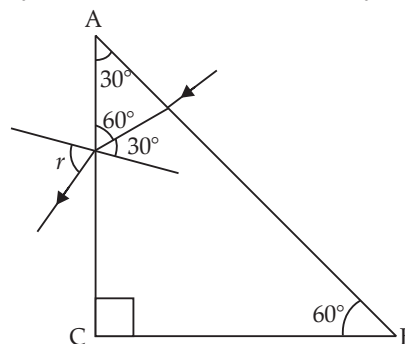
So, angle of incident on the surface AC(i) = 30°

Now, applying Snell's law,

Refractive index $(\mu) = \dfrac{\sin i}{\sin r}$

$$\Rightarrow \qquad \frac{\sin 30°}{\sin r} = \sqrt{3}$$

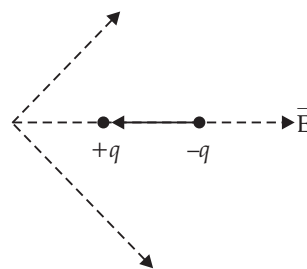$$\Rightarrow \qquad \sin r = \frac{\frac{1}{2}}{\sqrt{3}}$$

$$\Rightarrow \qquad \sin r = \frac{\sqrt{3}}{2} = \sin(60°)$$

$$r = 60°$$

Hence, the required deviation in the ray $\phi = 60°$

19. Option (c) is correct.

Potential energy of electric dipole

$$u = \vec{P} \cdot \vec{E}$$

Angle between electric field and electric dipole = 180°

$$u = -PE \cos 180°$$

$$u = -(-PE)$$

$\quad\quad\quad$ –F $\quad\quad$ +F
$\quad\quad\quad$ ⟵————————⟶

$$\Rightarrow \quad u = + PE$$

So, when we will move towards right, the strength of electric potential will decrease.

Net force and net torque on dipole will be zero.

20. Option (a) is correct.

Given,

Main scale reading = 0 mm

Circular scale reading = 52 divisions

1 mm on main scale = 100 divisions on circular scale

$$\text{Pitch } (p) = 1 \text{ mm}$$

$$n = 100$$

$$\text{Least count (LC)} = \frac{p}{n}$$

$$\text{LC} = \frac{1}{100}$$

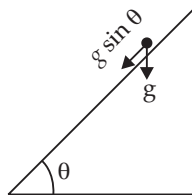$$= 0.01 \text{ mm}$$

Hence, diameter of the wire

$$= \text{MSR} + \text{CSR} \times \text{LC}$$

$$= 0 + (52 \times 0.01)$$

$$= 0.052 \text{ cm}$$

21. Option (c) is correct.

Let the angle of inclination be θ.

Distance covered in the duration n^{th} second is = S_n

Let distance travelled during $(n + 1)^{\text{th}}$ second = S_{n+1}

$$S_n = \frac{g}{2} \sin \theta (n^2) - \frac{g}{2} \sin \theta (n - 1)^2$$

$$\Rightarrow \quad S_n = \frac{g}{2} \sin \theta (n - n + 1)(n + n - 1)$$

$$\Rightarrow \quad S_n = \frac{g}{2} \sin(2n - 1) \quad\quad\quad ...(i)$$

Distance travel during $(n + 1)^{\text{th}}$ second

$$S_{n+1} = \frac{\sin \theta\, g}{2}(n + 1)^2 - \frac{1}{2} g \sin \theta (n)^2$$

$$\Rightarrow \quad S_{n+1} = \frac{1}{2} g \sin \theta (n + 1 - n)(n + 1 + n)$$

$$S_{n+1} = \frac{1}{2} g \sin \theta (1)(2n + 1) \quad\quad ...(ii)$$

From equation (i) and (ii)

$$\Rightarrow \quad \frac{S_n}{S_{n+1}} = \frac{\frac{1}{2} g \sin \theta (2n - 1)}{\frac{1}{2} g \sin \theta (2n + 1)}$$

$$\Rightarrow \quad \frac{S_n}{S_{n+1}} = \frac{(2n - 1)}{(2n + 1)}$$

22. Option (c) is correct.
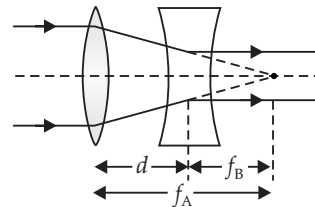
Given,

Focal length of the convex lens A,

$$(f_A) = 20 \text{ cm}$$

Focal length of concave lens (B) is

$$(f_B) = 5 \text{ cm}$$

Distance between the lens = d

The emergent ray is parallel to X-axis.

As we know, when any parallel beam of light incident on convex lens, then it will meet at focal point.

If a beam of light gets parallel to principal axis after the refraction, then it means that object is at focal point of the concave lens.

Hence,

$$d = f_A - f_B$$

$$= 20 \text{ cm} - 5 \text{ cm}$$

$$= 15 \text{ cm}$$

Hence, the required distance between the lens be 15 cm.

23. Option (a) is correct.

Given,

Escape velocity from Earth's surface = $V_e = V$

Escape velocity from another planet = ?

Let the radius of earth = R

Radius of other planet = 4R

Let, Escape velocity of other planet be V_o

Escape velocity on the surface of other planet

$$V_o = \sqrt{\frac{GM_o \times 2}{4R}}$$

Mass densities are same,

$$\sigma m_e = \sigma m_o$$

$$M_e = \sigma m_e \times V$$

$$= \sigma m_e \times \frac{4\pi}{3} R^3$$

$$M_o = \sigma m_o \times \frac{4}{3} \pi (4R)^3$$

$$= \sigma m_o \times \frac{4}{3} \pi R^3 \times 64$$

Now, $\quad \dfrac{V_e}{V_o} = \dfrac{\sqrt{\dfrac{GM_e \times 2}{R}}}{\sqrt{\dfrac{GM_o \times 2}{4R}}}$

$$= \sqrt{\frac{\sigma m_e \times \frac{4}{3}\pi R^3 \times 1}{\sigma m_o \times \frac{4}{3}\pi \frac{R^3 \times 64}{4}}}$$

$$\frac{V_e}{V_o} = \sqrt{\frac{1}{16}}$$

$\Rightarrow \qquad V_o = 4\,V_e$

$\Rightarrow \qquad V_o = 4\,V$

Hence, the required escape velocity on other planet's surface will be 4 V.
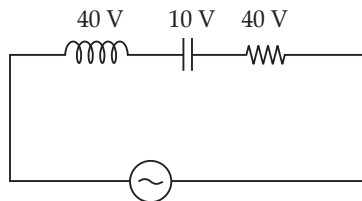
24. Option (a) is correct.

Given,

Inductance of the inductor = L

Capacitance of the capacitor = C

Resistance of the resistor = R

Potential difference = V

$I_0 = 10\sqrt{2}\,\text{A}$

$V_{rms} = \sqrt{V_R^2 + (V_L - V_C)^2}$

Now, substituting the values,

$V_{rms} = \sqrt{40^2 + (40 - 10)^2}$

$\qquad = \sqrt{40^2 + 30^2}$

$\qquad = \sqrt{1600 + 900}$

$\qquad = \sqrt{2500} = 50\,\text{V}$

$I_{rms} = \dfrac{I_0}{\sqrt{2}} = \dfrac{10\sqrt{2}}{\sqrt{2}}$

$\qquad = 10$

$V_{rms} = I_{rms} \times Z$

$\Rightarrow \qquad Z = \dfrac{V_{rms}}{I_{rms}}$

$\Rightarrow \qquad Z = \dfrac{50}{10}$

$\qquad Z = 5\,\Omega$

Hence, the required impedence of the circuit = 5 Ω.

25. Option (a) is correct.

Given,

Streatching in spring (X) = 5 cm

Force (F) = 10 N

Mass (m) = 2 kg

The time period of oscillation of spring

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$\Rightarrow \qquad T = 2\pi\sqrt{\dfrac{2}{k}} \qquad\qquad \ldots(i)$

From force balance equation,

$\qquad KX = F$

$\Rightarrow \qquad K = \dfrac{F}{X}$

$\Rightarrow \qquad K = \dfrac{10}{5 \times 10^{-2}}\,\text{N/m}$

$\Rightarrow \qquad K = 200\,\text{N/m}$

Now put the value of K in equation (i)

$\Rightarrow \qquad T = 2\pi\sqrt{\dfrac{2}{200}}$

$\qquad T = \dfrac{2\pi}{10}$

$\Rightarrow \qquad T = \dfrac{2 \times 3.14}{10}\,\text{s}$

$\Rightarrow \qquad T = \dfrac{6.28}{10}\,\text{s}$

$\Rightarrow \qquad T = 0.628\,\text{s}$

26. Option (d) is correct.

Radius of cable = R
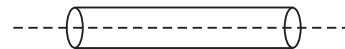
Current = I

B(r) = ?

From ampere's circuital law

$\qquad B = \dfrac{\mu_0 I}{2\pi R^2}\cdot r \qquad\qquad \text{(For } r < \text{R)}$

$\qquad B = \dfrac{\mu_0 I}{2\pi r} \qquad\qquad \text{(For } r \geq \text{R)}$
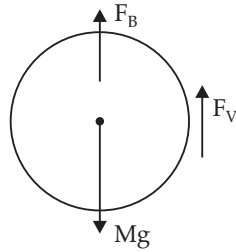
Hence,
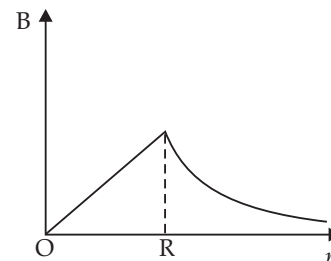
27. Out of Syllabus

28. Option (b) is correct.

Given,

Mass of ball   = M

Density of ball = d

Density of glycerine $= \dfrac{d}{2}$

Viscous force $= ?$

Now, applying force balance equation,

$$Mg = F_B + F_V$$

$$\Rightarrow \quad dVg = \dfrac{d}{2}Vg + F_V$$

$$\Rightarrow \quad F_V = dVg - \dfrac{d}{2}Vg$$

$$\Rightarrow \quad F_V = \dfrac{d}{2}Vg$$

$$dV = M$$

Hence, $\quad F_V = \dfrac{M}{2}g$

29. Option (c) is correct.

Given,

Height $= 60$ m

Rate of water fall $\left(\dfrac{dm}{dt}\right) = 15$ kg/s

Losses due to fractional force $= 10\%$

Power generated by the turbine $= ?$

Power $=$ Rate of change of energy

$$p = \dfrac{mgh}{dt}$$

$$g = 10 \text{ m/s}^2$$

$$\Rightarrow \quad p = 15 \times 10.0 \times 60$$

$$\Rightarrow \quad p = 9000 \text{ J/s}$$

But, here fractional loss $= 10\%$

So, generated power,

$$p_1 = 90 \times \dfrac{9000}{100} = 8100 \text{ W}$$

$$p_1 = 8.1 \text{ kW}$$

30. Option (b) is correct.

Capacitance of capacitor $= C$

AC source of voltage $= V$

$$V = V_0 \sin(\omega t)$$

Displacement current

$$I_d = C \cdot \dfrac{dV}{dt} \qquad \text{...(i)}$$

Now, $\quad \dfrac{dV}{dt} = V_0 \omega \cos(\omega t)$

So, $\quad I_d = V_0 \omega \cos(\omega t)$

31. Option (d) is correct.

Given,

Wavelength of monochromatic light

$$(\lambda) = 600 \text{ nm}$$

Delivered power $(p) = 3.3 \times 10^{-3}$ W

$$h = 6.6 \times 10^{-34} \text{ Js}$$

Power of photon $(P) = \dfrac{E}{t}$

$$\Rightarrow \quad p = \dfrac{n}{t}\dfrac{hc}{\lambda}$$

Now, $\quad \dfrac{n}{t} = \dfrac{p \times \lambda}{hc}$

$$\Rightarrow \quad \dfrac{n}{t} = \dfrac{600 \times 10^{-9} \times 3.3 \times 10^{-3} \text{ W}m}{6.6 \times 10^{-34} \times 3 \times 10^8}$$

$$\Rightarrow \quad \dfrac{n}{t} = \dfrac{1980 \times 10^{-12}}{19.8 \times 10^{-26}}$$

$$\Rightarrow \quad \dfrac{n}{t} = 10^{16}$$

Hence, the total number of photon per second be 10^{16}.

