NEET (Re-Exam) 2026

CHAPTERWISE ANALYSIS

Physics • Chemistry • Biology

Use the index for chapterwise analysis of NEET Paper and refer to these questions when you are practising MCQs Chapterwise.

PHYSICS

Class XI

Chapters Name	Question No.	Total
Units and Measurement	38	1
Motion in a Straight Line	16	1
Motion in a Plane	27	1
Laws of Motion	26	1
Work, Energy and Power	21, 23	2
System of Particles and Rotational Motion	3, 30	2
Gravitation	10, 37	2
Mechanical Properties of Solids	–	–
Mechanical Properties of Fluids	2, 9	2
Thermal Properties of Matter	5	1
Thermodynamics	15, 43	2
Kinetic Theory	18, 32	2
Oscillations	33, 45	2
Waves	34	1

Class XII

Electric Charges and Fields	41	1
Electrostatic Potential and Capacitance	13, 19, 25	3
Current Electricity	6	1
Moving Charges and Magnetism	20, 44	2
Magnetism and Matter	–	–
Electromagnetic Induction	4, 12, 14	3
Alternating Current	11	1
Electromagnetic Waves	17, 22	2
Ray Optics and Optical Instruments	24, 29	2
Wave Optics	–	–
Dual Nature of Radiation and Matter	1, 7, 39	3
Atoms	31, 42	2
Nuclei	35	1
Semiconductor Electronics: Materials, Devices and Simple Circuits	8, 28	2
Experimental Skills	36, 40	2

CHEMISTRY

Class XI

Chapters Name	Question No.	Total
Some Basic Concepts of Chemistry	62, 63	2
Structure of Atom	64	1
Classification of Elements and Periodicity in Properties	75, 85	2
Chemical Bonding and Molecular Structure	87, 88	2
Thermodynamics	59, 80, 83	3
Equilibrium	78	1
Redox Reactions	79	1
Organic Chemistry – Some Basic Principles and Techniques	65	1
Hydrocarbons	51, 76, 86	3

Class XII

Solutions	69, 81	2
Electrochemistry	67, 70	2
Chemical Kinetics	49, 77	2
The *d*- and *f*-Block Elements	48, 50, 84	3
Coordination Compounds	47, 55, 61, 66, 72, 82	6
Haloalkanes and Haloarenes	52	1
Alcohols, Phenols and Ethers	–	–
Aldehydes, Ketones and Carboxylic Acids	46, 60, 71, 90	4
Amines	57, 58	2
Biomolecules	56, 73, 89	3
The *p*-Block Elements	53, 54	2
Principles Related to Practical Chemistry	68, 74	2

BIOLOGY

Class XI

Chapters Name	Question No.	Total
The Living World	106, 116, 124	3
Biological Classification	96, 99, 122, 128, 129	5
Plant Kingdom	94, 103	2
Animal Kingdom	91, 109, 133	3
Morphology of Flowering Plants	98, 127, 132	3
Anatomy of Flowering Plants	–	
Structural Organisation in Animals	108, 135	2
Cell-The Unit of Life	97, 100, 107, 110, 111, 112, 120	7
Biomolecules	118, 130	2
Cell Cycle and Cell Division	126, 134	2
Photosynthesis in Higher Plants	92, 93, 102, 114, 117	5
Respiration in Plants	95	1
Plant Growth and Development	101, 105, 121	3
Breathing and Exchange of Gases	141	1
Body Fluids and Circulation	115, 123, 151	3
Excretory Products and Their Elimination	167	1
Locomotion and Movement	104, 119, 160, 163, 169	5
Neural Control and Coordination	125	1
Chemical Coordination and Integration	113, 131, 177	3

Class XII

Sexual Reproduction in Flowering Plants	145, 155, 171, 174	4
Human Reproduction	147, 149, 150, 164	4
Reproductive Health	137	1
Principles of Inheritance and Variation	139, 142, 180	3
Molecular Basis of Inheritance	157, 172	2
Evolution	138, 143, 152, 159, 162, 175	6
Human Health and Diseases	144, 154, 156, 165, 178	5
Microbes in Human Welfare	148	1
Biotechnology : Principles and Processes	136, 158, 173, 179	4
Biotechnology and Its Applications	153	1
Organisms and Populations	146, 161, 168, 170	4
Ecosystem	166, 176	2
Biodiversity and Conservation	140	1

PHYSICS

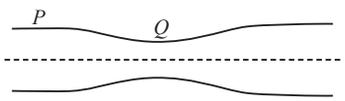
1. A photon and an electron, each of 20 eV energy, move in free space. The ratio of linear momentum of electron p_e to that of photon p_{Ph}, $\frac{p_e}{p_{Ph}}$ is

(Take speed of light = 3×10^8 ms^{-1}, charge of electron = -1.6×10^{-19} C and mass of electron = 9×10^{-31} kg)

(a) 275 (b) $\frac{2}{450}$

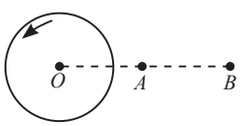
(c) $\frac{1}{250}$ (d) 225

2. Water flows in a streamline motion through a horizontal pipe of circular cross-section as shown in the figure. The pressure difference of water between P and Q is 15 Nm^{-2}. The area of cross-section at P and Q are 40 cm^2 and 20 cm^2, respectively. The rate of flow of water through the pipe, in cm^3 s^{-1}, is
[Take density of water = 1000 kg m^{-3}]



(a) 400 (b) 100
(c) 200 (d) 300

3. A thin horizontal disc is rotating about a vertical axis passing through its fixed centre O. Its angular momentum is L_A and L_B computed about points A and B, respectively, with $OB = 2 \times OA$. The value of $\frac{L_A}{L_B}$ is



(a) 2 (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) 1

4. Consider a long solenoid of length l and radius r. If n is the number of turns per unit length and μ_0 is the permeability of free space, the inductance of the solenoid is

(a) $2\mu_0\pi n^2r^2l$ (b) $\mu_0\pi n^2r^2l$

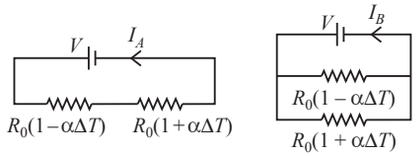
(c) $\mu_0 n^2r^2l$ (d) $(\mu_0/2\pi)n^2r^2l$

5. The temperature of a metallic sphere of radius R is increased by a small amount ΔT. If the linear coefficient of thermal expansion of the metal is α, the approximate increase in the volume of the sphere is

(a) $6\pi R^3\alpha\Delta T$ (b) $2\pi R^3\alpha\Delta T$

(c) $3\pi R^3\alpha\Delta T$ (d) $4\pi R^3\alpha\Delta T$

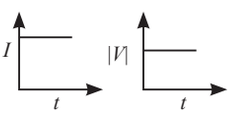
6. Consider two circuits, (A) and (B), each having two resistors. One of them has a positive temperature coefficient of resistance, $+\alpha$, while the other one has a negative temperature of coefficient, $-\alpha$, as shown in the figure. The current through these circuits are denoted by I_A and I_B. At initial temperature, the resistance of the two resistors is R_0. As the temperature is increased, the correct option that describes the variation of current in these circuits is

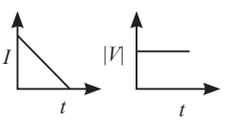


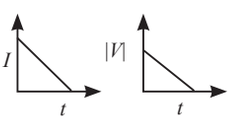
(A) (B)

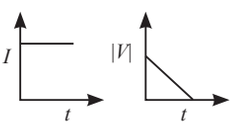
(a) both I_A and I_B remain constant
(b) I_A remains constant while I_B increases
(c) I_A decreases while I_B increases
(d) I_A increases while I_B decreases

7. A beam of light falls on a metal surface such that photoelectrons are generated. If power of the light source starts to decrease linearly with time t, then variation of the photocurrent I and magnitude of the stopping potential $|V|$ with time is best represented by

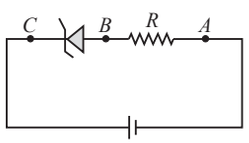
(a) 

(b) 

(c) 

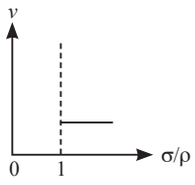
(d) 

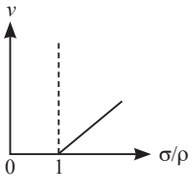
8. An ideal Zener diode with breakdown voltage of –3V is reverse biased with a negative input voltage $V_i = -5$V. The magnitude of voltage difference between points B and A is

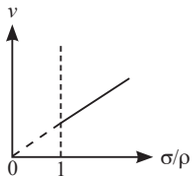


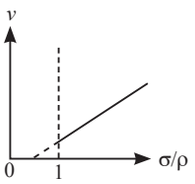
(a) 0 V (b) 3 V
(c) 2 V (d) 1 V

9. In the measurement of viscosity of liquids using terminal velocity experiment, spherical balls of same radius but having different densities are used. The variation of the terminal velocity (v) with the ratio of density of spherical balls (σ) to density of the liquid (ρ), is best represented by:

(a) 

(b) 

(c) 

(d) 

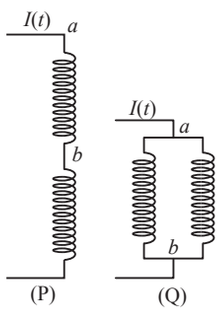
10. Two planets P_1 and P_2 with equal mass have radii R_1 and R_2, respectively, where $R_2 = \frac{R_1}{2}$. The escape speeds of P_1 and P_2 are v_1 and v_2, respectively. Then $\frac{v_2}{v_1}$ is

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

11. An ac voltage $V = 220 \sin(2 \times 10^3 t)$ Volt is applied to a series *LCR* circuit. Then the current amplitude in this circuit is
(Given : $L = 10$ mH, $C = 25$ μF, $R = 100$ Ω)

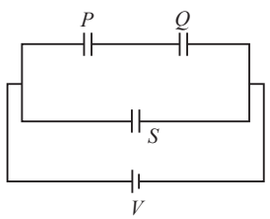
(a) 22.0 A (b) 2.2 A
(c) 5.5 A (d) 11.0 A

12. Two identical inductors are connected in two different configurations *P* and *Q*, where a time varying current $I(t)$ is flowing, as shown in the figure. The induced emf between points *a* and *b* for configuration *P* is E_P and that for configuration *Q* is E_Q. The ratio E_P/E_Q is
[Neglect the effect of mutual inductance.]



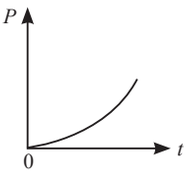
(a) 2 (b) 1/4 (c) 1/2 (d) 1

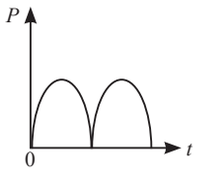
13. Three identical capacitors *P*, *Q* and *S*, each of the capacitance *C*, are connected to a battery of voltage *V*, as shown in the figure. If the energy stored in the capacitor *P* and total energy stored in the system are U_P and U_T, respectively, then the ratio $\frac{U_P}{U_T}$ is

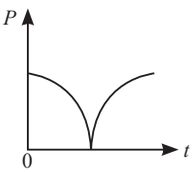


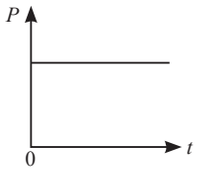
(a) 1/6 (b) 2/3
(c) 1/3 (d) 1/2

14. A conducting loop of finite resistance lies on the $x - y$ plane. There is a constant magnetic field in the *z* direction. The area of the loop varies with time *t*, as $A = A_0(1 + \sin t)$ in appropriate units. The figure that correctly indicates the qualitative behaviour of the power *P* dissipated in the loop as a function of time is

(a) 

(b) 

(c) 

(d) 

15. In an adiabatic expansion, the temperature of one mole of an ideal monatomic gas ($\gamma = 5/3$) decreases from 60 K to 50 K. The work done by the gas in the process is
(Take the universal gas constant as $R = 8.3$ J mol^{-1} K^{-1})

(a) 166 J (b) 41.5 J
(c) 83 J (d) 124.5 J

16. Consider a particle moving along a straight line, whose position as a function of time is given by $s(t) = \alpha t^2 - \beta t + \gamma$, where $\alpha = 1$ ms^{-2}, $\beta = 6$ ms^{-1} and $\gamma = 5$ m. The average speed of the particle, in ms^{-1}, from $t = 0$ to $t = 6$ s is

(a) 0 (b) 12 (c) 6 (d) 3

17. The following table presents the part of the electromagnetic spectrum and their corresponding major applications.

Part of the electromagnetic spectrum		**Applications**	
P.	Microwave	I.	For purifying the water
Q.	UV rays	II.	For warming the food
R.	Gamma rays	III.	For AM and FM communication systems
S.	Radio wave	IV.	For treating the cancer cells

The correct option is

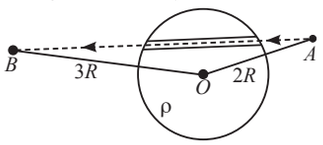
(a) P-II, Q-IV, R-III, S-I
(b) P-I, Q-II, R-III, S-IV
(c) P-I, Q-IV, R-II, S-III
(d) P-II, Q-I, R-IV, S-III

18. An ideal gas is made of polyatomic molecules. Each of the molecules has three translational, three rotational and *f* number of vibrational modes. If the ratio of heat capacities C_P/C_V of the gas is 8/7, then the value of *f* is

(a) 1 (b) 4 (c) 3 (d) 2

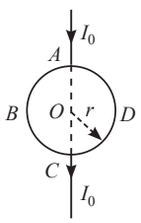
19. A unit positive point charge is taken slowly through and infinitesimally thin tube that is inside a charged dielectric sphere of radius *R*, having uniform positive charge density

ρ, as shown in the figure. The initial and final positions of the charge are marked by A and B at distances $2R$ and $3R$ respectively, from the centre of the sphere. In this process, the magnitude of the total work done on the point charge is $\frac{\rho R^2}{n\varepsilon_0}$. The value of n is
(ε_0 is the permittivity of vacuum)



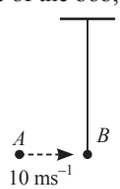
(a) 18 (b) 2 (c) 6 (d) 9

20. A current I_0 flows through a metallic circular loop of radius r as shown in the figure. Resistance of the segment ABC is half that of ADC. Magnitude of magnetic field at the center O of the loop is



(a) $\frac{\mu_0 I_0}{2\pi r}$ (b) $\frac{\mu_0 I_0}{12r}$ (c) $\frac{\mu_0 I_0}{4r}$ (d) $\frac{\mu_0 I_0}{2r}$

21. Bob B of mass m at rest is hanging vertically from the ceiling via a massless string of length 10 m, as shown in the figure. Point mass A of mass m travelling horizontally with speed 10 ms^{-1} hits bob B elastically. The bob B rises h meter after the collision. Taking the acceleration due to gravity g = 10 ms^{-2} and neglecting the size of the bob, the value of h is



(a) 2.5 (b) 8 (c) 7 (d) 5

22. An electromagnetic wave travelling in a lossless dielectric medium having a dielectric constant, ε_r = 9, has the electric field, $E_x = E_0 \sin(kz - 2\pi \times 10^6 t)$ Vm^{-1} where E_0 is the amplitude and k is the wave vector. Among the following options, the incorrect choice is

(a) The direction of propagation of the electromagnetic wave is along $+z$

(b) The speed of the electromagnetic wave inside the medium is 10^8 ms^{-1}

(c) The wavelength of the electromagnetic wave inside the medium is 300 m

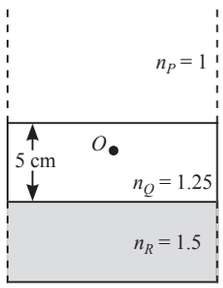
(d) The magnetic field is given by the relation $B_y = \frac{B_0}{v} \sin(kz - 2\pi \times 10^6 t)$

where v is the speed of the electromagnetic wave inside the medium.

23. A particle of mass M moves along a horizontal x axis from $x = 0$ to $x = L$. The coefficient of kinetic friction varies as a function of x as $\mu_k(x) = \mu_0 - \alpha x$, where μ_0, α are constants of appropriate dimensions, so that $\mu_k(L) = 0$. The total work done by the frictional force during the motion is $n\mu_0 MgL$, where g is the acceleration due to gravity. The value of n is

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

24. Consider three media P, Q and R with refractive indices 1, 1.25, and 1.5, respectively. The medium Q having a thickness of 5 cm is placed between extended media P and R as shown in the figure. An object O is placed at the centre of medium Q. If viewed from medium P near the normal direction, the apparent depth of O is h_1. For similar observation from medium R, the apparent depth is h_2. The value of $|h_1 - h_2|$, in cm, is



(a) 3 (b) 0 (c) 1 (d) 2

25. Consider a fixed uniformly charged insulating sphere with radius R and total charge $+Q$. A point charge $-q$ ($q << Q$) with mass m is released from rest at a distance of $3R$ from the centre of the charged sphere. When the point charge reaches the surface of the sphere, its speed is
(ε_0 is the permittivity of vacuum, neglect gravitational forces)

(a) $\sqrt{\frac{Qq}{4\pi\varepsilon_0 mR}}$ (b) $\sqrt{\frac{3Qq}{4\pi\varepsilon_0 mR}}$

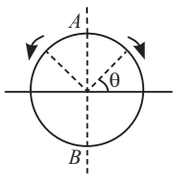
(c) $\sqrt{\frac{2Qq}{3\pi\varepsilon_0 mR}}$ (d) $\sqrt{\frac{Qq}{3\pi\varepsilon_0 mR}}$

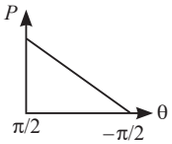
26. A car travels on a circular racetrack of radius 50 m, which is banked at an angle θ. If the car travels at a speed 10 ms^{-1}, then the wear and tear on its tyres is minimum. Taking the acceleration due to gravity to be 10 m s^{-2}, the value of θ is

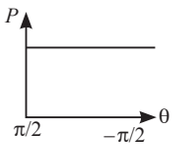
(a) $\tan^{-1}(2\sqrt{3})$ (b) $\tan^{-1}\left(\frac{1}{5}\right)$

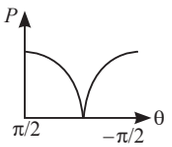
(c) $\tan^{-1}\left(\frac{2}{5}\right)$ (d) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

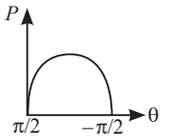
27. A frictionless circular wire of unit radius is fixed on the horizontal plane. Two point particles of unit mass start moving simultaneously from point $A\left(\theta = \frac{\pi}{2}\right)$ with identical uniform angular speeds in opposite directions, and meet again at point $B\left(\theta = -\frac{\pi}{2}\right)$. During this time, which of the following figures schematically represent the magnitude of the total linear momentum P of the system, as a function of θ?



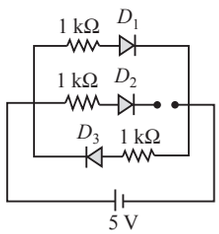
(a) 

(b) 

(c) 

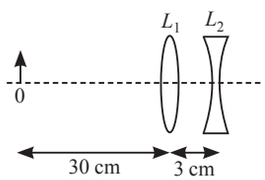
(d) 

28. Three identical *p-n* junction diodes D_1, D_2, and D_3 are connected across a battery as shown in the figure. If the width of the depletion regions of D_1, D_2, and D_3 are W_1, W_2 and W_3, respectively, then the correct option is



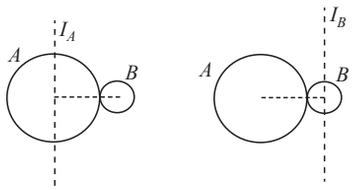
(a) $W_2 > W_1 = W_3$ (b) $W_1 > W_2 > W_3$
(c) $W_3 = W_1 > W_2$ (d) $W_3 > W_2 > W_1$

29. The lens combination as shown in the figure, consists of two lenses, L_1 and L_2 of the focal lengths +10 cm and –10 cm, respectively. The position of the image formed is



(a) 60 cm to the right of the concave lens
(b) 20 cm to the left of the concave lens
(c) 60 cm to the left of the concave lens
(d) 30 cm to the right of the concave lens

30. A solid sphere A of radius R and mass M is attached at a point to a smaller solid sphere B of radius $r < R$ and mass $m < M$. Assume that the line joining their centres lies along the horizontal. The moment of inertia of the system calculated about a vertical axis passing through the centre of A is I_A and that calculated about a vertical axis passing through the centre of B is I_B. The difference $I_A - I_B$ is



(a) 0 (b) $(M-m)(R+r)^2$
(c) $(m-M)(R+r)^2$ (d) $(m-M)(R-r)^2$

31. Consider that an electron is revolving in an excited state of Hydrogen atom with velocity $\sqrt{25.6}\times10^5$ m s^{-1}. The radius of the orbit is $x \times 10^{-9}$ m. The value of x is
[Take the mass of electron to be 9×10^{-31} kg,
charge of electron $= -1.6 \times 10^{-19}$ C and $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ Nm^{2}C^{-2}]

(a) 1 (b) 4
(c) 3 (d) 2

32. The mean free path of molecules in an ideal gas A is half that of another ideal gas B. The diameter of the spherical molecules of gas A is twice the diameter of the molecules of B. If number densities of the gases A and B are n_A and n_B, respectively, then the correct option is

(a) $n_A = \frac{1}{2}n_B$ (b) $n_A = n_B$

(c) $n_A = 2n_B$ (d) $n_A = \frac{1}{4}n_B$

33. A cylindrical cork of uniform density floats in a liquid of density ρ_1. If the cork is depressed slightly and released, it oscillates harmonically with time period T. If the same cork floats in another liquid of density ρ_2, then the similar oscillation has time period $2T$. The value of ρ_2/ρ_1 is

(a) 1/4 (b) 4
(c) 2 (d) 1/2

34. For sound waves, if the number of nodes for the 5th harmonic of an open-ended pipe is n and that for the 9th harmonic of the same pipe with one of its ends closed is m, the ratio $\frac{n}{m}$ is

(a) $\frac{3}{5}$ (b) $\frac{5}{9}$

(c) $\frac{9}{5}$ (d) 1

35. Consider the following nuclear reaction:
$^{238}U \rightarrow {}^{234}Th + {}^{4}He$

Take masses of ^{238}U, ^{234}Th and ^{4}He as 238.050 u, 234.043 u and 4.003 u, respectively. The Q value for the reaction, in keV, is
[Given: 1 u = 931.5 MeV c^{-2}]

(a) 3740 (b) 3726
(c) 3730 (d) 3736

36. Which of the following measurements require 'index correction'?

(a) Measurement of speed of sound using resonance tube
(b) Measurement of resistance of a wire using meter bridge
(c) Measurement of gravitational acceleration using simple pendulum
(d) Measurement of focal length of lenses using optical bench

37. In a solar system, the time-period of revolution of a planet tracing a circular orbit of radius R is proportional to

(a) R^3 (b) $R^{1/2}$

(c) $R^{3/2}$ (d) R^2

38. Consider that σ_s, k_B, b represent Stefan-Boltzmann constant, Boltzmann constant and Wien's displacement law constant, respectively. The dimension of $\sigma_s k_B^{-1} b$ is

(a) $[L^{-1} T^{-1} K^{-4}]$ (b) $[L^{-1} T^{-1} K^{-2}]$

(c) $[L^{-1} K^{-2}]$ (d) $[L^{-1} T^{-1} K^{-3}]$

39. A ray of light with wavelength λ is incident on three different photoelectric cells namely 1, 2 and 3. The threshold wavelength of these photoelectric cells are λ_1, λ_2, and λ_3 respectively and the magnitude of stopping potentials of these cells are V_1, V_2, and V_3 respectively. The relation between λ and threshold wavelengths are $\lambda_1 < \lambda$, $\lambda_2 > \lambda$ and $\lambda_3 >> \lambda$. The correct option is