32. Option (d) is correct.

Let the cross-sectional area be A,

Number of hole be n and drift velocity be V_d

$$i = ne \, A \, V_d \qquad \text{...(i)}$$

$$V_d = \mu E$$

For hole, $\quad V_d = \mu_h E$

For electron $\quad V_d = \mu_e E$

Hence, $\quad \dfrac{I_n}{I_p} = \dfrac{neA\propto_e E}{neA\propto_h E}$

$$\Rightarrow \quad \dfrac{I_n}{I_p} = \dfrac{\propto_e}{\propto_h}$$

As we know, electron density $>$ Hole density

$$\mu_e > \mu_h$$

So, $\quad I_n > I_p$

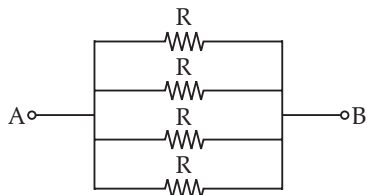Hence, current in n-type $>$ Current in p-type.

33. Option (a) is correct.

Given,

Let the length of wire be l and cross-section of the wire be A

Each wire is made-up of same material.

Resistance of wire $= 0.25\,\Omega$

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$$

$$\Rightarrow \qquad \frac{1}{R_{eq}} = \frac{4}{R}$$
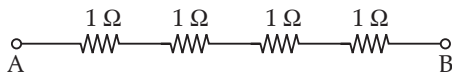
$$\Rightarrow \qquad R_{eq} = \frac{R}{4}$$

Now, substituting the values,

$$\Rightarrow \qquad 0.25 = \frac{R}{4}$$

$$\Rightarrow \qquad R = 0.25 \times 4 = 1\,\Omega$$

Now, if each wire are connected in series.

$$\mathbf{R_{eq}} = 1 + 1 + 1 + 1$$
$$= 4\,\Omega$$

34. Option (d) is correct.

Root mean square speed of gas molecule

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

Pressure exerted by ideal gas $= \dfrac{1}{3}nmV^2$

Average kinetic energy of molecule

$$= \frac{3}{2}k_B T$$

Total internal energy of gas $(u) = \dfrac{n}{2}f\,RT$

Hence,

$$n = 1$$
$$f = 5$$
$$u = \frac{5}{2}RT$$

$$(A) \rightarrow (Q)$$
$$(B) \rightarrow (P)$$
$$(C) \rightarrow (S)$$
$$(D) \rightarrow (R)$$

35. Option (d) is correct.

Given,

Wavelength of electromagnetic wave $= \lambda$

Mass of photoelectron $= m$

de-broglie wavelength $= \lambda_d$

Now, applying photoelectric equation,

$$KE = \frac{-hc}{\lambda} + \phi_0 \qquad\qquad ...(i)$$

Kinetic energy be maximum,

If $\qquad\qquad \phi_0 = 0$

So, $\qquad\qquad KE = \dfrac{hc}{\lambda} = \dfrac{p^2}{2m}$

$$\Rightarrow \qquad\qquad p^2 = \frac{2hcm}{\lambda}$$

$$\Rightarrow \qquad\qquad p = \sqrt{\frac{2hcm}{\lambda}}$$

Now for de-broglie wavelength,

$$\lambda_d = \frac{h}{p} = \frac{h}{\sqrt{\dfrac{2hcm}{\lambda}}}$$

$$\lambda_d = \sqrt{\frac{h\lambda}{2mc}}$$

$$\lambda_d^2 = \frac{h\lambda}{2mc}$$

$$\lambda = \lambda_d^2\left(\frac{2mc}{h}\right)$$

36. Option (b) is correct.

Given,

Mass of circular ring $= M$

Radius of Ring $= R$

Arc angle $= 90°$

$$I = kMR^2$$
$$K = ?$$
$$P = \frac{M}{2\neq R}$$
$$dM = p.dl \qquad\qquad ...(i)$$
$$d\theta = \frac{arc}{Radius}$$
$$dl = R.d\theta$$

So, $\quad dM = \dfrac{M}{2\pi R}R.d\theta \qquad\qquad ...(ii)$

$$dI = dM \cdot R^2$$

$$\Rightarrow \qquad dI = \frac{M}{2\pi R}\cdot R\cdot d\theta \cdot R^2$$

$$\Rightarrow \qquad dI = \frac{M}{2\pi}R^2 d\theta$$

Now, taking the integration of both side
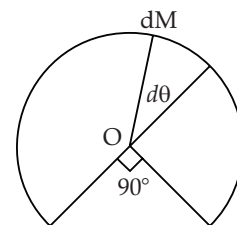
$$\int_0^1 dI = \int_0^{\frac{3\pi}{2}} \frac{M}{2\pi} R^2 \cdot d\theta$$

$$= \frac{M}{2\pi} R^2 d\theta \Big|_0^{\frac{3\pi}{2}}$$

$$= \frac{M}{2\pi} R^2 \frac{3 \times \pi}{2}$$

$$= \frac{3}{4} MR^2$$

Hence, the value of $K = \dfrac{3}{4}$
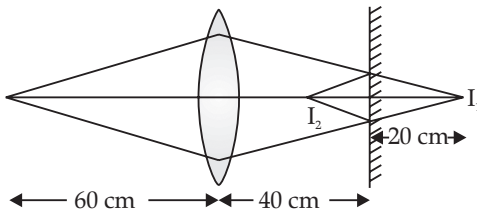
37. Option (a) is correct.

Given,

Distance, between object and convex lens

$$u = 60 \text{ cm}$$

Focal length of convex (f) = 30 cm

Distance between plane mirror and convex lens (d) = 40 cm

Applying lens law

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \qquad \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{30} + \frac{1}{(-60)}$$

$$\Rightarrow \qquad \frac{1}{v_1} = \frac{1}{60}$$

$$\Rightarrow \qquad v = 60 \text{ cm}$$

I_1, will work as a object for plane mirror which will produce image at 20 cm in front of it.

Now, again this image will work as a object.

So, $\qquad u_1 = 20$ cm
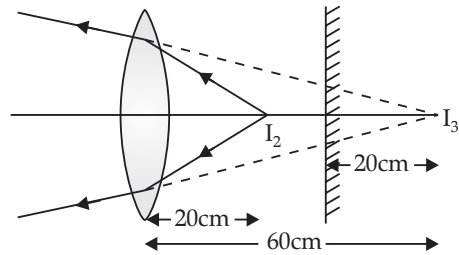
$$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f}$$

$$\Rightarrow \qquad \frac{1}{v_1} = \frac{1}{f} + \frac{1}{u_1}$$

$$\Rightarrow \qquad \frac{1}{v_1} = \frac{1}{30} + \frac{1}{(-20)} = \frac{2-3}{60}$$

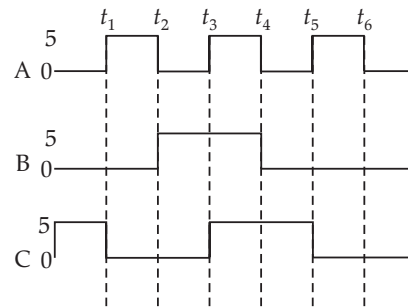$$\Rightarrow \qquad \frac{1}{v_1} = -\frac{1}{60}$$

$$v_1 = -60 \text{ cm}$$

Now, again I_2 will work as object
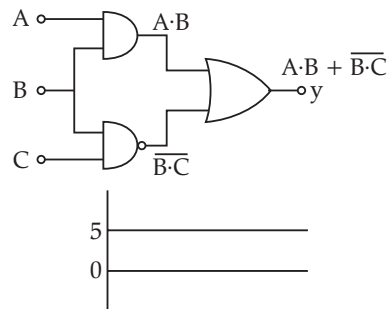

Hence, final virtual image will be formed at 60 cm from lens or we can say 20 cm behind mirror.

38. Option (c) is correct.

Now, from the above diagram creating the truth table

	A	B	C	A.B	$\overline{B \cdot C}$	$y = A \cdot B + \overline{B \cdot C}$
$0 \to t_1$	0	0	1	0	1	1
$t_1 \to t_2$	1	0	1	0	1	1
$t_2 \to t_3$	0	1	0	0	1	1
$t_3 \to t_4$	1	1	0	1	1	1
$t_4 \to t_5$	0	0	1	0	1	1
$t_5 \to t_6$	1	0	1	0	1	1
$t_6 \to t_7$	0	0	1	0	1	1

39. Option (a) is correct.

Given,

Initial speed of car (u) = 0

Acceleration of car (a) = 5 m/s^2

$t_i = 4$ s

$t_2 = 6$ s

Velocity gained by car at 4 s

$$V_x = u + at$$

$\Rightarrow \qquad V_x = 0 + 5 \times 4$

$\Rightarrow \qquad V_x = 20$ m/s

So, ball also will acquire 20 m/s in horizontal direction.

Velocity gained by car at 6th s

$$V_y = u + gt$$

$\Rightarrow \qquad V_y = 0 + 10 \times (6 - 4)$

$\Rightarrow \qquad V_y = 10 \times 2 = 20$ m/s

Hence, net velocity acquired by car

or $\qquad V = \sqrt{V_x^2 + V_y^2}$

$\Rightarrow \qquad V = \sqrt{20^2 + 20^2}$

$\Rightarrow \qquad V = \sqrt{20^2 \times 2}$

$\Rightarrow \qquad V = 20\sqrt{2}$ m/s

Acceleration on the ball $= g = 10$ m/s^2
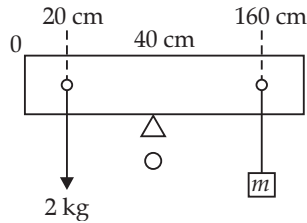
40. Option (a) is correct.

Given,

Length of rod = 200 cm

Mass = 500 g

$\qquad = 1/2$ kg

Balance marks = 40 cm

Now, taking the torque, about point 'O'.

$\Rightarrow 2 \times 20 \times 10^{-2} = m \times (160 - 40) \times 10^{-2}$

$\qquad\qquad + 0.500 \times 60 \times 10^{-2}$

$\Rightarrow \quad 40 \times 10^{-2} = 1.2\, m + 0.3$

$\Rightarrow \qquad 0.4 = 1.2\, m + 0.3$

$\Rightarrow \qquad 1.2\, m = 0.4 - 0.3$

$\Rightarrow \qquad 1.2\, m = 0.1$

$\Rightarrow \qquad m = \dfrac{1}{12}$ kg

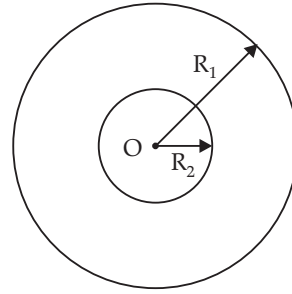**41. Option (a) is correct.**

Given,

Radii of the circular loops are R_1 and R_2

$\qquad\qquad R_1 >> R_2$

Mutual inductance = M

Let current in coil = i

Magnetic field at centre of the loop

$$B = \frac{\mu_0 i}{2\pi R_1}$$

So, magnetic flux through the inner coil

$$\phi = B \cdot A$$

$\Rightarrow \qquad \phi = \dfrac{\mu_0 i}{2\pi R_1} \times \pi R_2^2$ ...(i)

But, magnetic flux $= M_i$ ...(ii)

So, from equation (i) and (ii)

$$\frac{\mu_0 i}{2\pi R_1} \times \pi R_2^2 = M_i$$

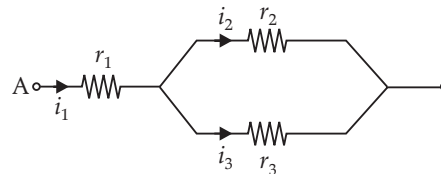$\Rightarrow \qquad M = \dfrac{\infty_0 R_2^2}{2 R_1}$

or $\qquad M \propto \dfrac{R_2^2}{R_1}$

42. Option (c) is correct.

Given,

Resistance of the resistor are r_1, r_2, and r_3.

$$i_1 = i_2 + i_3$$

$V_2 = V_3 \qquad\qquad (\because \text{ Parallel connection})$

$\Rightarrow \qquad i_2 r_2 = i_3 r_3$

$\Rightarrow \qquad i_2 = i_3 \times \dfrac{r_3}{r_2}$ ...(ii)

Now, from equation (i) and (ii)

$$i_1 = i_3 \times \frac{r_3}{r_2} + i_3$$

$\Rightarrow \qquad i_1 = \dfrac{i_3 r_3 + i_3 r_2}{r_2}$

$\Rightarrow \qquad i_1 = i_3 \dfrac{(r_3 + r_2)}{r_2}$

$\Rightarrow \qquad \dfrac{i_3}{i_1} = \dfrac{r_2}{r_2 + r_3}$

43. Option (a) is correct.

Given,

Mass of particle $= m$

Velocity of projection $(v) = kV_e$

$(k < 1)$

Now, applying the conservation of energy,

$$\frac{1}{2}mv^2 - \frac{GmM}{R} = -\frac{GmM}{(R+h)}$$

$$\Rightarrow \quad \frac{v^2}{2} = \frac{GM}{R} - \frac{GM}{(R+h)}$$

$$\Rightarrow \quad \frac{v^2}{2} = GM\left(\frac{1}{R} - \frac{1}{R+h}\right)$$

$$\Rightarrow \quad \frac{v^2}{2} = GM\left(\frac{R+h-R}{R(R+h)}\right)$$

$$\Rightarrow \quad \frac{v^2}{2} = GM\left(\frac{h}{R(R+h)}\right)$$

$$\Rightarrow \quad \frac{(kV_e)^2}{2} = GM\left(\frac{h}{R(R+h)}\right) \quad ...(i)$$

Since, escape velocity

$$V_e = \sqrt{\frac{2GM}{R}}$$

Now, substituting the value of V_e in equation (1)

$$\frac{k^2}{2}\left(\frac{2GM}{R}\right) = \frac{2GMh}{R(R+h)}$$

$$\Rightarrow \quad k^2 = \frac{h}{R+h}$$

$$\Rightarrow \quad \frac{R+h}{h} = \frac{1}{k^2}$$

$$\Rightarrow \quad \frac{R}{h} + 1 = \frac{1}{k^2}$$

$$\Rightarrow \quad \frac{R}{h} = \frac{1}{k^2} - 1 = \frac{1-k^2}{k^2}$$

$$\Rightarrow \quad h = R\left(\frac{k^2}{1-k^2}\right)$$

44. Option (b) is correct.

Given,

Length of conducting wire $= 12\,a$

Resistance of the wire $= R$

Let current in each shape $= I$

(i) Side of equilateral triangle $= a$

(ii) Side of square coil $= a$

Magnetic dipole for triangular coil

$$M = NIA \quad ...(i)$$

Number of turns in triangular coil

$$N = \frac{12a}{3a} = 4$$

$$I = \frac{V}{R}$$

$$A = \frac{\sqrt{3}}{4}a^2$$

So, $$M_1 = 4 \times \frac{\sqrt{3}}{4}a^2 \times \frac{V}{R}$$

$$M_1 = \sqrt{3}a^2 I$$

Magnetic dipole for square coil

$$M_2 = N_2 I\, A_2$$

$$= \left(\frac{12a}{4a}\right) \times \frac{V}{R} \times a^2$$

$$M_2 = 3Ia^2$$

Hence, the required magnetic dipole moments are

$$M_1 = \sqrt{3}Ia^2$$

and $$M_2 = 3Ia^2$$

45. Option (b) is correct.

Given,

The potential of AC mains supply

$$V = 220\ V$$

Operational rating,

$$V_0 = 11\ V$$

$$P_0 = 44\ W$$

As there is no power loss, so

Input power = Output power

$$\Rightarrow \quad V_p I_p = V_s I_s = P_o$$

$$\Rightarrow \quad 220 \times I_p = 44$$

$$\Rightarrow \quad I_p = \frac{44}{220}\ A$$

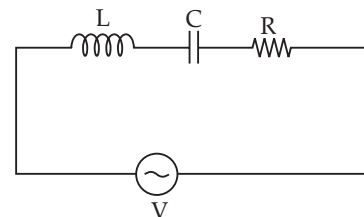$$\Rightarrow \quad I_P = \frac{2}{10} = 0.2\ A$$

46. Option (d) is correct.

Given,

Inductance of inductor $(L) = 5.0\ H$

Capacitance of capacitor $(C) = 80\ \mu F$

Resistance of resistor $(R) = 40\ \Omega$

Terminal voltage $(V) = 230\ V$

Resonance frequency

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$\Rightarrow \qquad \omega_0 = \frac{1}{\sqrt{5.0 \times 80 \times 10^{-6}}}$$

$$\Rightarrow \qquad \omega_0 = \frac{1}{20 \times 10^{-3}} \text{ rad/s}$$

$$\Rightarrow \qquad \omega_0 = 50 \text{ rad/s}$$

As per question,

Half power frequencies are given as

$$\omega = \omega_0 \pm \frac{R}{2L}$$

$$\omega_L = 50 - \frac{40}{2 \times 5}$$

$$\Rightarrow \qquad \omega_L = (50 - 4) \text{ rad/s}$$

$$\Rightarrow \qquad \omega_L = 46 \text{ rad/s}$$

$$\omega_H = 50 + \frac{40}{2 \times 5}$$

$$= 50 + 40$$

$$= 54 \text{ rad/s}$$

47. Option (a) is correct.

Given,

Total number of drops = 27

Potential of drops = 200 V

When all the drops will combine, then the new potential of the drop = ?

Total volume always be conserve.

$$\frac{4}{3} \neq R^3 = 27 \times \frac{4}{3} \pi r^3$$

$$R = 3r$$

For smaller drop

$$V = \frac{1}{4\pi\varepsilon_0} \frac{q}{r}$$

$$\Rightarrow \qquad 200 = \frac{1}{4\pi\varepsilon_0} \frac{q}{r} \qquad \qquad ...(i)$$

Let charge on one drop = q

For larger drop,

$$V_1 = \frac{1}{4\pi\varepsilon_0} \frac{Q}{R} \qquad \qquad ...(ii)$$

and $\qquad Q = 27q$

$$\Rightarrow \qquad V_1 = \frac{1}{4\pi\varepsilon_0} \frac{27q}{3r}$$

$$\Rightarrow \qquad V_1 = \frac{27}{3} \left(\frac{1}{4\pi\varepsilon_0} \frac{q}{r} \right)$$

$$\Rightarrow \qquad V_1 = 9 \times 200 \text{ V}$$

$$\Rightarrow \qquad V_1 = 1800 \text{ V}$$

Note: Data given in the question is incorrect. Due to which answer is not matching with option.

If we will take V = 220 V

So, $\qquad V_1 = 9 \times 220$ V

$$= 1980 \text{ V}$$

48. Option (c) is correct.

Given,

Mass of ball (m) = 0.15 kg

Height from which ball dropped = 10 m

Gravitational acceleration (g) = 10 m/s²

Magnitude of impulse imparted to the ball = ?

Velocity, at which ball is going to hit the ground (v) = ?

$$v^2 = u^2 + 2gh$$

$$\Rightarrow \qquad v = \sqrt{0 + 2 \times 10 \times 10}$$

$$v = 10\sqrt{2} \text{ m/s}$$

As it is given that, ball rebounds with same speed.

So, Magnitude of imparted impulse

$$= P_f - P_i$$

$$= m \vec{v}(\hat{j}) - mv(-\hat{j})$$

$$|L| = 2 \times 0.15 \times 10\sqrt{2} \text{ kg m/s}$$

$$\Rightarrow \qquad |L| = 0.3 \times 10\sqrt{3} \text{ kg m/s}$$

$$\Rightarrow \qquad |L| = 30\sqrt{3} \text{ kg m/s}$$

$$\Rightarrow \qquad |L| = 4.2$$

$$\Rightarrow \qquad |L| = 4.2 \text{ kg m/s}$$

49. Option (c) is correct.

Given,

$$\vec{F} = q(\vec{V} \times \vec{B})$$

$$\Rightarrow \qquad \vec{F} = q\vec{V} \times (B\hat{i} + B\hat{j} + B\hat{k})$$

$$\vec{F} = 2\hat{i} + 4\hat{i} + 6\hat{k}$$

$$q = 1$$

$$\vec{F} = 4\hat{i} - 20\hat{j} + 12\hat{k}$$

Now $\qquad \vec{V} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 4 & 6 \\ B & B & B_0 \end{vmatrix}$

$$= \hat{i}(4B_0 - 6B) - \hat{j}(2B_0 - 6B)$$

Now, $\qquad + \hat{k}(2B - 4B)$

$$4\hat{i} - 20\hat{j} + 12\hat{k} = \begin{bmatrix} (4B_0 - 6B)\hat{i} - \hat{j}(2B_0 - 6B) \\ + (-2B)\hat{k} \end{bmatrix}$$

Comparing both side,

$$4 = 4B_0 - 6B \qquad \qquad ...(i)$$

$$-20 = (2B_0 - 6B) \qquad ...(ii)$$
$$12 = -2B \qquad ...(iii)$$

Solving equation (i), (ii) and (iii)

$$B = -6$$
$$-20 = -B_0 - 36$$
$$\Rightarrow \qquad B_0 = \frac{-36 + 20}{2} = -8$$