(a) $V_1 < V_2, V_3 = 0$ (b) $V_1 = 0, V_2 < V_3$

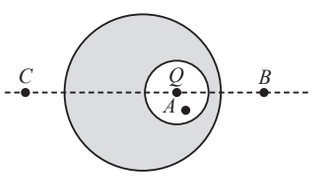
(c) $V_1 = 0, V_2 > V_3$ (d) $V_1 > V_2, V_3 = 0$

40. One main scale division of a Vernier calliper is equal to 1 mm and the number of divisions on the Vernier scale is 10. When both the jaws touch each other, the Vernier scale shifts to the left of zero of the main scale in such a way that 4th Vernier division coincides with a division of the main scale. If this Vernier calliper measures the length of a wire to be 1 cm, the actual length of the wire is

(a) 1.04 cm (b) 0.60 cm

(c) 0.96 cm (d) 1.00 cm

41. A point charge Q is placed inside a cavity within a solid isolated conducting sphere. consider points A, B and C as shown in the figure, where the magnitudes of the electric fields are E_A, E_B and E_C, respectively. The points B and C are at the same distance from the centre of the solid sphere. The correct option is

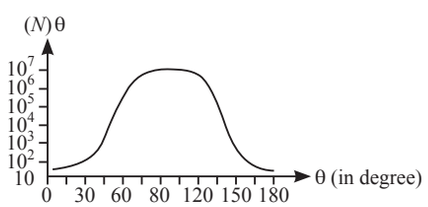


(a) $E_A \neq 0, E_B < E_C$ (b) $E_A = 0, E_B = E_C$

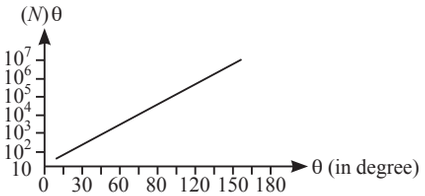
(c) $E_A \neq 0, E_B = E_C$ (d) $E_A = 0, E_B > E_C$

42. In Geiger-Marsden experiment, the number of scattered α-particles $N(\theta)$ is plotted as a function of scattering angle θ. Which of the following options represents the correct plot?

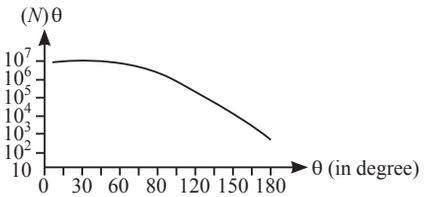
(a)



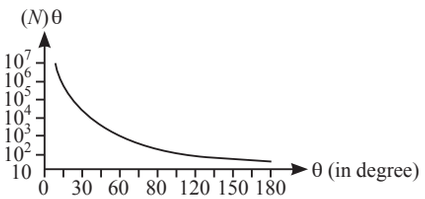
(b)



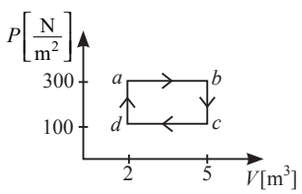
(c)



(d)



43. One mole of an ideal monatomic gas undergoes a cyclic process as shown in the figure. The total heat supplied to the gas is



(a) 800 J (b) 400 J

(c) 500 J (d) 600 J

44. Two infinitely long parallel conducting wires A and B carry currents I and $2I$, respectively, in the same direction. The wire A has uniform mass per unit length λ and lies on an insulated floor. The wire B is kept fixed at a height h above the floor. The minimum magnitude of h so that the wire A does not rise from the floor is

[g is the acceleration due to gravity and μ_0 is the permeability of free space]

(a) $\dfrac{4\mu_0 I^2}{\pi\lambda g}$ (b) $\dfrac{\mu_0 I^2}{2\pi\lambda g}$

(c) $\dfrac{\mu_0 I^2}{\pi\lambda g}$ (d) $\dfrac{2\mu_0 I^2}{\pi\lambda g}$

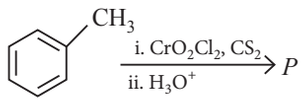
45. Consider a spring-mass simple harmonic oscillator in one dimension. The mass of the particle is m kg and the spring constant is k Nm^{-1}. At a given instant, the extension of the spring is x meter and the speed of the particle is v ms^{-1}. On the $x - v$ plane, if the graph of v as a function of x is a circle, then the correct option is

(a) $k = \sqrt{m}$ (b) $k = \dfrac{1}{m}$

(c) $k = m$ (d) $k = m^2$

CHEMISTRY

46. Consider the following reaction, and choose the correct option.



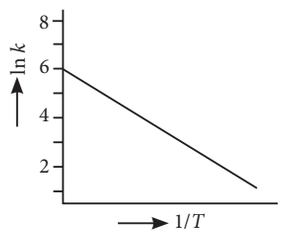
(a) Compound *P* is obtained by the hydrogenation of benzoyl chloride with Pd on $BaSO_4$.
(b) On treating compound *P* with saturated $NaHCO_3$ solution, brisk effervescence is observed.
(c) Compound *P* can be prepared by treating benzene with anhydrous $AlCl_3$ and CH_3COCl.
(d) On treatment with bromine water, compound *P* gives a white precipitate.

47. The formula of tetraammineaquachloridocobalt(III) chloride is

(a) $[Co(NH_3)_4(H_2O)Cl]Cl_2$ (b) $[Co(NH_3)_4Cl_2]\cdot H_2O$
(c) $[Co(NH_3)_4]Cl_3\cdot H_2O$ (d) $[Co(NH_3)_4(H_2O)Cl]Cl$

48. The lanthanide ion having four unpaired electrons is
(Given : Atomic numbers of Ce = 58, Nd = 60, Tb = 65 and Ho = 67)
(a) Ho^{3+} (b) Nd^{3+} (c) Ce^{3+} (d) Tb^{3+}

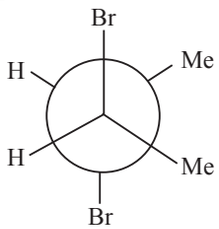
49. For an elementary chemical reaction, the Arrhenius plot is given below.



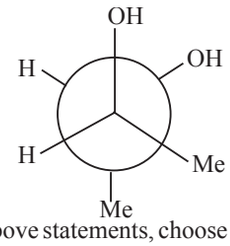
If the energy of activation is 6.64 kJ mol^{-1} and $R = 8.3$ J K^{-1} mol^{-1}, the temperature at which the rate constant becomes e^2 min^{-1}, is
(a) 250 K (b) 125 K
(c) 150 K (d) 200 K

50. The green paramagnetic species formed by heating $KMnO_4$ at 513 K is
(a) KO_2 (b) K_2MnO_4
(c) Mn_3O_4 (d) MnO

51. Given below are two statements:
Statement I: *trans*-But-2-ene upon treatment with Br_2 in CCl_4 gives the following product.

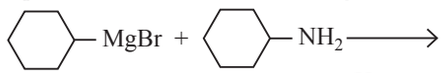


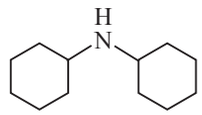
Statement II : *cis*-But-2-ene upon treatment with alkaline $KMnO_4$ gives the following product

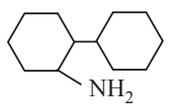


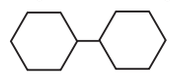
In the light of the above statements, choose the most appropriate answer from the options given below.
(a) Statement I is incorrect but statement II is correct.
(b) Both statement I and statement II are correct.
(c) Both statement I and statement II are incorrect.
(d) Statement I is correct but statement II is incorrect.

52. One of the products formed in the following reaction is



(a) 
(b) 

(c) 

(d) 

53. Given below are two statements:
Statement I: Heating NaCl with concentrated H_2SO_4 and MnO_2 results in oxidation of Mn.
Statement II: Heating NaI with concentrated H_2SO_4 and MnO_2 results in reduction of Mn.
In light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement I is incorrect but statement II is correct.
(b) Both statement I and statement II are correct.
(c) Both statement I and statement II are incorrect.
(d) Statement I is correct but statement II is incorrect.

54. Among the following options, the correct trend in the electron gain enthalpy is
(a) I > Br > Cl > F (b) F > Cl > Br > I
(c) Br > Cl > F > I (d) Cl > F > Br > I

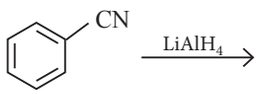
55. Give below are two statements:
Statement I: $[Fe(ox)_3]^{3-}$ is chiral.
Statement II: *trans*-$[Cr(H_2O)_2(ox)_2]^-$ is chiral.
(Given : oxH_2 = HOOC – COOH)
In light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement I is incorrect but statement II is correct.
(b) Both statement I and statement II are correct.
(c) Both statement I and statement II are incorrect.
(d) Statement I is correct but statement II is incorrect.

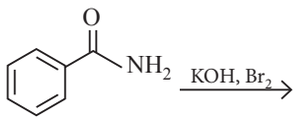
56. The correct statement about peptides and proteins is
(a) in α-helices, the polypeptide chain is twisted into a left-handed screw (helix) through intramolecular hydrogen bonds

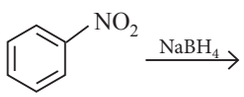
(b) tertiary structure of proteins has two or more polypeptide subunits
(c) only the proteins having a quaternary structure are biologically active
(d) in β-pleated sheet structures, peptide chains are held together by intermolecular hydrogen bonds.

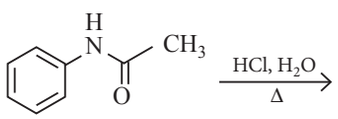
57. Given below are two statements:
Statement I: Oxidation of *p*-nitrotoluene with acidic $KMnO_4$ gives an acid that is stronger than benzoic acid.
Statement II: Reduction of *p*-nitrotoluene with Sn/HCl followed by neutralization gives an amine that is more basic than aniline.
In light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement I is incorrect but statement II is correct.
(b) Both statement I and statement II are correct.
(c) Both statement I and statement II are incorrect.
(d) Statement I is correct but statement II is incorrect.

58. Identify the reactions which give aniline as the major product.

A. 

B. 

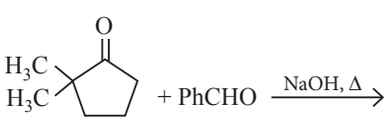
C. 

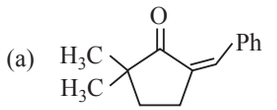
D. 