Hence, $\qquad \vec{B} = -6\hat{i} - 6\hat{j} - 8\hat{k}$

50. Option (a) is correct.

Given,

Radius of circle $= R$

Time period of revolution $= T$

Now, again particle were projected with same speed $= v$

Angle of projection $= \theta$

Maximum height $= 4R$

$$\theta = ?$$

For circular motion,

$$V = \frac{2\pi R}{T}$$

Now, for projectile motion,

$$H_{max} = \frac{v^2 \sin^2 \theta}{2g}$$

$$\Rightarrow \qquad 4R = \left(2\frac{\pi R}{T}\right)^2 \frac{\sin^2 \theta}{2g}$$

$$\Rightarrow \qquad 4R = \frac{4\pi^2 R^2}{T^2} \frac{\sin^2 \theta}{2g}$$

$$\Rightarrow \qquad \sin^2 \theta = \frac{2gT^2}{\pi^2 R}$$

$$\sin \theta = \sqrt{\frac{2gT^2}{\pi^2 R}}$$

$$\Rightarrow \qquad \theta = \sin^{-1}\left(\sqrt{\frac{2gT^2}{\pi^2 R}}\right)^{1/2}$$

CHEMISTRY

51. Option (c) is correct.

From Kohlrausch's law, Λ_m^o of weak acid can be calculated.

$$\Lambda_{m(CH_3COOH)}^o = \Lambda_{m(CH_3COONa)}^o$$
$$+ \Lambda_{m(HCl)}^o - \Lambda_{m(NaCl)}^o$$

$$= 91.0 \text{ S cm}^2 \text{ mol}^{-1} + 426.16$$
$$\text{S cm}^2 \text{ mol}^{-1} - 126.45$$
$$\text{S cm}^2 \text{ mol}^{-1}$$
$$= 390.71 \text{ S cm}^2 \text{ mol}^{-1}$$

52. Option (a) is correct.

C_2H_5MgBr is a Grignard reagent in which $\overset{\ominus}{C_2H_5}$ acts as a nucleophile and gives nucleophilic addition reaction with ketone to form tertiary alcohol as a major product.

2-Methyl butan-2-ol
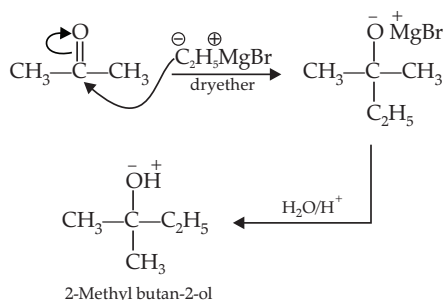
53. Option (b) is correct.

First, we find molarity of the solution from the formula:

$$M = \frac{\text{weight of solute}}{\text{molar mass}} \times \frac{1}{V_{(L)}}$$

For glucose $\Rightarrow M = \frac{10g}{180g/mol} \times \frac{1}{0.250L}$

$$= 0.22 \text{ M}$$

For urea $\Rightarrow \quad M = \frac{10g}{60g/mol} \times \frac{1}{0.250 \text{ L}}$

$$= 0.66 \text{ M}$$

For sucrose $\Rightarrow M = \frac{10g}{342 \text{ g/mol}} \times \frac{1}{0.250 \text{ L}}$

$$= 0.12 \text{ M}$$

From the formula $\pi = CRT$ here C is molar concentration of the solution.

At a given temperature $\pi \propto C$, higher the concentration, higher will be osmotic pressure.

So, from molarity of the given solution, osmotic pressure of the solution will be $P_2 > P_1 > P_3$

54. Out of Syllabus

55. Out of Syllabus

56. Out of Syllabus

57. Option (d) is correct.

Element	Mass percentage (w/w)	Number of mole	Mole Ratio
C	78%	78/12 =6.5	6.5/6.5 = 1
H	22%	22/1 = 22	22/6.5 = 3.38 ≈ 3

On the basis of above calculation, the empirical formula is CH_3.

58. Option (d) is correct.

Due to Lanthanoid contraction, the atomic radii of Zr (z = 40) and Hf (z = 72) are nearly same. Because of poor screening effect by $4f$ electrons, which lead to the lanthanoid contraction. This is the reason of Zr and Hf have almost equal atomic size.

59. Option (b) is correct.
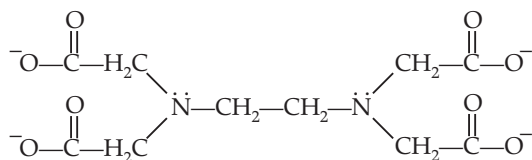
EDTA ion is a hexadentate ligand having four O-donor atoms and two N-donor atoms.

Nitrogen atom contains lone pair of electrons while oxygen carries negative charge which can be donated to metal or metal ion.
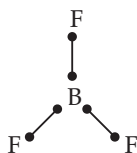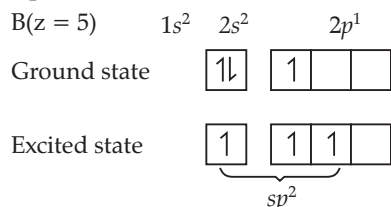
60. Option (b) is correct.
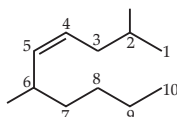
2,6 – Dimethyl – dec – 4 – ene

From IUPAC name it is clear that, main chain contains 10 carbon atoms and a double bond at position 4. Similarly it contains 2 methyl substituent at carbon 2 and 6.

61. Option (b) is correct.

| Vitamin	Deficiency diseases
B_2 (Riboflavin)	Burning sensation of the skin, Digestive disorder and cheilosis.
B_{12}	Pernicious anaemia (RBC deficient in haemoglobin)
B_6 (Pyridoxine)	Convulsions
B_1 (Thiamine)	Beri beri (loss of appetite, retarded growth)

62. Option (d) is correct.

B(z = 5) $1s^2$ $2s^2$ $2p^1$

Here, Boron atom is sp^2 hybridized and it contain 6 electrons around the central atom after the formation of bond with boron atom.

63. Option (a) is correct.

Conformers are obtained by the free rotation of carbon-carbon single bond. Ethane has two conformer (1) Eclipsed (2) Staggered.

In eclipsed structure, dihedral angle is 0° and it is least stable while in staggered structure, dihedral angle is 60° and it is stable.

Eclipsed (θ = 0°)   Staggered (θ = 60°)
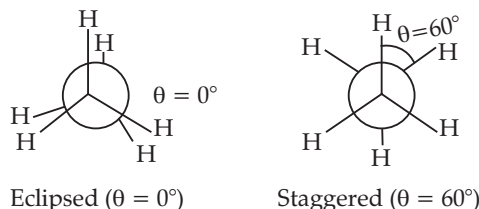
64. Option (a) is correct.

All given options belong to the chloride of alkaline earth metals, all chloride of alkaline earth metals are ionic in nature except Be because due to high polarizability of small size Be^{2+} ion, it forms covalent halide which is soluble in organic solvent.

65. Out of Syllabus

66. Option (b) is correct.

$BeCl_2$ is an electron-deficient compound which through coordinate bond tries to complete its octet. $BeCl_2$ is solid state and in vapour phase forms chain and dimer respectively to complete its octet.
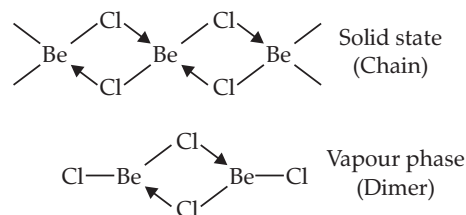
$BeCl_2$ exist as $(BeCl_2)_n$ polymeric chain in solid form, while $BeCl_2$ exist as dimer $(BeCl_2)_2$ in vapour phase.

67. Out of Syllabus

68. Option (c) is correct.

Here $q_V = C_V \Delta T = \Delta U$

$q_P = C_P \Delta T = \Delta H$

ΔH = Enthalpy change

ΔU = Internal energy change

We know $\Delta H = \Delta U + \Delta(PV)$

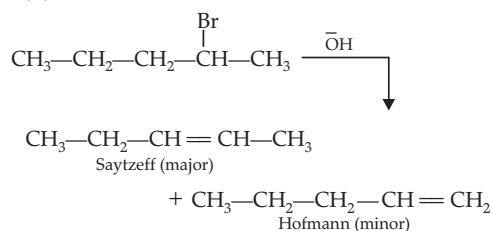$= \Delta U + \Delta(RT)$

$\Delta H = \Delta U + R \Delta T$

Or $C_P \Delta T = C_V \Delta T + R \Delta T$

$C_P = C_V + R$

$C_P - C_V = R$

69. Out of Syllabus

70. Option (b) is correct.

$$CH_3-CH_2-CH_2-\overset{\overset{\displaystyle Br}{|}}{CH}-CH_3 \xrightarrow{\bar{O}H}$$

$$CH_3-CH_2-CH=CH-CH_3$$
<center>Saytzeff (major)</center>

$$+\ CH_3-CH_2-CH_2-CH=CH_2$$
<center>Hofmann (minor)</center>

Saytzeff product is that product which contains highly substituted alkene while in Hofmann product less substituted alkene is formed during dehydrohalogenation of 2-bromopentane.

71. Option (b) is correct.

$$\text{Energy} = \frac{hc}{\lambda} = hv$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$v = 1368 \text{ kHz} = 1368 \times 10^3 \text{ s}^{-1}$$

$$\lambda = \frac{c}{v} = \frac{3 \times 10^8 \text{ m/s}}{1368 \times 10^3 \text{ s}^{-1}} = 219.3 \text{ m}$$

72. Out of Syllabus

73. Option (d) is correct.

Hinsberg reagent is Benzene Sulphonyl chloride $C_6H_5SO_2Cl$ which is used to distinguish between primary, secondary and tertiary amine.

Primary amines react with Hinsberg reagent to form N-ethyl benzene Sulphonamide which is soluble in alkali, while 2° and 3° amines do not get dissolve in alkali.

<center>N-Ethyl benzene sulphonamide
(soluble in alkali)</center>
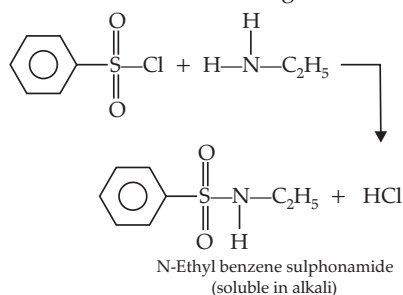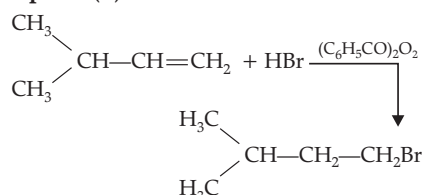
74. Option (d) is correct.

Dimethyl ammonium acetate

$((CH_3)_2 NH\ COOCH_3)$ is a salt of weak acid and weak base whose pH can be calculated as

$$pH = \frac{1}{2}(pk_w + pk_a - pk_b)$$

$$= \frac{1}{2}(14 + 4.77 - 3.27)$$
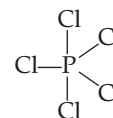
$$pH = 7.75$$

75. Option (b) is correct.

Here Anti-Markonikov's rule or peroxide effect takes place where Br^- attach to that carbon of alkene which contains higher number of C-atoms.