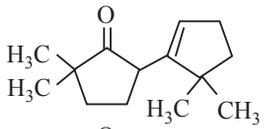
Choose the correct answer from the options given below.
(a) C and D only
(b) A and B only
(c) B and D only
(d) A and C only

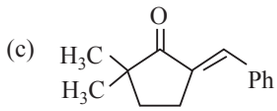
59. Two moles of an ideal gas undergo free expansion from 10 L to 100 L at 300 K. The values of ΔS_{system} and $\Delta S_{surroundings}$ are (R is universal gas constant).
(a) $\Delta S_{system} = 4.606R$; $\Delta S_{surroundings} = 0$
(b) $\Delta S_{system} = 0$; $\Delta S_{surroundings} = 0$
(c) $\Delta S_{system} = 4.606R$; $\Delta S_{surroundings} = -4.606R$
(d) $\Delta S_{system} = 0$; $\Delta S_{surroundings} = 4.606R$

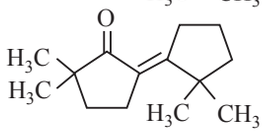
60. The compound that cannot be obtained from the aldol condensation reaction shown below, is



(a) 

(b) 

(c) 

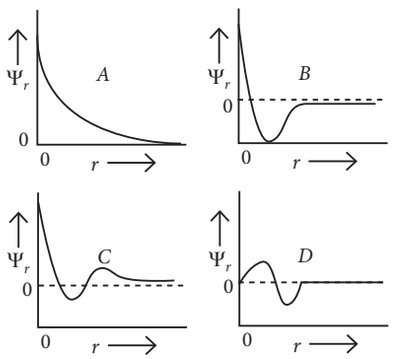
(d) 

61. The complex which has facial and meridional isomers is
(Given : *py* = pyridine and
en = $H_2N—CH_2—CH_2—NH_2$)
(a) $[Ni(en)_2(H_2O)_2]^{2+}$ (b) $[Cr(py)_3(Cl)_3]$
(c) $[Cr(H_2O)_6]^{3+}$ (d) $[Co[NH_3]_4(H_2O)_2]^{3+}$

62. The numbers 17.0145 and 21.0235 where rounded to three figures after the decimal point. The resulting numbers respectively, are
(a) 17.015 and 21.024 (b) 17.014 and 21.023
(c) 17.015 and 21.023 (d) 17.014 and 21.024

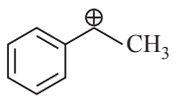
63. The amount of carbon dioxide evolved upon complete combustion of 116 g of *n*-butane is
(Given : Atomic mass in amu H = 1, C = 12
and O = 16)
(a) 362 g (b) 352 g (c) 322 g (d) 176 g

64. Consider the following schematic plots of orbital wavefunction (Ψ_r) against distance (r) from the nucleus.



The figure representing two radial nodes in the orbital is
(a) *D* (b) *A* (c) *B* (d) *C*

65. The following carbocation is stabilized by the interaction of the empty *p* orbital with



(a) empty σ* and empty π* orbitals
(b) filled σ and filled π orbitals
(c) empty σ and empty π* orbitals
(d) empty σ* and filled π orbitals

66. A 1 : 3 electrolyte in an aqueous solution is
(a) $[Co(NH_3)_3(NO_2)_3]$ (b) $[CoCl_2(NH_3)_4]Cl$
(c) $[CoCl(NH_3)_5]Cl_2$ (d) $[Co(NH_3)_6]Cl_3$

67. The standard electrode potential ($E°$) for the half-cell reaction, $Fe^{3+} + e^- \rightarrow Fe^{2+}$ at 298 K is
(Given: $E°_{(Fe^{3+}/Fe)} = -0.04$ V and $E°_{(Fe^{2+}/Fe)} = -0.44$ V at 298 K)
(a) +0.92 V (b) +0.40 V
(c) +0.76 V (d) –0.48 V

68. In potash alum, the ratio of K^+ and SO_4^{2-} ions is
(a) 3 : 2 (b) 1 : 2
(c) 2 : 1 (d) 2 : 3

69. Consider the following statements about the solutions formed by mixing two liquids.
A. An ideal solution thus formed obeys Raoult's law throughout the composition range.
B. Mixture of chloroform and acetone shows negative deviation from Raoult's law.
C. Mixture of aniline and phenol shows positive deviation from Raoult's law.
(a) A and C only (b) A and B only
(c) B and C only (d) A only

70. For a salt *XY*, which is a strong electrolyte, the plot of Λ_m versus $\sqrt{c}$ has a slope of –90.0 S cm^2 mol$^{-3/2}$ L$^{1/2}$ at 298 K. At 0.01 M concentration of *XY*, the value of Λ_m is 145.0 S cm^2 mol^{-1}. The limiting molar conductivity of Y^- ion ($\lambda°_{Y^-}$, in S cm^2 mol^{-1}) at 298 K will be
(Given: $\lambda°_{X^+} = 74.0$ S cm^2 mol^{-1})
(a) 76.0 (b) 80.0
(c) 100.0 (d) 90.0

71. Arrange the following compounds in the increasing order of polarity.
A. $CH_3CH_2OCH_2CH_3$ B. CH_3CH_2OH
C. CH_3COCH_3 D. CH_3COOH
Choose the correct answer from the options given below.
(a) A < C < B < D (b) A < B < C < D
(c) C < A < D < B (d) C < A < B < D

72. According to crystal field theory, the correct order of ligands with respect to their decreasing order of field strength is
(a) $Cl^- > NH_3 > H_2O > CO$
(b) $CO > NH_3 > H_2O > Cl^-$
(c) $CO > H_2O > NH_3 > Cl^-$
(d) $Cl^- > H_2O > NH_3 > CO$

73. The amino acid that gives a red-blood colour on treating is sodium fusion extract with sodium nitroprusside is
(a) serine (b) leucine
(c) threonine (d) methionine.

74. In an acidic medium, 10 mL of 0.25 M oxalic acid is titrated with $KMnO_4$ solution. If the volume of $KMnO_4$ solution required to reach end point is 10 mL, the strength of the $KMnO_4$ solution is
(a) 0.15 M (b) 0.10 M
(c) 0.20 M (d) 0.25 M

75. The correct statement is
(a) aluminium has five valence orbitals
(b) boron has a maximum covalency of four
(c) beryllium has three valence orbitals
(d) magnesium has a maximum covalency of four.

76. Among the following, the compound having conjugated double bonds is
(a) hepta-1,6-diene (b) hepta-1,3-diene
(c) hepta-1,4-diene (d) hepta-1,5-diene.

77. $2A \xrightarrow{k} B$ is a zero-order reaction, where $k = 1.0$ mol L^{-1} min^{-1}. If the initial concentration of *A* is 2 M, then the time taken to complete 75% of the reaction will be
(a) 2.0 min (b) 1.5 min
(c) 0.75 min (d) 1.0 min.

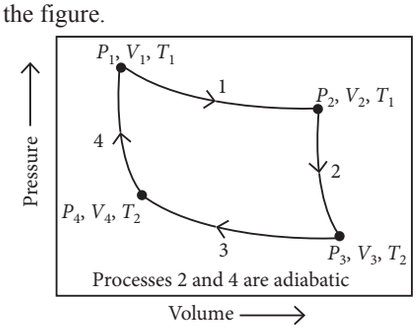
78. The correct order of solubility of the given salts in water at 298 K is

Salt	K_{sp} at 298 K
AgBr	5.0×10^{-13}
$Zn(OH)_2$	1.0×10^{-15}
Hg_2Cl_2	1.3×10^{-18}

(a) $Zn(OH)_2 > AgBr > Hg_2Cl_2$
(b) $Hg_2Cl_2 > Zn(OH)_2 > AgBr$
(c) $AgBr > Zn(OH)_2 > Hg_2Cl_2$
(d) $Hg_2Cl_2 > AgBr > Zn(OH)_2$

79. The correct decreasing order of oxidation state of the underlined atom in each molecule is
(a) $\underline{P}_4O_6 > \underline{Cl}_2O_7 > \underline{Al}H_3$ (b) $\underline{P}_4O_{10} > \underline{S}O_3 > H_2\underline{O}$
(c) $\underline{N}_2O_5 > \underline{Al}_2O_3 > H_2\underline{S}$ (d) $\underline{Pb}O_2 > \underline{N}_2O_3 > \underline{S}O_3$

80. Consider the reversible processes for 1.0 mol of an ideal gas as shown in the figure.



w_1, w_2, w_3 and w_4 represent work done (in calories) in the processes 1, 2, 3 and 4, respectively; ΔU_2 and ΔU_4 are changes in the internal energy for the processes 2 and 4, respectively.
[use $R = 2$ cal K^{-1} mol^{-1}]
The correct option is
(a) $w_1 + w_2 + w_3 + w_4 = 0$
(b) $w_1 + w_3 = -2T_1 \ln\frac{V_2}{V_1} - 2T_2 \ln\frac{V_4}{V_3}$
(c) $w_2 + w_4 = \Delta U_2 - \Delta U_4$
(d) $w_1 + w_2 = 2T_1 \ln\frac{V_2}{V_1}$

81. **Assertion A :** For an ideal solution formed by mixing liquids P and Q, $\Delta_{mix}H = 0$ and $\Delta_{mix}V = 0$.
Reason R : No interactions occur between P and Q. In the light of the above statements, choose the most appropriate answer from the options given below.
(a) A is not correct but R is correct.
(b) Both A and R are correct and R is the correct explanation of A.
(c) Both A and R are correct but R is not the correct explanation of A.
(d) A is correct but R is not correct.

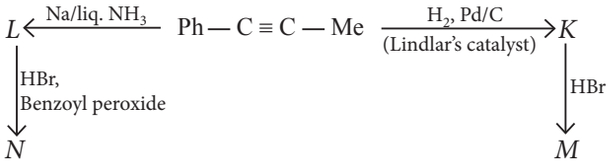
82. Among the species given below, the spin-only magnetic moment is highest for
(Given : Atomic number of Ti = 22, Mn = 25, Fe = 26 and Co = 27)
(a) $[Ti(H_2O)_6]^{3+}$ (b) $[Mn(CN)_6]^{3-}$
(c) $[Fe(CN)_6]^{3-}$ (d) $[Co(NH_3)_6]^{3+}$

83. A protein undergoes reversible thermal denaturation from its initial state N to denatured state D according to $N \rightleftharpoons D$. At 60°C, the concentration of both N and D are equal at equilibrium, and the standard enthalpy change of denaturation is 666 kJ mol^{-1}. The standard entropy change ($\Delta S°$ in kJ K^{-1} mol^{-1}) of the protein upon denaturation at 60°C is closest to
(a) 11.1 (b) 2.0
(c) 2000.0 (d) 333.0

84. Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Generally, 3*d* transition metals have high melting points.
Reason (R) : Involvement of 3*d*-electrons in addition to 4*s*-electrons in the interatomic metallic bonding.
In light of the above statements, choose the most appropriate answer from the options given below:
(a) A is not correct but R is correct.
(b) Both A and R are correct and R is the correct explanation of A.
(c) Both A and R are correct but R is not the correct explanation of A.
(d) A is correct but R is not correct.

85. Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : The first ionization enthalpy of O is lower than that of N and F.
Reason (R) : The loss of an electron from O leads to stable half-filled *p* orbital.
In light of the above statements, choose the most appropriate answer from the options given below:
(a) A is not correct but R is correct.
(b) Both A and R are correct and R is the correct explanation of A.
(c) Both A and R are correct and R is not the correct explanation of A.
(d) A is correct but R is not correct.

86. Consider the following reaction sequences and choose the correct option.



(a) M and N are stereoisomers.
(b) K and L are geometrical isomers.
(c) K and L are enantiomers.
(d) M and N are geometrical isomers.

87. The highest occupied molecular orbital for Ne_2 is
(a) σ^*_{2p} (b) π_{2p} (c) σ_{2p} (d) π^*_{2p}

88. Match the species in list-I with their geometry in list-II.

List-I		List-II	
A.	PCl_5	I.	Tetrahedral
B.	BrF_5	II.	Square planar
C.	BF_4^-	III.	Trigonal bipyramidal
D.	$[Ni(CN)_4]^{2-}$	IV.	Square pyramidal

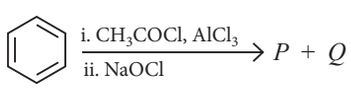
Choose the correct answer from the options given below:
(a) A-III, B-II, C-I, D-IV (b) A-IV, B-III, C-I, D-II
(c) A-III, B-IV, C-I, D-II (d) A-III, B-I, C-II, D-IV

89. Match the vitamins in list-I with their sources in list-II.

List-I		List-II	
A.	Vitamin A	I.	Meat
B.	Vitamin B_{12}	II.	Sunflower oil
C.	Vitamin E	III.	Green leafy vegetables
D.	Vitamin K	IV.	Carrots

Choose the correct answer from the options given below:
(a) A-III, B-I, C-IV, D-II (b) A-II, B-III, C-IV, D-I
(c) A-IV, B-I, C-II, D-III (d) A-IV, B-II, C-I, D-III

90. For the following reaction sequence, choose the correct option.



(a) Both P and Q are carbonyl compounds.
(b) If P is the sodium salt of a carboxylic acid, Q is a primary alcohol.
(c) P and Q are aromatic compounds.
(d) If P gives a carboxylic acid on acidification, Q gives a poisonous gas on exposure to air and light.

BIOLOGY

91. Given below are two statements:
Statement-I : The class name Reptilia refers to creeping or crawling mode of locomotion.
Statement-II : All organisms belonging to Reptilia have three chambered heart.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement-I is incorrect but Statement-II is correct.
(b) Both Statement-I and Statement-II are correct.
(c) Both Statement-I and Statement-II are incorrect.
(d) Statement-I is correct but Statement-II is incorrect.

92. How many turns of Calvin cycle are required for the formation of three molecules of glucose?
(a) 18 (b) 6 (c) 3 (d) 1

93. Photorespiration reaction catalysed by RuBisCo is shown below:
RuBP + $O_2 \rightarrow$ 3-Phosphoglycerate + *X*
Identify "*X*" from the given options:
(a) Malate (b) Phosphoenolpyruvate
(c) 2-Phosphoglycolate (d) Oxaloacetate

94. Given below are two statements:
Statement-I : In gymnosperms, the male and female gametophytes remain within the sporangia.
Statement-II : In gymnosperms, seeds are not covered.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement-I is incorrect but Statement-II is correct.
(b) Both Statement-I and Statement-II are correct.
(c) Both Statement-I and Statement-II are incorrect.
(d) Statement-I is correct but Statement-II is incorrect.

95. How many molecules of pyruvic acid are produced at the end of glycolysis from 206 molecules of glucose?
(a) 412 (b) 206 (c) 309 (d) 103

96. Match List-I with List-II.

List-I	List-II
A. Fusion of protoplasms between gametes	I. Meiosis
B. Fusion of two nuclei	II. Plasmogamy
C. Generation of haploid spores	III. Karyogamy

Choose the correct answer from the options given below:
(a) A-I, B-III, C-II (b) A-II, B-III, C-I
(c) A-II, B-I, C-III (d) A-III, B-II, C-I

97. Mitochondrial inner membrane encloses _____.
(a) aqueous humor (b) matrix
(c) cytosol (d) mucus

98. Phyllotaxy is the pattern of arrangement of ____.
(a) sepals (b) leaves
(c) flowers (d) fruits

99. Mad cow disease is caused by _____.
(a) *Mycoplasma sp*. (b) prions
(c) viroids (d) *Aspergillus sp*.

100. Cell theory was formulated by _____.
(a) Antonie Von Leeuwenhoek
(b) Schleiden and Schwann
(c) Robert Brown
(d) Singer and Nicolson

101. Which of the following plant growth regulators promotes internode elongation prior to flowering cabbage?
(a) Ethephon (b) Abscisic acid
(c) Gibberellin (d) Indole butyric acid

102. Which pigment has absorption peak at 700 nm in the photosynthetic reaction centre PS I (P700)?
(a) Carotenoids (b) Chlorophyll *b*
(c) Chlorophyll *a* (d) Xanthophylls

103. Sphenopsida class belongs to _____.
(a) pteridophytes (b) bryophytes
(c) angiosperms (d) gymnosperms

104. Which of the following represents the correct sequence of arrangement of bones in the lower limb of humans?
(a) Femur-tarsal-patella-tibia
(b) Femur-tibia-patella-tarsal
(c) Patella-femur-tibia-tarsal
(d) Femur-patella-tibia-tarsal

105. Which of the following plant growth regulators is used as herbicide?
(a) Gibberellin (b) 2,4-D
(c) Kinetin (d) Abscisic acid

106. Genus represents _____.
(a) a group of closely related families
(b) an individual plant or animal
(c) a population of plants and animals
(d) a group of closely related species

107. The plastid that stores xanthophyll is known as _____.
(a) amyloplast (b) chloroplast
(c) chromoplast (d) aleuroplast

108. In water, frogs respire using _____.
(a) trachea (b) skin
(c) buccal cavity (d) lungs

109. Which of the following is not a characteristic of chordates?
(a) Presence of post anal part (tail)
(b) Presence of notochord
(c) Central nervous system is dorsal
(d) Absence of gills

110. Smooth endoplasmic reticulum _____.
(a) is a site for the synthesis of carbohydrates
(b) has ribosomes attached to its surface
(c) is the major site for the synthesis of lipids
(d) is actively involved in protein synthesis

111. Which of the following are characteristics of prokaryotic cells?
(A) Ribosomes are made of 50S and 30S subunits
(B) They can have plasmids
(C) They contain mesosome
(D) They have peroxisomes
Choose the correct answer from the options given below:
(a) (A), (B) and (C) only
(b) (B) and (C) only
(c) (A) and (C) only
(d) (A), (C) and (D) only

112. Match List-I with List-II.

	List-I		List-II
A.	Cristae	I.	Flat membrane sacs in stroma of chloroplast
B.	Cisternae	II.	Infoldings in mitochondria
C.	Thylakoids	III.	Cell membrane
D.	Phospholipid	IV.	Disc shaped sacs in the Golgi apparatus

Choose the correct answer from the options given below:
(a) A-IV, B-III, C-I, D-II
(b) A-III, B-IV, C-I, D-II
(c) A-II, B-IV, C-I, D-III
(d) A-II, B-IV, C-III, D-I

113. Which of the following statements related to pituitary gland are correct?
(A) It is divided anatomically into adenohypophysis and neurohypophysis.
(B) It secretes follicle stimulating hormone.
(C) It secretes melanocyte stimulating hormone.
(D) It does not secrete prolactin.
Choose the correct answer from the options given below:
(a) (B) and (C) only
(b) (A) and (B) only
(c) (A), (B) and (C) only
(d) (C) and (D) only

114. Which of the following statements regarding photorespiration are correct?
(A) Do not occur in C_3 plants
(B) CO_2 is consumed and O_2 is generated
(C) Phosphoglycolate is formed
(D) No synthesis of ATP and NADPH
Choose the correct answer from the options given below:
(a) (A) and (B) only (b) (A) and (D) only
(c) (C) and (D) only (d) (B) and (D) only

115. Which of the following statements is incorrect?
(a) Fibrinogen is produced from fibrin
(b) Blood coagulates in response to an injury
(c) Blood clot consists of fibrins
(d) Fibrin is produced from fibrinogen

116. Arrange the following taxonomic categories in ascending order.
(A) Genus (B) Class
(C) Order (D) Phylum
(E) Family (F) Kingdom
(G) Species
Choose the correct answer from the options given below:
(a) (F), (C), (B), (G), (D), (E), (A)
(b) (G), (A), (E), (C), (B), (D), (F)
(c) (A), (C), (D), (G), (F), (B), (E)
(d) (G), (C), (D), (B), (E), (A), (F)

117. Select the correct sequence of experiments that led to a gradual understanding of photosynthesis in green plants.
(a) Production of glucose → role of air → release of oxygen → absorption spectra of chlorophyll *a* and *b*
(b) Absorption spectra of chlorophyll *a* and *b* → production of glucose → release of oxygen → role of air
(c) Role of air → release of oxygen → production of glucose → absorption spectra of chlorophyll *a* and *b*
(d) Release of oxygen → production of glucose → absorption spectra of chlorophyll *a* and *b* → role of air

118. Match List-I with List-II.

	List-I		List-II
A.	Starch	I.	Fights infection
B.	Antibody	II.	Energy storage
C.	Concanavalin A	III.	Glucose transport
D.	GLUT-4	IV.	Lectin

Choose the correct answer from the options given below:
(a) A-I, B-II, C-III, D-IV
(b) A-I, B-II, C-IV, D-III
(c) A-II, B-I, C-IV, D-III
(d) A-II, B-I, C-III, D-IV

119. The number of vertebrae in a human is _____.
(a) 206 (b) 7 (c) 12 (d) 26

120. Endomembrane system includes _____.
(a) Golgi complex, chloroplast, peroxisomes and vacuole
(b) endoplasmic reticulum, Golgi complex, lysosomes and vacuole
(c) endoplasmic reticulum, chloroplast, peroxisomes and vacuole
(d) mitochondria, chloroplast, peroxisomes and vacuole

121. Length of the stem at time 0 is 20 cm. The arithmetic growth rate is 30 cm per day. What is the length of the stem at the end of the 7^{th} day?
(a) 460 cm (b) 50 cm (c) 170 cm (d) 230 cm

122. Match List-I with List-II.

	List-I		List-II
A.	Spherical	I.	Vibrio
B.	Rod	II.	Cocci
C.	Comma	III.	Spirilla
D.	Spirillum	IV.	Bacilli

Choose the correct answer from the options given below:
(a) A-II, B-IV, C-I, D-III (b) A-I, B-III, C-II, D-IV
(c) A-III, B-II, C-I, D-IV (d) A-II, B-I, C-IV, D-III

123. The number of action potentials generated by sino-arterial node (SAN) in a healthy human is _____ per minute.
(a) 120-140 (b) 28-30
(c) 70-75 (d) 100-110

124. Match List-I with List-II.

	List-I		List-II
A.	Family	I.	Sapindales
B.	Genus	II.	Dicotyledonae
C.	Class	III.	Anacardiaceae
D.	Phylum	IV.	Angiospermae
E.	Order	V.	*Mangifera*

Choose the correct answer from the options given below:
(a) A-III, B-V, C-II, D-IV, E-I
(b) A-I, B-V, C-II, D-IV, E-III
(c) A-II, B-I, C-III, D-IV, E-V
(d) A-II, B-III, C-V, D-I, E-IV

125. Which of the following is not a part of human central neural system?
(a) Pericardium (b) Arachnoid
(c) Dura mater (d) Pia mater

126. Given below are two statements:
Statement I : Chromosomes are fully condensed at the end of prophase I.
Statement II : Meiosis I resembles mitosis.
In the light of the above statements choose the most appropriate 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

127. Match List-I with List-II.

	List-I		List-II
A.	Marginal placentation	I.	*Argemone*
B.	Axile placentation	II.	Tomato
C.	Parietal placentation	III.	*Primrose*
D.	Free central placentation	IV.	Pea

Choose the correct answer from the options given below:
(a) A-IV, B-II, C-I, D-III (b) A-II, B-IV, C-I, D-III
(c) A-IV, B-II, C-III, D-I (d) A-IV, B-III, C-I, D-II

128. Symbiotic association between fungi and algae are called _____.
(a) chrysophytes (b) lichens
(c) sponges (d) mycorrhiza

129. Which of the following is not a prokaryote?
(a) Fungi (b) Bacteria
(c) Blue green algae (d) Mycoplasma

130. Arrange the following elements in descending order of their contribution to percentage weight of the human body.
(A) Oxygen (B) Carbon
(C) Hydrogen (D) Nitrogen
Choose the correct answer from the options given below:
(a) (B), (A), (C), (D) (b) (A), (B), (C), (D)
(c) (C), (A), (B), (D) (d) (B), (C), (D), (A)

131. Which one of the following statements is incorrect?
(a) β-cells of pancreas secrete insulin
(b) α-cells of pancreas secrete glucagon
(c) α-cells of pancreas secrete insulin
(d) Glucagon stimulates glycogenolysis

132. Which of the following are characteristic features of Solanaceae family?
(A) Flowers are bisexual and actinomorphic
(B) Calyx have five sepals and are united
(C) Androecium have five stamens and are epipetalous
(D) Ovary is inferior
Choose the correct answer from the options given below:
(a) (B), (C) and (D) only
(b) (A), (B) and (C) only
(c) (D) only
(d) (A) and (B) only

133. Given below are two statements:
Statement-I : When any plane passing through the central axis of the body divides the organism into two identical halves, it is called radial symmetry.
Statement-II : In phylum Echinodermata, both adults and larvae are radially symmetrical.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement-I is incorrect but Statement-II is correct.
(b) Both Statement-I and Statement-II are correct.
(c) Both Statement-I and Statement-II are incorrect.
(d) Statement-I is correct but Statement-II is incorrect.