76. Option (b) is correct.

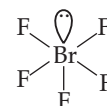(a) PCl_5 – (iv) Trigonal bipyramidal

sp^3d hybridised

(b) SF_6 – (iii) Octahedral
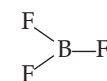
sp^3d^2 hybridised

(c) BrF_5 – (i) Square pyramidal

sp^3d^2 hybridised

(d) BF_3 – (ii) Trigonal planar

sp^2 hybridised

77. Option (c) is correct.

Most of the trivalent Lanthanoid ions are coloured in both their solid state as well as in aqueous solution. Option (c) is incorrect statement rest option are correct.

78. Option (b) is correct.

In a periodic table, among haloacids of halogen acidic nature increases when we move from top to bottom because the bond strength of H – X decrease due to increase in bond length of HX. Both statement (I) and (II) are correct.

Acidic strength of HX

HI > HBr > HCl > HF

79. Option (c) is correct.

Noble gases have weak dispersion force or London dispersion force due to which the boiling point and melting point of noble gas are low. So statement (c) is incorrect about noble gas.

80. Option (a) is correct.

Metamerism is a type of position isomerism which is shown by divalent species, like ether, thioether, ketone, 2° amine etc.

(a) $C_4H_{10}O$ will have different alkyl group attached with polyvalent functional group that's why show metamerism.

$$CH_3-CH_2-O-CH_2-CH_3 \quad CH_3-O-\overset{\overset{\displaystyle CH_3}{|}}{CH}-CH_3$$

$$CH_3CH_2CH_2OCH_3$$
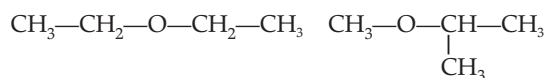
(b) No, polyvalent functional group in C_5H_{12}, so can not show metamerism.

(c) $C_3H_8O \Rightarrow CH_3-O-CH_2-CH_3$

Only one arrangement possible so cannot show metamerism.

(d) $C_3H_6O \Rightarrow CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$

Only one arrangement possible, so cannot show metamerism.

81. Out of Syllabus

82. Option (c) is correct.

In a periodic table, on moving down the group, size of halogen atom increases from F to I. Hence bond lengths from C – F to C – I increases.

∴ Bond dissociation enthalpy decreases from CH_3 – F to CH_3 – I decreases.
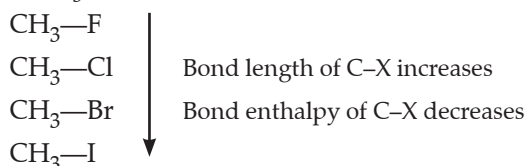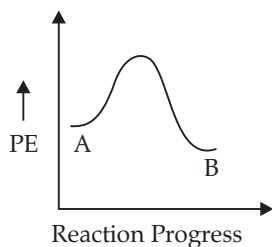
CH_3—F
CH_3—Cl   Bond length of C–X increases
CH_3—Br   Bond enthalpy of C–X decreases
CH_3—I

83. Out of Syllabus

84. Option (c) is correct.

From $\Delta H_{rxn} = (E_a)_f - (E_a)_b$

87. Option (d) is correct.

(a)	$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	(iv)	Tropospheric pollution
(b)	$HOCl(g) \xrightarrow{h\nu} \dot{C}l + \dot{O}H$	(iii)	Ozone depletion
(c)	$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$	(i)	Acid rain
(d)	$NO_2(g) \xrightarrow{h\nu} NO(g) + O(g)$	(ii)	Smog

88. Option (a) is correct.

(a)		(ii)	Gattermann Koch reaction
(b)		(iii)	Haloform reaction
(c)		(iv)	Esterification
(d)		(i)	Hell Volnard Zelinsky reaction

89. Option (a) is correct.

The species which contain same number of electrons are called Isoelectronic species.

Species	Number of e^-
Fe^{2+}	$26 - 2 = 24$
Mn^{2+}	$25 - 2 = 23$

$-4.2 = 9.6 - (E_a)_b$

$(Ea)_b = 9.6 + 4.2 = 13.8$ kJ/mol.

Here $(Ea)_b$ is highly positive and the reaction is exothermic in nature. So possible graph is (c).

85. Option (c) is correct.

$Cr_2O_3 + Al \rightarrow Al_2O_3 + 2Cr$ represent metal displacement reaction, Both reaction (a) and (b) are decomposition reaction while reaction (d) does not represent metal displacement reaction.

86. Option (b) is correct.

From Arrhenius equation $K = Ae^{-E_a/RT}$

on taking $\log_{10}$ both side

$$\log K = \log A - \frac{E_a}{R} \times \frac{1}{2.303\,T}$$

Slope of $\log K$ v/s $\dfrac{1}{T} \Rightarrow m = \dfrac{-E_a}{R}$

$$-5 \times 10^3 = \frac{-E_a}{R}$$

$E_a = 5 \times 10^3 \times 8.314$ J/mol
     $= 41.57 \times 10^3$ J/mol
$E_a = 41.5$ kJ/mol

O^{2-} $8 + 2 = 10$
F^- $9 + 1 = 10$
Na^+ $11 - 1 = 10$
Mg^{2+} $12 - 2 = 10$
Fe^{3+} $26 - 3 = 23$
Fe^{2+} and Mn^{2+} are not isoelectronic pair.

90. Option (d) is correct.

Given, $\Lambda_m = 20$ S cm^2 mol^{-1}

$\Lambda^o_{m\,CH_3OOH} = \Lambda^°_{CH_3COO^-} + \Lambda^°_{H^+}$

$= 50 + 350$

$= 400$ S cm^2 mol^{-1}

From $\alpha = \dfrac{\Lambda_m}{\Lambda^\infty_m} = \dfrac{20}{400} = \dfrac{1}{20}$

As $K_a = \dfrac{C\alpha^2}{1-\alpha}$

(Since α is very small $\therefore$ $1 - \alpha \approx 1$)

$K_a = C\alpha^2 = 7 \times 10^{-3} \times (^1/_{20})^2$

$= 1.75 \times 10^{-5}$ mol/L.

91. Option (c) is correct.

In a modern periodic table, down the group the acidic strength of hydracid increases because the bond length of H –X (X = O, S, Se, Te) increases due to which bond energy decreases as a result K$_a$ value will increase and Pk$_a$ will decrease. So correct order of Pk$_a$ value will be

H$_2$O > H$_2$S > H$_2$Se > H$_2$Te
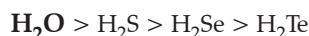
92. Option (b) is correct.

The given reaction is Etard's reaction which is used to prepare aromatic aldehyde.

(intermediate X)
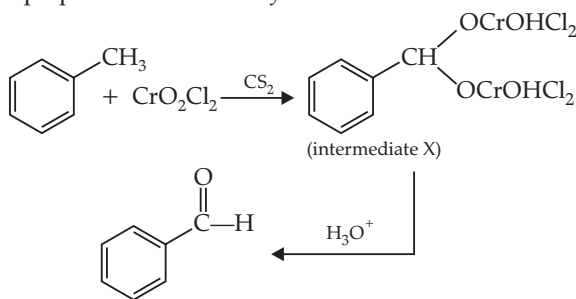
93. Option (d) is correct.

The molecule which has dipole moment value equal to zero ($\mu = 0$) are considered as Non-polar molecule. In SbCl$_5$, net vector summation of bond moments will be zero, so it is a non-polar molecule.

sp^3d, Trigonal bipyramidal
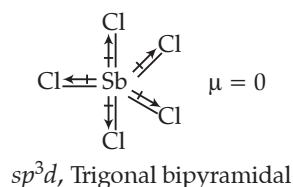
94. Option (a) is correct.

The magnetic moment of the given complexes can be calculated by

$\mu = \sqrt{n(n+2)}$ where n = number of unpaired electrons.

$[Fe(CN)_6]^{3-}$ $Fe^{+3} = 3d^5$
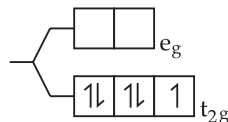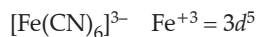
Unpaired electron = 1

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

$= \sqrt{3} = 1.7$ BM

$[Fe(H_2O)_6]^{3+}$ $Fe^{+3} = 3d^5$
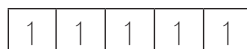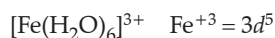
Unpaired electrons = 5

$\mu = \sqrt{5(5+2)} = \sqrt{5 \times 7}$

$= \sqrt{35} = 5.9$ BM

$[Fe(CN)_6]^{4-}$ $Fe^{+2} = 3d^6$
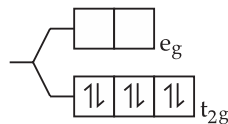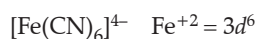
Unpaired electron = 0, $\mu = 0$ BM

$[Fe(H_2O)_6]^{+2}$ $Fe^{+2} = 3d^6$
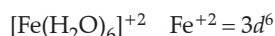
Unpaired electron = 4

$\mu = 4.9$ BM

Complex	Number of unpaired e$^-$	Nature of ligand	μ(BM)
(a) Fe(CN)$_6$]$^{3-}$	1	Strong	1.73
(b) [Fe(H$_2$O)$_6$]$^{3+}$	5	Weak	5.92
(c) [Fe(CN)$_6$]$^{4-}$	0	Strong	0
(d) [Fe(H$_2$O)$_6$]$^{2+}$	4	Weak	4.90

95. Option (d) is correct.

The given reaction is an example of soda lime decarboxylation reaction where NaOH and CaO are mixed in the ratio of 3 : 1 to convert sodium salt of carboxylic acid into alkane. This reaction is used to prepare both symmetrical as well as asymmetrical alkane.

$CH_3CH_2COO^-\overset{+}{N}a \xrightarrow[\text{heat}]{NaOH+CaO}$

$CH_3CH_3 + Na_2CO_3$
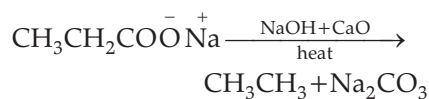
96. Option (a) is correct.

NaBH$_4$ is a weak reducing agent which can reduce carbonyl group into alcohol but does not reduce esters.
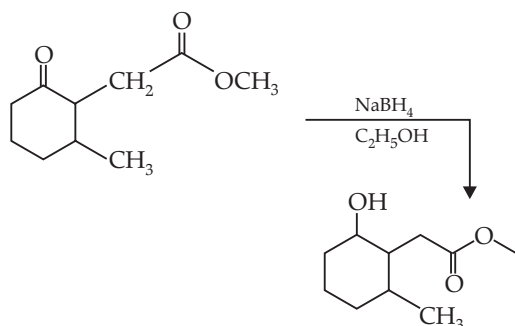
97. Option (d) is correct.