134. The correct sequence of adult cell cycle phases is _____.
(a) S-M-G_2-G_1 (b) G_1-G_2-S-M
(c) G_1-M-G_2-S (d) G_1-S-G_2-M

135. In frogs, the number of pairs of cranial nerves arising from the brain are _____.
(a) 12 (b) 6 (c) 9 (d) 10

136. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : In recombinant DNA technology, lysozyme is used for disrupting bacterial cells while cellulase is for plant cells.
Reason R : Isolation of genetic material needs disruption of cells.

In the light of the above statements, choose the most appropriate answer from the options given below:

(a) A is not correct but R is correct.
(b) Both A and R are correct and R is the correct explanation of A.
(c) Both A and R are correct but R is not the correct explanation of A.
(d) A is correct but R is not correct.

137. The method of directly of injecting a sperm into ovum in assisted reprodutive technology is called:

(a) Embryo transfer (ET)
(b) Gamete intra fallopian transfer (GIFT)
(c) Zygote intra fallopian transfer (ZIFT)
(d) Intra cytoplasmic sperm injection (ICSI)

138. Adaptive radiation in placental mammals and Australian Marsupials leading to similarity between distant species is an example of _____.

(a) genetic drift (b) divergent evolution
(c) convergent evolution (d) founder effect

139. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : In an experiment, Mendel observed that the F_1 progeny plants are all tall and none are dwarf.

Reason R : Stem height is a contrasting trait, with tall being dominant and dwarf being recessive.

In the light of the above statements choose the most appropriate answer from the options given below:

(a) A is not correct but R is correct
(b) Both A and R are correct and R is the correct explanation of A
(c) Both A and R are correct but R is not the correct explanation of A
(d) A is correct but R is not correct

140. Arrange the following in descending order of number of species in the Amazonian rain forest.

(A) Plants (B) Birds
(C) Fishes (D) Invertebrates
(E) Mammals

Choose the correct answer from the options given below:

(a) (B) > (A) > (D) > (C) > (E)
(b) (C) > (B) > (D) > (E) > (A)
(c) (D) > (A) > (C) > (B) > (E)
(d) (E) > (B) > (A) > (C) > (D)

141. Sponges exchange O_2 with CO_2 by _____.

(a) gills
(b) simple diffusion over their entire body surfaces
(c) moist cuticle
(d) tracheal tubes

142. For a person with blood group 'O', which of the following is not a possible combination of parent's blood group genotypes?

(a) Father : I^AI^B and Mother : I^Ai
(b) Father : I^Ai and Mother : I^Bi
(c) Father : I^Ai and Mother : I^Ai
(d) Father : I^Bi and Mother : I^Bi

143. Given below are two statements:

Statement I : Modern *Homo sapiens* arose in Australia and moved across continents .

Statement II : *Homo sapiens* arose around 75000 to 10000 years ago.

In the light of the above statements choose the most appropriate answer from the options given below:

(a) Statement I is incorrect but Statement II is correct
(b) Both Statement I and Statement II are correct
(c) Both Statement I and Statement II are incorrect
(d) Statement I is correct but Statement II is incorrect

144. Which of the following is used as an effective sedative and painkiller for treating post-surgery patients?

(a) Anti-retroviral drugs (b) Interferon
(c) Antibiotics (d) Morphine

145. Which of the following plant produces non-albuminous seeds?

(a) Pea (b) Wheat
(c) Maize (d) Barley

146. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Abingdon tortoise in Galapagos islands became extinct within a decade after goats were introduced.

Reason R : Goats were more efficient at browsing than Abingdon tortoise.

In the light of the above statements, choose the most appropriate answer from the options given below:

(a) A is not correct but R is correct
(b) Both A and R are correct 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 correct but R is not correct

147. The covering of ovum at ovulation is ____.

(a) chorion (b) endometrium
(c) zona radiata (d) zona pellucida

148. Which of the following is used as a clot buster?

(a) Statins (b) Streptokinase
(c) Penicillin (d) Cyclosporin A

149. Which of the following structure is not a part of the male reproductive system?

(a) Infundibulum (b) Rete testis
(c) Epididymis (d) Vasa efferentia

150. Given below are two statements:

Statement I : Ovulation is caused by LH surge leading to rupture of Graafian follicles.

Statement II : Graafian follicle remaining after ovulation transform into corpus luteum and secretes large amount of estrogen.

In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement I is incorrect but Statement II is correct
(b) Both Statement I and Statement II are correct.
(c) Both Statement I and Statement II are incorrect.
(d) Statement I is correct but Statement II is incorrect.

151. The opening between the right atrium and the right ventricle is guarded by _____.
(a) sino-atrial node (b) bicuspid valve
(c) tricuspid valve (d) semilunar valve

152. Which of the following is not evidence for evolution?
(a) Divergent evolution of anatomical structures such as forelimbs
(b) Convergent evolution of traits like wings of birds and butterflies
(c) Paleontological evidence from fossil records
(d) Embryological support for evolution as proposed by Ernst Heckel

153. The inactive form of Bt toxin is converted to the active form in the insect gut _____.
(a) by nucleases (b) due to alkaline pH
(c) due to acidic pH (d) by proteases

154. Colostrum, secreted by mother during initial days of lactation, is abundant in ____
(a) IgD (b) IgG (c) IgM (d) IgA

155. Which of the following in female gametophyte of an angiosperm helps in guiding the pollen tube for fertilizing the eggs?
(a) Polar nucleus (b) Antipodals
(c) Synergids (d) Central cells

156. Which of the following disease is not sexually transmitted?
(a) Genital warts (b) Syphilis
(c) Tuberculosis (d) Gonorrhoea

157. Which of the following statements about *lac*-operon is correct?
(a) Galactose can act as an inducer of *lac* operon
(b) Gene *i* is constitutively expressed
(c) Lactose activates repressor to bind to the operator
(d) Genes *i*, *z*, *y* and *a* share single common promoter

158. Match List-I with List-II.

	List-I		**List-II**
A.	Transformation	I.	Restriction enzyme
B.	Cloning site	II.	Transfer DNA to host bacteria
C.	Selection	III.	Replication
D.	*ori*	IV.	Antibiotic

Choose the correct answer from the options given below:
(a) A-IV, B-I, C-III, D-II (b) A-II, B-I, C-IV, D-III
(c) A-I, B-II, C-IV, D-III (d) A-III, B-IV, C-II, D-I

159. A population of diploid organisms is at Hardy-Weinberg equilibrium. If the frequency of allele A is 0.1, the frequency of AA is _____.
(a) 0.99 (b) 0.01 (c) 0.02 (d) 0.10

160. Sperm motility is due to _____.
(a) muscular movement (b) flagellar movement
(c) ciliary movement (d) amoeboid movement

161. Consider a population of 10 million cells. Given the per-capita birth rate of 0.002 (per unit time) and the per-capita death rate of 0.002 (per unit time), the expected number of cells after 10 generations is _____.
(a) 100 million (b) 1 million
(c) 5 million (d) 10 million

162. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : Forelimbs of human and bats are homologous.
Reason R : Forelimbs of humans and bats have similar anatomical structure.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) A is false but R is true
(b) Both A and R are correct 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

163. Muscle contraction is initiated by a signal sent by the central nervous system by the release of _____.
(a) cyclic adenine monophosphate
(b) acetyl choline
(c) acetyl coenzyme A
(d) cyclic guanine monophosphate

164. Which of the following hormone is not secreted by human placenta?
(a) LH (b) hCG
(c) Estrogen (d) Progesterone

165. Which of the following statements is correct about *Plasmodium*?
(a) Fertilization takes place in mosquito gut
(b) Reproduces sexually in liver cells
(c) Reproduces sexually in RBCs
(d) Gametocytes develop in mosquito gut

166. Which of the following are primary consumers in a food chain?
(a) Carnivores (b) Parasites
(c) Predators (d) Herbivores

167. Which of the following statements about the reabsorption process in Henle's loop are correct?
(A) The descending limb of Henle's loop is permeable to water but almost impermeable to electrolytes.
(B) Urine gets concentrated in Henle's loop.
(C) Reabsorption of Na^+ and water takes place in Henle's loop.
(D) Active or passive transport of electrolytes occurs in the ascending limb of Henle's loop.
Choose the correct answer from the options given below:
(a) (A),(B) and (D) only (b) (A) and (B) only
(c) (B), (C) and (D) only (d) (A), (B) and (C) only

168. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : The logistic growth model of populations is considered more realistic than the exponential growth model.
Reason R : Resources are finite.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) A is not correct but R is correct
(b) Both A and R are correct and R is the correct explanation of A
(c) Both A and R are correct but R is not the correct explanation of A
(d) A is correct but R is not correct

169. Which of the following is the correct order of arrangement of vertebrate column from the head to toe?
(a) Cervical vertebra, thoracic vertebra, lumbar vertebra, sacrum
(b) Cervical vertebra, thoracic vertebra, sacrum, lumbar vertebra
(c) Sacrum, lumbar vertebra, thoracic vertebra, cervical vertebra
(d) Cervical vertebra, lumbar vertebra, thoracic vertebra, sacrum

170. Match List-I with List-II.

	List-I		**List-II**
A.	Both species are harmed	I.	Predation
B.	One species is harmed and the other is benefited	II.	Mutualism
C.	Both species are benefited	III.	Competition
D.	One is benefited while the other has no effect	IV.	Commensalism

Choose the correct answer from the options given below:
(a) A-III, B-I, C-II, D-IV (b) A-III, B-IV, C-II, D-I
(c) A-I, B-II, C-III, D-IV (d) A-II, B-I, C-IV, D-III

171. If the diploid chromosome number of typical angiosperm is 36, what would be the chromosome number in its endosperm?
(a) 72 (b) 18 (c) 36 (d) 54

172. Which of the following enzymes synthesizes precursor mRNA?
(a) DNA polymerase (b) RNA polymerase I
(c) RNA polymerase II (d) RNA polymerase III

173. Given below are two statements:
Statement I : Plasmids are autonomously replicating DNA.
Statement II : Plasmids are extrachromosomal DNA.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement I is incorrect but Statement II is correct.
(b) Both Statement I and Statement II are correct
(c) Both Statement I and Statement II are incorrect
(d) Statement I is correct but Statement II is incorrect

174. How many theca are present in each lobe of a typical bilobed angiosperm anther?
(a) 12 (b) 2 (c) 6 (d) 8

175. Natural selection can lead to _____.
(A) stabilisation (B) genetic drift
(C) directional change (D) disruption
Choose the correct answer from the options given below:
(a) (A) and (C) only (b) (A) only
(c) (A), (C) and (D) only (d) (A), (B), (C) and (D)

176. Which of the following statements are correct?
(A) Energy flow from producers to consumers is unidirectional
(B) Energy pyramid can never be inverted
(C) Transfer of energy follows the 1% law
Choose the correct answer from the options given below:
(a) (B) and (C) only (b) (A), (B) and (C)
(c) (A) and (B) only (d) (A) and (C) only

177. Match List-I with List-II.

	List-I		**List-II**
A.	Excess growth hormone	I.	Reabsorption of water and electrolytes in kidney
B.	Luteinizing hormone	II.	Contraction of uterus during child birth
C.	Vasopressin	III.	Acromegaly
D.	Oxytocin	IV.	Ovulation

Choose the correct answer from the options given below:
(a) A-IV, B-III, C-I, D-II (b) A-III, B-IV, C-II, D-I
(c) A-III, B-IV, C-I, D-II (d) A-II, B-IV, C-I, D-III

178. Which of the following are secondary lymphoid organs?
(A) Bone marrow (B) Tonsils
(C) Spleen (D) Thymus
Choose the correct answer from the options given below:
(a) (A) and (D) only (b) (A) and (B) only
(c) (B) and (C) only (d) (B) and (D) only

179. During PCR, primers bind to the DNA strands in the _____ step.
(a) ligation (b) denaturation
(c) extension (d) annealing

180. Given below are two statements:
Statement I : Down's syndrome is caused by the absence of one of the X-chromosomes.
Statement II : Turner's syndrome is caused by the presence of an additional copy of the chromosomes.
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 correct.
(b) Both Statement I and Statement II are correct
(c) Both Statement I and Statement II are incorrect
(d) Statement I is correct but Statement II is incorrect