From Raoult's law

$$P_{solution} = P_A^\circ X_A + P_B^\circ X_B$$

Here $P_A^\circ = P_{C_6H_6} = 280$ mm Hg

$P_B^\circ = P_{octane} = 420$ mm Hg

$n_{C_6H_6} = 3, n_{octane} = 2$

Total mole $= 3 + 2 = 5$

$$X_{C_6H_6} = \frac{3}{5}, X_{octane} = \frac{2}{5}$$

$$P_{(solution)} = 280 \times \frac{3}{5} + 420 \times \frac{2}{5}$$

$$= 168 + 168 = 336 \text{ mm Hg}$$

98. Option (d) is correct.

For spontaneous process, $\Delta S_{total} > 0$ and since irreversible process is always spontaneous

$\therefore$ $\Delta S_{total} > 0$

For isothermal process, $\Delta T = 0$. So, $\Delta U = 0$

99. Option (d) is correct.

$$n_{O_2} = \frac{\text{Mass of O}_2}{\text{Molar mass}} = \frac{4}{32} = \frac{1}{8} \text{ mol}$$

$$n_{H_2} = \frac{\text{Mass of H}_2}{\text{Molar mass}} = \frac{2}{2} = 1 \text{ mol}$$

$$n_{total} = n_{O_2} + n_{H_2} = \frac{1}{8} + 1 = \frac{9}{8} \text{ mol}$$

$P_t V = n_t RT$ – ideal gas equation

T = 273 K

V = 1.0 L

$$P_t = \frac{\frac{9}{8} \text{ mol} \times 0.082 \text{ L} - \text{atm} \times 273 \text{ K}}{1 \text{ L} \times \text{K-mol}}$$

$$= 25.18 \text{ atm.}$$

100. Option (c) is correct.
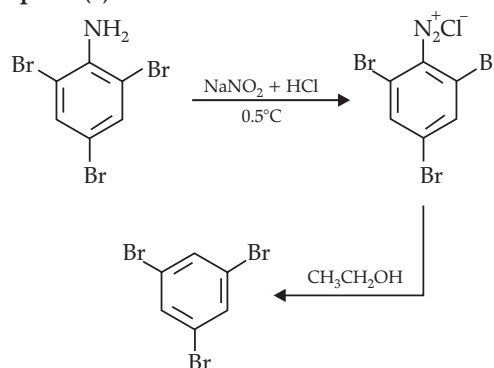
Here, replacement of $-N_2^+Cl^-$ takes place with CH_3CH_2OH. So correct answer is CH_3CH_2OH.

BOTANY

101. Option (d) is correct.

The Punnett square helps to predict the output of a genetic cross easily. Reginald Punnett proposed this method. It is a graphical representation used to calculate the probable genotypes of offspring in genetic analysis. Mendel uses it to understand the monohybrid cross between pure-tall and dwarf breeding plants. It also helps to understand the gamete produced by parents, the formation of the zygote, the genotype of F_1 and F_2 plant.

102. Option (a) is correct.

Some liverworts reproduce asexually by the formation of special structures called gemmae. Gemmae are asexual buds with green and multicellular structures developed in a small receptacle called gemma cups. Gemma cups are located on the thallus. When it detached from the parent plant. It germinates to produce a new individual plant.

103. Option (a) is correct.

Sewall Wright proposed the concept of genetic drift. It is a changes in the frequency of alleles in a population because of random mutations. It occurs by chance in the gametes due to crossing over and results in genetic recombination. When such gametes unite to form zygotes, they differ from generation to generation. The genetic drift has two consequences called the bottleneck effect and the founder's effect. The migration of a small population is involved in the Founder's effect, when a small population is isolated from a large population due to migration and form a colony in a new location with a new gene pool.

104. Option (d) is correct.

The ability of a plant to show different pathways in response to changes in the environment or different phases leads to form different types of structures. This is called for example, heterophylly of cotton, coriander, and larkspur. The shape of the leaves of the juvenile plant differs from the shape of the mature plant.

105. Option (b) is correct.

Meristematic tissue consists of cells that are active and continuously divides. Simple tissue consists of cells similar in structure and function. Vascular tissues are complex permanent tissue and have different types of cells and sclereids are sclerenchymatous cells and they are dead cells. They have thick cells wall and narrow lumen.

106. Option (b) is correct.

Transfer of pollen grains from the anther to the stigma of the same flower is called autogamy. Transfer of pollen grains from the anther to the stigma of another flower of the same species is called geitonogamy. Transfer of pollen grain from the anther of one flower to the stigma of the different plant is called xenogamy. This type of pollination gives a chance to bring a genetically different pollen grain to reach the stigma.

107. Option (b) is correct.

Polymerase chain reaction includes three sequential steps called denaturation, annealing, and extension.

At 94ºC, the two complementary strands are separated. This is called denaturation. The process of binding primer to single strand templet DNA is called annealing. The extension of DNA by the addition of nucleotides at -3'OH end of the primer based on templet DNA in the presence of Taq DNA polymerase is called extension.

108. Out of Syllabus

109. Option (b) is correct.

As per Gause's theory of the Principle', when two closely related species compete for the same resources they cannot co-exist, and the weaker one is eliminated. But the recent studies show that they do not rule out the presence of interspecific competition and lead to co-existence. This type of interaction is called resource partitioning. The two species will avoid competition by choosing a different time for feeding or foraging patterns.

110. Option (c) is correct.

The isolated DNA fragments cannot be seen in visible light without staining. Hence, the electrophoresed DNA fragments are stained with ethidium bromide. When such DNA strands are exposed to ultraviolet rays they can be seen in bright orange colour. So, DNA strands on staining with ethidium bromide appear as bright orange bands.

111. Option (d) is correct.

Algae is useful in several ways. Half of the total carbon dioxide on the earth is fixed by algae by photosynthesis. About 70 marine algae species act as for several marine organisms and play a key role in the food chain. Brown and red algae produce a huge quantity of water-holding material called hydrocolloids. Carrageen is produced by red algae, and algin is produced by brown algae. They are used for commercial purposes.

112. Option (d) is correct.

Sometimes stamens of the flower are attached or united with other parts of the flower such as the petal. When stamens are attached to the petal, they are called epipetalous. When the stamens are united into one bunch, they are called monadelphous in two bunches they are called diadelphous. The diadelphous stamens are common characteristic in pea plants.

113. Option (d) is correct.

The term Auxins is derived from the Greek language. It means 'to grow', and it was from human urine. Auxins can be natural and synthetic. Indole-3-acetic acid (IAA) and Indole butyric acid are examples of natural auxins. Naphthalene acetic and 2, 4- Dichlorophenoxyacetic

(2, 4-D) are synthetic auxins. The auxin 2, 4-D is used as weedicide in agriculture to destroy weeds in the field. It can destroy the weeds of dicotyledonous plants in cereal crops.

114. Option (c) is correct.

The organisms with male and female sex organs are called monoecious. The organism with either male or female sex organs is called dioecious organisms. Chara plant is monoecious and has both male and female reproductive organs on the same plant. It is a bisexual plant.

115. Option (c) is correct.

The biochemical substances in an organism are called metabolites. Metabolites are of two types, which are primary and secondary metabolites. Carbohydrates, amino acids, lipids, nitrogen bases, nucleosides, and nucleotides are some primary metabolites. They play an important role in normal physiological processes. The materials which are required for growth and development are called secondary metabolites. These are useful to human welfare. Alkaloids, rubber, latex, flavonoids, antibiotics, scents, gums, spices and coloured pigments are examples of secondary metabolites.

116. Option (d) is correct.

Francis Crick proposed the Central dogma in molecular biology. It states the flow of genetic information from DNA to RNA to Protein. The transfer of information from DNA to DNA is called replication. The transfer of information from DNA to primary transcript (mRNA) is called transcription. It contains coding regions called exons and non-coding regions called introns. The process of synthesizing a protein from mRNA is called translation. So, the complete flow chart of central dogma is in the order of a) Replication; b) Transcription; c) Translation; and d) Protein.

117. Option (a) is correct.

Garner and Allard discovered the process of photoperiodism for the first time in the tobacco plant. Some plants need to expose to light for a well-defined critical period. Such a phenomenon is called photoperiodism. The exposure of a plant to light for a certain period will induce flowering. Leaves are the sites of the perception of light. Some phytohormones migrate from leaves to shoot apices to induce flowering when exposed to light.

118. Option (a) is correct.

The amount of biomass or organic matter produced per unit area for a certain period during photosynthesis is called primary production. It is measured in terms of weight. The rate of biomass production is called productivity. It is represented in terms of g^{-2} yr^{-1}. It is divided into gross primary productivity (GPP) and net primary productivity NPP). A certain amount of GPP is used by the plant during respiration (R). The gross primary productivity minus respiration is equal to the net primary productivity. In the equation GPP-R = NPP, the letter 'R' denotes respiratory loss.

119. Option (d) is correct.

Cristae are inner foldings found in the inner mitochondrial membrane. Thylakoids are flat disk-like membranous sac-like structures in the stroma of plastids. The centromere is the constriction in the chromosome which holds two arms of chromatids

together. Cisternae are disc-shaped sacs in the Golgi complex. They contain secretion like enzymes or hormones to be transported to another part of the cell.

120. Option (b) is correct.

Ectocarpus belongs to the class Phaeophyceae. They are very simple branched, filamentous, and represented by kelps. It stores food as complex carbohydrates in the form of laminarin or mannitol.

121. Options (b) is correct.

In Angiosperms, phloem tissue is made up of sieve tube elements, companion cells, phloem parenchyma, and phloem fibres. Mature sieve elements contain a peripheral cytoplasm, large vacuole but do not have a nucleus.

122. Option (d) is correct.

The process of inducing mutation artificially by using certain chemicals by gamma radiation, and selecting and utilizing plants with desirable character as a source of breeding is called mutation breeding. This type induced breeding is carried out by gamma rays in mung bean, which is resistant to yellow mosaic virus and powdery mildew.

123. Option (c) is correct.

All C_4 plants show the presence of a characteristic feature called Kranz Anatomy. It shows the presence of bundle sheath cells that form several layers around the vascular bundles. They are characterized by having a large number of chloroplasts in their leaves. The vascular bundles are surrounded by large parenchymatous tissue, which is again surrounded by mesophyll cells. Bundle sheaths have large chloroplasts and grana while mesophyll cells have small chloroplasts. Sorghum is a kind of C_4 plant. The first stable product of the C_4 plant is oxaloacetic acid.

124. Option (b) is correct.

The attraction between water molecules due to hydrogen bonds is called cohesion. The attraction between polar surfaces or molecules is called adhesion. Surface tension states that water molecules are attracted more in the liquid phase than the gaseous phase. Loss of water from the margin of the leaf in the form of tidy water drops is called guttation.

125. Option (c) is correct.

To cut DNA with a restriction enzyme, it should be pure and free from other impurities. The plasma membrane RNA, proteins, polysaccharides, and lipids are treated with enzymes like lysozyme, cellulose, chitinase, and proteases. RNA can be removed with ribonuclease. Finally, the purified DNA is precipitated by adding chilled ethanol. Change - to fine threads of DNA.

126. Option (b) is correct.

The interaction between the population of two different species is called interspecific interaction. It can be beneficial, detrimental, or neutral. It can be represented by the sign of ' + ', '-' and '0' respectively. In amensalism, one species is harmed, whereas the other is unaffected. This type of interaction will prevent the growth of other species by releasing certain chemicals.

127. Option (d) is correct.

Meiosis ensures the production of the haploid phase in the life cycle. It involves two sequential cycles of nuclear division called meiosis I and meiosis II.