ANSWER KEY

PHYSICS

1.	(d)	2.	(a)	3.	(d)	4.	(b)	5.	(d)	6.	(b)	7.	(b)	8.	(c)	9.	(b)	10.	(d)
11.	(b)	12.	(a)	13.	(a)	14.	(c)	15.	(d)	16.	(d)	17.	(d)	18.	(b)	19.	(a)	20.	(b)
21.	(d)	22.	(c, d)	23.	(a)	24.	(c)	25.	(d)	26.	(b)	27.	(d)	28.	(d)	29.	(c)	30.	(c)
31.	(a)	32.	(a)	33.	(a)	34.	(d)	35.	(b)	36.	(d)	37.	(c)	38.	(b)	39.	(b)	40.	(*)
41.	(c)	42.	(d)	43.	(d)	44.	(c)	45.	(c)										

CHEMISTRY

46.	(a)	47.	(a)	48.	(a)	49.	(d)	50.	(b)	51.	(a)	52.	(a)	53.	(a)	54.	(d)	55.	(d)
56.	(d)	57.	(b)	58.	(c)	59.	(a)	60.	(b)	61.	(b)	62.	(d)	63.	(b)	64.	(d)	65.	(b)
66.	(d)	67.	(c)	68.	(b)	69.	(b)	70.	(b)	71.	(a)	72.	(b)	73.	(d)	74.	(b)	75.	(b)
76.	(b)	77.	(b)	78.	(a)	79.	(c)	80.	(b)	81.	(d)	82.	(b)	83.	(b)	84.	(b)	85.	(c)
86.	(b)	87.	(a)	88.	(c)	89.	(c)	90.	(d)										

BIOLOGY

91.	(d)	92.	(a)	93.	(c)	94.	(b)	95.	(a)	96.	(b)	97.	(b)	98.	(b)	99.	(b)	100.	(b)
101.	(c)	102.	(c)	103.	(a)	104.	(d)	105.	(b)	106.	(d)	107.	(c)	108.	(b)	109.	(d)	110.	(c)
111.	(a)	112.	(c)	113.	(c)	114.	(c)	115.	(a)	116.	(b)	117.	(c)	118.	(c)	119.	(d)	120.	(b)
121.	(d)	122.	(a)	123.	(c)	124.	(a)	125.	(a)	126.	(d)	127.	(a)	128.	(b)	129.	(a)	130.	(b)
131.	(c)	132.	(b)	133.	(d)	134.	(d)	135.	(d)	136.	(b)	137.	(d)	138.	(c)	139.	(b)	140.	(c)
141.	(b)	142.	(a)	143.	(a)	144.	(d)	145.	(a)	146.	(b)	147.	(d)	148.	(b)	149.	(a)	150.	(d)
151.	(c)	152.	(d)	153.	(b)	154.	(d)	155.	(c)	156.	(c)	157.	(b)	158.	(b)	159.	(b)	160.	(b)
161.	(d)	162.	(b)	163.	(b)	164.	(a)	165.	(a)	166.	(d)	167.	(a)	168.	(b)	169.	(a)	170.	(a)
171.	(d)	172.	(c)	173.	(b)	174.	(b)	175.	(c)	176.	(c)	177.	(c)	178.	(c)	179.	(d)	180.	(c)

**None of the given options is correct.*

Explanations

1. (d) : Energy of photon = Energy of electron = 20 eV

$c = 3 \times 10^8$ m/s, $m_e = 9 \times 10^{-31}$ kg

Momentum of photon, $p_{Ph} = \frac{E}{c}$ ...(i)

Momentum of electron, $p_e = \sqrt{2mE}$ ...(ii)

So, $\frac{p_e}{p_{ph}} = \frac{\sqrt{2mE}}{E/c} = c\sqrt{\frac{2m}{E}}$ ...(iii)

Substituting all values in equation (iii) we have

$$\frac{p_e}{p_{ph}} = 3\times10^8\sqrt{\frac{2\times9\times10^{-31}}{20\times1.6\times10^{-19}}}$$

$= 3\times10^8\sqrt{56.25\times10^{-14}}$ $= 3 \times 10^8\ (7.5 \times 10^{-7}) = 225$

So, $\frac{p_e}{p_{ph}} = 225$

2. (a) : $\Delta P = 15$ N/m^2, $A_P = 40$ cm^2, $A_Q = 20$ cm^2 and $\rho = 1000$ kg/m^3

According to the equation of continuity,

$v_P \times A_P = v_Q \times A_Q$

$v_P \times 40 = v_Q \times 20 \Rightarrow 2v_P = v_Q$ ...(i)

Now, by using Bernoulli's theorem

$P_P - P_Q = \frac{1}{2}\rho(v_Q^2 - v_P^2)$

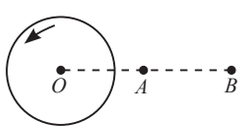
$\Delta P = \frac{1}{2} \times 1000\ (4v_P^2 - v_P^2)$

$\frac{15\times2}{1000} = 3v_P^2 \Rightarrow v_P = \frac{1}{10}$ m/s

Rate of flow, $Q = A_P v_P = 40\times10^{-4} \times \frac{1}{10} = 4 \times 10^{-4}$ m^3/s

$= 4 \times 10^{-4} \times 10^6$ cm^3/s $= 400$ cm^3/s

3. (d) : $OB = 2 \times OA$



For a rigid body, angular momentum about a point A is,

$\vec{L}_A = \vec{L}_O + \vec{r}_{OA} \times \vec{M}v_{CM}$

As the centre is fixed, so the velocity of centre of mass is zero.

Angular momentum about any point A or B is

$L = I\omega \Rightarrow$ so, $L_A = L_B$

$\therefore \quad L_A : L_B = 1$

4. (b) : Length = l, radius = r,

number of turns per unit length = n

Inductance of coil, $L = \mu_0 n^2 Al$

$L = \mu_0 n^2 \pi r^2 l$

5. (d) : Volume of sphere = $\frac{4}{3}\pi R^3$

The coefficient of volumetric expansion, $\gamma = 3\alpha$

Now, $\Delta V = V\gamma\Delta T$

$\Delta V = \frac{4}{3}\pi R^3 \times 3\alpha\, \Delta T$

$\Delta V = 4\pi R^3\, \alpha\Delta T$

6. (b) : Let $R_1 = R_0(1 + \alpha\Delta T)$ and $R_2 = R_0(1 - \alpha\Delta T)$

For circuit A:

$R_S = R_1 + R_2 = R_0[1 + \alpha\Delta T + 1 - \alpha\Delta T] = 2R_0$

Here, total resistance remains same so, I_A remains constant.

Fror circuit B :

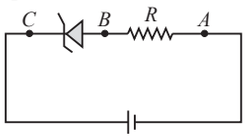
$$R_P = \frac{R_1R_2}{R_1+R_2} = \frac{R_0^2(1+\alpha\Delta T)\,(1-\alpha\Delta T)}{R_0(1+\alpha\Delta T+1-\alpha\,\Delta T)}$$

$$R_P = \frac{R_0(1-\alpha^2\Delta T^2)}{2}$$

So, the total resistance decrease and thus, I_B increases.

7. (b) : In photoelectric effect, photo current depends on intensity of incident light. So, $i \propto I$ (Intensity) as power decreases linearly, so intensity also decreases linearly but stopping potential remains constant as it does not depend on intensity of light.

8. (c) : $V_i = -5$V, $V_z = -3$V



$V_{BA} = V_i - V_z$

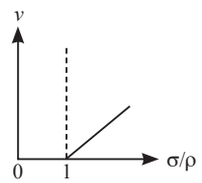
$V_{BA} = -5 - (-3) = -2$V

$|V_{BA}| = |-2| = 2$V

9. (b) : Terminal velocity is given by

$$v = \frac{2}{9}r^2\frac{(\sigma-\rho)g}{\eta} \quad \Rightarrow v \propto (\sigma-\rho) \quad \Rightarrow \quad v \propto \left(\frac{\sigma}{\rho}-1\right)$$

So, the graph is a straight line and starts from $\sigma/\rho = 1$ touching σ/ρ axis as shown in option (b).



10. (d) : $M_1 = M_2$, $R_2 = \frac{R_1}{2}$

$$v_{escape} = \sqrt{\frac{2GM}{R}} \quad \Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{M_2\,R_1}{M_1\,R_2}} = \sqrt{1\times\frac{R_1\times 2}{R_1}}$$

$$\frac{v_2}{v_1} = \sqrt{2}$$

11. (b) : $V = 220\sin(2\times10^3 t)$ volt ...(i)

By comparing equation (i) with $V = V_0\sin(\omega t)$

$V_0 = 220$ V, $\omega = 2\times10^3$ rad/s

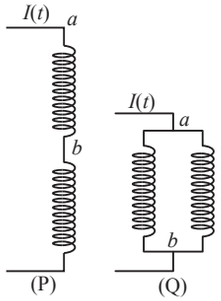
$X_L = \omega L = 2\times10^3\times10\times10^{-3} = 20\ \Omega$

$$X_C = \frac{1}{\omega C} = \frac{1\times10^6}{2\times10^3\times25} = 20\ \Omega$$

$$Z = \sqrt{R^2+(X_L-X_C)^2} = \sqrt{100^2+0^2} = 100\ \Omega$$

$$I_0 = \frac{V_0}{Z} = \frac{220}{100} = 2.2\text{ A}$$

12. (a) : In diagram (P):



Only one inductor is there between a and b.

So, $E_P = L\frac{dI}{dt}$ ...(i)

Now, in diagram (Q):

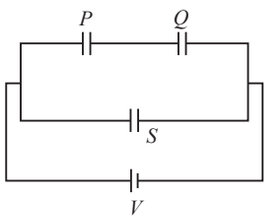
Two identical inductors are connected in parallel.

So, $L_p = \frac{L}{2}$

$E_Q = \frac{L}{2}\frac{dI}{dt}$ ...(ii)

So, $\frac{E_P}{E_Q} = 2$

13. (a) : Here, P and Q in series, their equivalent capacitance will be $C_S = \frac{C}{2}$.



Now, C_S and S is in parallel.

So, $C_{\text{total}} = \frac{C}{2} + C = \frac{3C}{2}$

Energy stored in upper branch (PQ)

$$E' = \frac{1}{2}C_SV^2 = \frac{1}{2}\times\frac{C}{2}V^2 = \frac{CV^2}{4}$$

Now, $C_P = C_Q$, so energy stored in C_P is

$$U_P = \frac{E'}{2} = \frac{CV^2}{8} \quad ...(1)$$

Total energy, $U_T = \frac{1}{2}C_{total}\,V^2 = \frac{1}{2}\left(\frac{3C}{2}\right)V^2 = \frac{3CV^2}{4}$

So, $\frac{U_P}{U_T} = \frac{CV^2\times4}{8\times3CV^2} = \frac{1}{6}$

14. (c) : $A = A_0(1 + \sin t)$

Induced emf, $\varepsilon = \frac{-d\phi}{dt} = -B\frac{dA}{dt} = -BA_0(\cos t)$

Power, $P = \frac{\varepsilon^2}{R} = B^2A_0^2\frac{\cos^2 t}{R}$

So, $P \propto \cos^2 t$ hence the correct graph is in option (c).