In meiosis II, during anaphase II, sister chromatids are held together with centromere. During this phase, the splitting of the centromere of each chromosome takes place. It allows moving chromosomes towards the opposite poles.

128. Option (c) is correct.

A person born with genetic defects can be cured by injecting cells with a corrected gene is called gene therapy. The defective gene is replaced by a normal gene in gene therapy. It also involves the delivery of a normal gene into an embryo or the individual to take over the function and compensate for the non-functional gene. This therapy involves the amplification of the target gene in an individual's tissue to treat disease.

129. Option (d) is correct.

The organisms require a continuous supply of nutrients for growth, reproduction, and to regulate severe body functions. The number of nutrients like carbon, phosphorous, nitrogen, calcium, etc., present in the soil at any given time is called the standing state. It differs in the different ecosystem and seasonal basis.

130. Option (c) is correct.

The measure of the amount of food available in an ecosystem is called biomass. The pyramid of biomass represents the relations between the quantity of living matter at the different trophic levels. The pyramid of biomass in the sea is generally inverted due to the higher biomass of fishes than the phytoplankton.

131. Option (b) is correct.

An embryo sac is present at the centre the of each ovule. The embryo sac consists of the gametophytic cell. The female gametophyte undergoes three mitotic cell divisions to form eight nucleate stages of the embryo sac. Among these, two cells at the center fused to form polar nuclei. Three cells move towards the top, called antipodals. The remaining three cells are forming egg apparatus with one egg and two synergids at the micropylar end. Thus, a typical angiosperm embryo sac at maturity consists of 7 cells with 8 nuclei.

132. Option (b) is correct.

A chromosome consists of two chromatids held together by a centromere. Depending on the position of the centromere, the chromosomes are classified into four types. They are metacentric, sub-metacentric, acrocentric, and telocentric. In the metacentric chromosome, the centromere is located at the centre and forms two equal arms of chromatids.

133. Option (a) is correct.

The process of producing similar types of spores is called homosporous plants, as in pteridophytes. The process of producing two kinds of spores like macro and microspores, is called heterosporous plants. In genera like Selaginella and Salvinia produce two types of spores called microspores and macrospores.

134. Option (c) is correct.

Protoplast fusion is applied to obtain a hybrid variety called pomato. Totipotency is used in plant tissue culture. In this method, a cell from the explant can develop into a whole plant. Meristem culture is used to obtain tissues or plants free from viruses. Micropropagation is used to obtain somaclones.

135. Option (d) is correct.

Polymerase Chain Reactions is used to multiply the gene of interest in vitro by using two sets of primers. This technique is used to detect gene mutation, molecular diagnosis, and gene amplification. Except for the purification of isolated proteins.

136. Option (c) is correct.

The process of copying genetic information from one strand of the DNA into RNA is called transcription. It is carried out by the transcription unit. The transcription unit has three regions in DNA called a promoter, structural gene, and terminator. RNA polymerase can catalyze the process of elongation in transcription. But the initiation and termination depend on the initiation factor and termination factor. The termination factor can also be called the Rho factor. When RNA polymerase binds to the Rho factor, the process of transcription is terminated in bacteria.

137. Option (d) is correct.

A probe is a radiolabelled ssDNA or RNA molecule. It is allowed to find the mutated gene by hybridizing to its complementary DNA in a clone of cells. It can be detected by autoradiography. But mutated genes cannot be found on photographic film, because the probe does not have complementarity with the mutated gene.

138. Option (c) is correct.

There are three types of RNA polymerases in the nucleus. They are RNA polymerase I, II, and III. RNA polymerase I transcribe rRNA. RNA polymerase II transcribes the precursor of mRNA, which PSII, while in the stroma lamellae membrane, is also called heterogeneous nuclear RNA. RNA polymerase III transcribes tRNA, 5S rRNA, and small nuclear RNAs.

139. Option (d) is correct.

The meristematic tissue is present in the mature regions of roots and shoots and form the woody axis, and appears later than the primary meristem, known as secondary meristem. The cambium cells present in the dicot stem between the primary xylem and phloem are called intrafascicular cambium. The cells of medullary rays joint these cambial rings and become meristematic.

140. Option (d) is correct.

The equation $N_t = N_0 e^{rt}$ represents the exponential growth of a population.

N_t = Population density after time t

N_0 = Population density at time zero

r = Intrinsic rate of natural increase and

e = The base of natural logarithms

141. Option (c) is correct.

The synthesis of ATP is associated with the chemiosmotic hypothesis. It is linked with the development of proton gradient across the intermembrane space of the mitochondria. It is established by oxidation-reduction reactions. In Electron Chain each NADH + H^+ produces 3 ATP, and one molecule of $FADH_2$ produces 2 ATP molecules. They are produced when proton gradients of passed through ATP synthase.

142. Option (a) is correct.

In grana, lamellae contain both the PSI and PSII, while in the stroma lamellae membrane, PSII and NADP reductase are absent. The cyclic photophosphorylation takes place at light wavelengths beyond 680 nm. It occurs on at PSI, but not on PSII. Both of them are involved in non-cyclic photophosphorylation.

143. Option (c) is correct.

Different spores are produced by a different structure called fruiting bodies. The sexual cycle involves the three following steps. They are plasmogamy karyogamy, and meiosis in a zygote. The fusion of protoplasm between motile and non-motile gametes is called plasmogamy.

144. Option (c) is correct.

DNA fingerprinting can identify the differences in certain specific regions of DNA sequences called repetitive DNA. These small stretches of DNA are repeated several times to form a bulk peak of DNA called satellite DNA. Based on the composition of the base, length of a segment, and the number of repetitive units, the satellite DNA is of several types like micro-satellite and mini-satellite, etc. But DNA fingerprinting involves in finding differences the sequence of repetitive DNA.

145. Option (b) is correct.

A protein is made of polymerization of several amino acid molecules linked by peptide bonds. Unsaturated fatty acids contain one or more double bonds between the two carbon atoms. In a nucleic acid, a phosphate molecule links 3'- carbon of one nucleotide to the 5'- carbon of another sugar molecule of nucleotide to form an ester bond. A glycosidic bond links several monosaccharides to form a large complex polymer called a polysaccharide.

146. Option (b) is correct.

Nitrococcus oxidizes ammonia to nitrite, and it is converted into nitrate by Nitrobacter. Rhizobium bacteria help in converting atmospheric nitrogen to ammonia. *Thiobacillus* helps in the process of denitrification.

147. Option (a) is correct.

The viability of retaining pollen grains on the stigma depends on prevailing temperature and humidity. In some plants, Rosaceae, Leguminosae, and Solanaceae, stigma maintain the viability of pollen grains for several months. But in rice, pollen grains lose viability in 30 minutes.

148. Option (b) is correct.

The process of inactivating certain gene expressions by inserting recombinant DNA into them is called insertional inactivation. For the selection of recombinant DNA, the inactivation of antibiotics is a complicated process, and it requires simultaneous plating on two plates with different antibiotics. The alternative selective marker is developed by inserting recombinant DNA into the coding sequence of enzyme β-galactosidase.

The pBR[322] is used as a cloning vector. In this vector, the β-galactoside gene is inserted into the ampicillin

resistance gene using Pst I, and the recombinant. *E. Coli* will not express the ampicillin-resistant gene. The bacteria are susceptible to ampicillin antibiotics. So, It will not confer ampicillin resistance to the host cell.

149. Option (b) is correct.

The floral formula of different families:

Brassicaceae family $\oplus\, \male\female\, K_{2+2}\, C_4\, A_{2+4}\, G_{(2)}$

Solanacae family $\oplus\, \female\, K_{(5)}\, C_{(5)}\, A_5\, \underline{G}_{(2)}$

Fabaceae family $\female\, K_{(5)}\, C_{1+2+(2)}\, A_{(9)+1}\, \underline{G}_1$

Liliaceae family $\oplus\, \female\, P_{(3+3)}\, A_{3+3}\, \underline{G}_{(2)}$

150. Option (d) is correct.

During the S phase, replication of DNA occurs. During the G_2 phase, the synthesis of protein and RNA takes place. Quiescent stage, the cell undergoes an active stage, and it remains undivided. During this phase, the cell remains metabolically active. The G_1 phase occurs between mitosis and the initiation of DNA replication. The cell grows to maximum size during this phase.

151. Option (a) is correct.

When a double-stranded RNA is breakdown into small pieces these pieces are called small interfering RNAs (siRNA). The siRNAs are used to silence and bind to complementary *m*RNA. It is not required for the synthesis of protein.

152. Out of Syllabus

153. Option (c) is correct.

The single DNA-dependent RNA polymerase can catalyze the transcription of all varieties of RNA in bacteria. It is also called a holoenzyme made up of several polypeptides. It is made up of two subunits of an alpha, a single subunit of beta, beta prime, and omega fragment. Those all together can catalyze the process of initiation, elongation, and termination in the process of transcription.

154. Out of Syllabus

155. Option (d) is correct.

Metamerism is a common characteristic of the phylum Annelida. Canal system is present in phylum Porifera. Comb plates are found in the body of Ctenophores, useful for locomotion. Cnidoblasts are found in the family members of coelenterates. Hence, they are called cnidarians.

156. Option (c) is correct.

Biofortification is a method of breeding crops, to enhance their nutritional values. This can be done by selective breeding or through genetic engineering and breeding crops with higher vitamins, minerals, proteins, and healthy fats, which improve public health. This method is not used to create a plant resistance against the diseases.

157. Option (a) is correct.

The plant products are of two types called primary metabolites and secondary metabolites. Pigments, alkaloids, terpenoids, toxins, lectins, drugs, and polymeric substances are secondary metabolites. Ricin is a kind of toxin obtained from Ricinus. But it is not a drug.

158. Option (b) is correct.

Microbes are used for industrial and comme-rcial production of some organic acids, alcohols, and enzymes. *Aspergillus niger* is used to produce citric acid. *Acetobacter aceti* is used to produce acetic acid. *Clostridium butylicum* is used to produce butyric acid, and *Lactobacillus* is used to produce lactic acid.

159. Option (d) is correct.

Insulin is a hormone produced by the beta-cell of the Islet of Langerhans. It is synthesized as pro-insulin. It has C-peptide. In the initial stage, it comprises two polypeptides, called A-peptide and B-peptide, along with a stretch of C peptide. Later these two polypeptides are linked by disulphide linkage by removing a stretch of C peptide. So C-peptide is not present in the mature insulin.

160. Option (b) is correct.

When percentage saturation of haemoglobin with oxygen is plotted against the pO_2, a sigmoid curve is formed. The Sigmoid curve can also be called the oxygen dissociation curve. It is used in studying the effect of factors like pCO_2, H^+ concentration, etc. In the alveoli, high pO_2, low pCO_2, less H^+, and low temperature will favour the formation of oxyhaemoglobin.

161. Option (d) is correct.

Physalia is known as the Portuguese man of war. *Limulus* is called a living fossil. *Ancylostoma* is a kind of roundworm called hookworm. *Pinctada* is called pearl oyster, belongs to phylum Mollusca.

162. Option (b) is correct.

If a cell in a fruit fly with 8 chromosomes is at the G_1 phase, the number of chromosomes remains the same after the S phase. Because during the S phase, the amount of DNA is double by the process of replication. But the number of chromosomes remains the same.

163. Option (b) is correct.

The skeletal system of birds is very long, hollow with air cavities called pneumatic. Pneumatic cavities are present in birds like, *Neophron*.

164. Option (d) is correct.

The thickness of the ozone layer in a column of air from the ground to the top region of the atmosphere is measured in Dobson units.

165. Option (b) is correct.

The process of coagulation of blood involves, several complex enzymes in a sequence of reactions. Thrombokinase converts prothrombin into thrombin in the plasma. This thrombin converts the inactive form of fibrinogen into fibrins. These fibrins form a network of threads on the surface of ruptured blood vessels and form a clot.

166. Option (d) is correct.

In the case of HIV/AIDS, an Enzyme-linked immunosorbent assay was used for early detection of an infection. This technique is used to detect in the early stages of the disease. It is detected by antibodies produced by the host against the pathogen by the immune system.

167. Option (c) is correct.

The membranous organelles are different in terms of their structure and functions. They together form endomembrane system, because their functions are coordinated, it includes the endoplasmic reticulum, Golgi complex, lysosome, and vacuole.

168. Option (d) is correct.

According to Chargaff's rule, DNA consists of a 1:1 (base pair rule) ratio of pyrimidine and pyrine bases. The amount of guanine is equal to the amount of cytosine. Similarly, the amount of thymine is equal to adenine.

Number of Adenine = number of thymine

If the number of (A) is 30%, then the number of thymine would be 30%

Therefore $= 100 - (A+T)$

$= 100 - (30 + 30)$

$= 100 - 60 = 40$

The percentage of (C) and (G) = 40

Then (C) and (G) would be 20%.

T=30%, A=30%, G=20%, and C=20%

169. Option (d) is correct.

The restriction enzyme endonucleases are called molecular scissors, which cut the DNA at a specific sequence. The restriction endonucleases can find specific nucleotide recognition sequences. The sequence of the first half of one strand will be like a mirror image with the second half of the complementary strand. This is called a palindromic nucleotide sequence.

170. Option (d) is correct.

The intercalated discs are located only in cardiac muscles. They are absent in smooth muscles. They are involuntary muscles present in the uterus, alimentary canal, gall bladder, and wall of the blood vessels.

171. Option (c) is correct.

Vaults, diaphragms, and cervical caps are temporary contraceptive methods adapted for females. They block the entry of sperm.

IUDs enhance the phagocytosis of sperms in the uterus. They act as a spermicide.

Vasectomy is a surgical method of contraception adapted for males. Vas deferens are cut and tied up with a small incision on the scrotum.

Tubectomy is a surgical method of contra-ception adapted for females. A small portion of the fallopian tube is cut and tied up through an incision in the abdomen or through the vagina.

172. Option (d) is correct.

Polymerase chain reaction includes three steps called denaturation, annealing, and extension.

At 94ºC, the two complementary strands are separated. This is called denaturation. If this temperature is not maintained in the beginning, it will affect the process of denaturation.

173. Option (d) is correct.

Sickle cell anaemia is an example of auto-somal recessive disorder. It is caused due to frameshift mutation, which leads to the replacement of valine in the place of glutamic acid. It is transmitted from parent to offspring when both the partners are heterozygous carriers. It is expressed only in the homozygous (Hb^SHb^S) individuals that are about only 25%.

Male × Female

Parents: Hb^A Hb^S Hb^A Hb^S

Gametes: (Hb^A) (Hb^S) (Hb^A) (Hb^S)

♀ \ ♂	Hb^A	Hb^S
Hb^A	Hb^A Hb^A Normal	Hb^A Hb^S Carrier
Hb^S	Hb^A Hb^S Carrier	Hb^S Hb^S Sickle cell

Normal: 25%
Carriers: 50%
Sickle cell: 25%

174. Option (a) is correct.

Echinoderms are triploblastic and coelomates with true coelom. Roundworms have an organ-system level of body organization. The water vascular system is a characteristic of Echinoderms. The above three statements are correct.

175. Option (a) is correct.

Zona pellucida is a glycoprotein polymer capsule surrounding the secondary oocyte. It is an antral follicle, and the acellular layer contains receptors (ZP3) for the binding of sperm. It contains enzymes that catalyze the sperm to penetrate the oocyte during fertilization and remains even after ovulation.

176. Option (c) is correct.

The common hepatic duct and cystic duct unite together to form bile duct. The bile duct and main pancreatic duct reach the major duodenal papilla. These two ducts join each other and expand to form hepatopancreatic ampulla. The sphincter of Oddi is a muscular structure located at the junction hepatopancreatic duct and duodenum.

177. Option (d) is correct.

Myasthenia gravis is an autoimmune disorder disorder. It mainly is affects the neuromuscular junction results in fatigue, weakening, and paralysis of skeletal muscle.

178. Option (a) is correct.

A person with 'AB' blood groups is called "Universal recipients". Because they do not have anti-A and anti-B antibodies in their plasma, their bodies can accept blood from all blood groups.

179. Option (b) is correct.

In animal cells, replication of DNA occurs during the S phase of the cell cycle. At the same time, centrioles also duplicate in the cytoplasm and move towards the opposite poles.

180. Option (a) is correct.

The Juxtaglomerular cells in the kidneys produce a peptide hormone known as erythropoietin. This hormone stimulates the process of erythropoiesis.

181. Option (a) is correct.

The housefly belongs to the phylum – Arthropoda, the class – Insecta, the order – Diptera, the family -Muscidae, and the Genus – Musca. The scientific name of a housefly is *Musca* domestica.

182. Option (d) is correct.

Some diseases are transmitted through sexual intercourse. Such diseases are called sexually transmitted diseases or venereal diseases. It can spread by the transfusion of blood from an infected person to a healthy person and from an infected mother to a fetus.

183. Option (b) is correct.

The pressure exerted by an individual gas in a mixture of gases is called the partial pressure of that gas. It is represented with the letter 'p'. The partial pressure of oxygen and carbon dioxide at the alveoli are $pO_2 = 104$ and $pCO_2 = 40$, respectively

184. Option (c) is correct.

The process of preventing fertilization from preventing pregnancy in women is called contraception. It is the most widely accepted method to delay pregnancy or space for children. LNG-20 is a kind of contraceptive. It is used as an intrauterine device. It releases a hormone called levonorgestrel 20 mg. It acts as phagocytosis of sperms so that a woman can avoid pregnancy.

185. Option (d) is correct.

Diakinesis is the last stage of meiotic prophase I. During this phase, the terminalisation of chiasmata takes place. Chromosomes are fully condensed, and the meiotic spindle is assembled to separate homologous chromosomes.

186. Option (a) is correct.

The process of delivering a baby is called parturition. It is induced by a complex neuroendocrine mechanism. An increase in estrogen and progesterone ratio, synthesis of prostaglandins, and release of oxytocin will induce the contraction of the uterus. This can lead to parturition. But prolactin does not play any role in parturition. It promotes the growth of the mammary gland and the formation of milk.

187. Option (b) is correct.

In earthworms, prostomium serves as a covering for the mouth. It looks like a wedge and is used to open cracks in the soil into which it can crawl. It has receptors and can also act as a sensory structure.

188. Option (b) is correct.

Adenosine deaminase is an enzyme which is very crucial for the immune system. Defects in this gene of adenosine deaminase result in a disease called severe combined immunodeficiency disease. This occurs due to dysfunction of the immune system.

189. Option (b) is correct.

Adaptive radiation is the process of evolution of different species in a geographical area and radiating to other areas—for example, Darwin's finches.

The species with anologous organs exhibit convergent evolution. The organs are anatomically not similar, but have same functions. e.g., wing of birds and bats.

The species with homologous organs exhibit divergent evolution. The organs are anatomically similar but perform different functions in different organisms— bone of man and whale.

Evolution by anthropogenic action occurs due to human interference, such as selecting antibiotic-resistant microbes, herbicides, and pesticide-resistant varieties.

190. Option (d) is correct.

Mammals from cold climates possess shorter ears and limbs to reduce heat loss. This is called Allen's Rule.

Physiological adaptation can be observed in Kangaroo rats.

Behavioural adaptation can be seen in the desert lizard.

Biochemical adaptation can be observed in marine fishes living at the deep bottom of seas and oceans.

191. Option (c) is correct.

Histone octamers consist of units of 8 histone molecules with a pair of each protein H2A, H2B, H3, and H4. H1 histone present outside of the octamer connects the DNA with the octomer. Histones consist of basic amino acid residues such as lysine and arginine with a side chain. They have a positive charge in the side chain. But they are not acidic.

192. Option (b) is correct.

At high altitudes, mountaineers experience altitude sickness due to a lack of sufficient oxygen. At such altitude, atmospheric pressure is very less. Hence, the person feels nausea, fatigue, and heart palpitation.

Hence, both the Assertion (A) and Reason (R) are correct.

193. Option (b) is correct.

Multiple Ovulation Embryo Transfer Techno-logy is used for herd improvement. The cow is given FSH – a hormone to induce follicular and superovulation but not LH. Each cow produces about 6-8 eggs per cycle. 8-32 celled embryos are transferred to the surrogate mother. The cow is fertilized by artificial insemination.

194. Option (c) is correct.

Filariasis is caused by *Wuchereria bancrofti*. Amoebic dysentery is caused by *Entamoeba histolytica*. Pneumonia is caused by a bacteria called *Streptococcus Pneumoniae*. Ringworm is caused by fungi that belongs to genera Microsporum, Epidermophyton, and Trichophyton.

195. Option (d) is correct.

Lecithin is a kind of phospholipid. It has phosphorus and a phosphorylated organic compound. Ex. Soyabean oil. It is present in neural tissues with a more complex structure. Glycerol is an example of simple lipid. It can also be called trihydroxy propane. Several lipids have both glycerol and fatty acids.

196. Option (c) is correct.

The ovary produces the hormone relaxin in the later phase of pregnancy. After ovulation, the ruptured Graafian follicles are converted into corpus luteum. The corpus luteum produces a hormone called relaxin.

197. Option (c) is correct.

In the epithelium and other tissues, three types of junctions are present. They are tight junctions, adhering junctions, and gap junctions. Tight junctions prevent the leakage of substances across a tissue. Gap junctions help in communication with each other by connecting the cytoplasm of adjoining cells. It helps in the rapid transfer of ions, small molecules, and other big molecules.

198. Option (a) is correct.

The scapula is a triangular flat bone located between the second and seventh ribs. Cranium is formed by the fusion of fibrous joints by dense connective tissue. Sternum is a flat bone on the ventral midline of thorax. The vertebral column is formed by the joining of cartilaginous joints between the adjacent vertebrae.

199. Option (b) is correct.

During muscular contraction, the following events occur in the following sequence order. There are disappearing 'H'zone, decrease in the width of the 'I' band, myosin hydrolyzes ATP to release ADP and inorganic phosphate, and Z-lines are pulled inward attached to actin filaments.

200. Option (a) is correct.

The code which has at least three letters is called the triplet code. There are about 64 codons to code for 20 amino acids. Among them, AUG has an initiator dual function. It codes for Methionine and acts as an initiator codon. The codon 'AAA' and 'AAG' code for amino acid lysine. So, statement I is incorrect, but statement II is correct.

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