15. (d) : Given, $\gamma = \frac{5}{3}$, $n = 1$, $\Delta T = 60 - 50 = 10$ K,

$R = 8.3$ J mol^{-1} K^{-1}

The work done (W) by an ideal gas during an adiabatic process is given by;

$$W = \frac{nR\Delta T}{\gamma - 1}$$

$$W = \frac{8.3}{\frac{5}{3} - 1} \times 10 = \frac{83 \times 3}{2} = 124.5 \text{ J}$$

16. (d) : Given, $s(t) = \alpha t^2 - \beta t + \gamma$, $\alpha = 1$ m/s^2, $\beta = 6$ m/s, $\gamma = 5$ m

Put the given values in the position equation

$s = t^2 - 6t + 5$

A particle changes direction when its instantaneous velocity is zero.

$$v = \frac{ds}{dt} = 2t - 6$$

For turning point, $v = 0 \Rightarrow 2t - 6 = 0$, $t = 3$ s

So, $t = 3$ s in the turning point and it lies within the range $t = 0$ s to $t = 6$ s

So, at $t = 0$, $s(0) = 5$ m

At $t = 3$ s, $s(3) = 9 - 6 \times 3 + 5 = -4$ m

At $t = 6$ s, $s(6) = 36 - 6 \times 6 + 5 = 5$ m

Total distance, $s_T = |-4 - 5| + |5 - (-4)|$

$s_T = 9 + 9 = 18$ m

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{18}{6} = 3 \text{ m/s}$$

17. (d) : Microwave $\rightarrow$ for cooking food, $P \rightarrow$ II

U.V. rays $\rightarrow$ for purifying water, $Q \rightarrow$ I

Gamma rays $\rightarrow$ for treating cancer cells, $R \rightarrow$ IV

Radio waves $\rightarrow$ for AM/FM, $S \rightarrow$ III.

18. (b) : Polyatomic gas : 3 translational, 3 rotational and 2 vibrational degree of freedom

Total effective degrees of freedom,

$d = 3_{rot.} + 3_{trans.} + 2(f_{vib.}) = 6 + 2f$

For polyatomic gas:

$$C_v = \frac{d \times R}{2} = \frac{(6 + 2f)R}{2} = (3 + f)R$$

By Mayer's relation, $C_p = C_v + R$

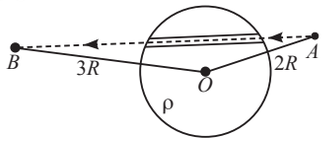
$C_p = (4 + f)R$

$$\gamma = \frac{C_p}{C_v} = \frac{8}{7} \quad \text{(given)}$$

$$\frac{4 + f}{3 + f} = \frac{8}{7}$$

$\Rightarrow \quad 28 - 24 = 8f - 7f \Rightarrow f = 4$

19. (a) : As, $q = 1$ C



Radius of sphere = R

Work done, $W = q|V_B - V_A|$

$$V_{\text{inside}} = \frac{KQ}{R}$$

$$V_A = \frac{KQ}{2R}, V_B = \frac{KQ}{3R}$$

Therefore, work done

$$W = q \times \left(\frac{KQ}{R}\right)\left(\frac{1}{3} - \frac{1}{2}\right) = Q \times \frac{1}{4\pi\varepsilon_0 R} \times \frac{1}{6}$$

As, $Q = \rho\left(\frac{4}{3}\pi R^3\right)$

$$\therefore \quad W = \frac{Q}{24\pi\varepsilon_0 R} = \frac{\frac{4}{3}\pi R^3\rho}{24\pi\varepsilon_0 R} \qquad \text{...(i)}$$

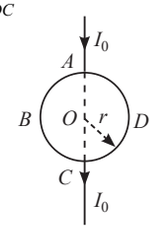
Now, $W = \frac{\rho R^2}{n\varepsilon_0}$ (Given) ...(ii)

So, by comparing (i) and (ii)

$$\frac{4\pi R^3\rho}{3 \times 24 \times \pi \times \varepsilon_0 R} = \frac{\rho R^2}{n\varepsilon_0} \quad \Rightarrow \quad \frac{\rho R^2}{18\varepsilon_0} = \frac{\rho R^2}{n\varepsilon_0}$$

So, $n = 18$

20. (b) : $R_{ABC} = \frac{1}{2}R_{ADC}$



Current is inversely proportional to resistance, as voltage is same at A and C; $I \propto \frac{1}{R}$

So, $I_{ABC} = 2I_{ADC}$

$I_0 = I_{ABC} + I_{ADC}$

$I_0 = 2I_{ADC} + I_{ADC}$

$$I_{ADC} = \frac{1}{3}I_0 \text{ and } I_{ABC} = \frac{2}{3}I_0$$

Magnetic field at the centre due to semicircle is

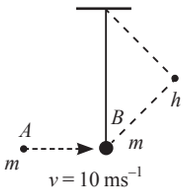
$$\vec{B}_{ABC} = \frac{\mu_0}{4\pi} \cdot \frac{\pi I_{ABC}}{r} \odot = \frac{\mu_0}{4\pi}\left(\frac{\pi 2I_0}{3r}\right) \odot$$

and $\vec{B}_{ADC} = \frac{\mu_0}{4\pi} \cdot \frac{\pi I_{ADC}}{r} \otimes = \frac{\mu_0}{4\pi}\left(\frac{\pi I_0}{3r}\right) \otimes$

So, $\left|\vec{B}_{net}\right| = \left|\vec{B}_{ABC}\right| - \left|\vec{B}_{ADC}\right| = \frac{\mu_0}{4\pi} \cdot \frac{\pi}{r}\left[\frac{2}{3}I_0 - \frac{I_0}{3}\right]$

$$\Rightarrow \quad B_{net} = \frac{\mu_0}{4 \times r} \times \frac{I_0}{3} = \frac{\mu_0 I_0}{12r}$$

21. (d) : Given, $l = 10$ m



As collision is elastic, so velocity of bob B after collision, $v_B = 10$ m/s

Using conservation of energy

Kinetic energy at the bottom = Potential energy at the maximum height

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

$$\Rightarrow \quad \frac{1}{2}\times 10\times 10 = 10\times h$$

$$\Rightarrow \quad h = 5 \text{ m}$$

22. (c, d) : As, $\varepsilon_r = 9$, $E_x = E_0 \sin(kz - 2\pi \times 10^6 t)$ V/m^{-1}

So, $\omega = 2\pi \times 10^6$ rad/s

For lossless dielectric medium,

$\mu_r = 1$

and $v = \dfrac{c}{\sqrt{\mu_r \varepsilon_r}} = \dfrac{3\times 10^8}{\sqrt{1\times 9}} = 10^8$ m/s

So, wave is travelling along $+z$ direction as it is in the form of $E = E_0 \sin(kz - \omega t)$.

$$f = \frac{\omega}{2\pi} = 10^6 \text{ Hz}$$

$$\lambda = \frac{v}{f} = \frac{10^8}{10^6} = 100 \text{ m}$$

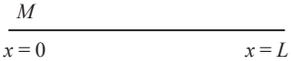
Since, the wave travels along $+z$-axis and electric field is polarised along $+x$ and magnetic field must be along $+y$ axis $(\vec{E}\times\vec{B} = \hat{k})$. Thus, the equation of magnetic field is:

$$B_y = \frac{E_0}{v}\sin(kz - 2\pi\times 10^6 t)$$

So, option (c, d) are incorrect.

23. (a) : Given, $\mu_k(x) = \mu_0 - \alpha x$

$\mu_k(L) = 0$



$W = n\mu_0 MgL$ ...(i)

As, $\mu_k(L) = 0 \Rightarrow \mu_0 - \alpha L = 0 \Rightarrow \alpha = \mu_0/L$

Frictional force at any position

$$f = \mu_k(x)\cdot Mg = (\mu_0 - \alpha x)Mg$$

Work done from $x = 0$ to $x = L$

$$W = \int_0^L f dx = Mg\int_0^L (\mu_0 - \alpha x)dx$$

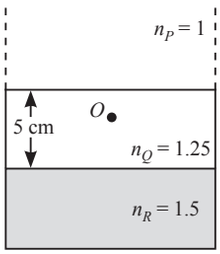
$$W = Mg\left(\mu_0 x - \frac{\alpha x^2}{2}\right)_0^L ; \; W = Mg\left(\mu_0 L - \alpha\frac{L^2}{2}\right)$$

$$W = Mg\left(\mu_0 L - \frac{\mu_0}{L}\frac{L^2}{2}\right) = Mg\frac{\mu_0 L}{2} \qquad ...(ii)$$

By comparing eqns (i) and (ii)

So, $n = \dfrac{1}{2}$

24. (c) : Object O is at the centre of Q



When viewed from P, $\left(d = \dfrac{5}{2}\right)$

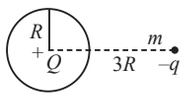
$$h_1 = d\cdot\frac{n_P}{n_Q} = \frac{5}{2}\times\frac{1}{1.25} = 2 \text{ cm}$$

When viewed from R.

$$h_2 = d\cdot\frac{n_R}{n_Q} = \frac{5}{2}\times\frac{1.5}{1.25} = 3 \text{ cm}$$

So, $|h_1 - h_2| = |2 - 3| = 1$ cm

25. (d) : Here, $r_i = 3R$, $r_f = R$



P.E. of Q and $(-q)$ is

$$U_f - U_i = -\frac{1}{4\pi\varepsilon_0}\left(\frac{Qq}{3R} - \frac{Qq}{R}\right)$$

By using conservation of energy, $\dfrac{1}{2}mv^2 = \Delta U$

$$\frac{1}{2}mv^2 = -\frac{1}{4\pi\varepsilon_0}\cdot\frac{Qq}{R}\left(-\frac{2}{3}\right)$$

$$\Rightarrow \quad v = \sqrt{\frac{Qq}{3\pi\varepsilon_0 mR}}$$

26. (b) : For minimum wear and tear, $\tan\theta = \dfrac{v^2}{gr}$

Given, v = 10 m/s, r = 50 m, g = 10 m/s^2

$$\therefore \quad \tan\theta = \frac{(10)^2}{10\times 50} = \frac{100}{500} = \frac{1}{5} \quad \Rightarrow \quad \theta = \tan^{-1}\left(\frac{1}{5}\right)$$

27. (d) : Given, $r = 1$ unit, $m = 1$ unit

Start : $\theta = \dfrac{\pi}{2}$; at A

Meet : $\theta = -\dfrac{\pi}{2}$; at B

Particle 1 : $\vec{v}_1 = \omega(-\sin\theta\hat{i} + \cos\theta\hat{j})$ = Clockwise

Particle 2 : $\vec{v}_2 = \omega(-\sin\theta\hat{i} + \cos\theta\hat{j})$ = Anticlockwise

$\therefore \quad \vec{p} = m(\vec{v}_1 + \vec{v}_2)$

$= 1\times\omega[-\sin\theta + \sin\theta]\hat{i} + \omega\times 1\times[\cos\theta + \cos\theta]\hat{j}$

$\Rightarrow \quad \vec{p} = 2\omega\cos\theta\hat{j} \quad \Rightarrow \quad |\vec{p}| = 2\omega|\cos\theta|$

Thus, graph should start from zero at $\dfrac{\pi}{2}$, at 0 it should be maximum and again 0 at $-\dfrac{\pi}{2}$. That is it should semicircle

28. (d) : As we know when the diode is forward biased then depletion width decreases. Similarly, in reverse bias it increases.

From the figure

D_1 : Forward biased

D_2 : Unbiased

D_3 : Reverse biased

$W_1 < W_2 < W_3$

29. (c) : Given, $f_1 = +10$ cm, $f_2 = -10$ cm
Distance between lenses = 3 cm
For lens L_1, $u_1 = -30$ cm

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}\ ;\ \frac{1}{10}=\frac{1}{v_1}+\frac{1}{30}\ \Rightarrow\ \frac{1}{v_1}=\frac{1}{10}-\frac{1}{30}=\frac{1}{15}$$

$\therefore \quad v_1 = 15$ cm
L_1 forms an image 15 cm to its right.
For lens L_2, $u_2 = 15 - 3 = 12$ cm

$$-\frac{1}{10}=\frac{1}{v_2}-\frac{1}{12}$$

$$\Rightarrow\quad -\frac{1}{10}+\frac{1}{12}=\frac{1}{v_2}\quad\Rightarrow\quad \frac{1}{v_2}=-\frac{1}{60}$$

$\therefore \quad v_2 = -60$ cm
L_2 forms an image 60 cm to the left of it.

30. (c) : Distance between the centres, $d = h + r$
about axis through centre of sphere A,

$$I_A=\frac{2}{5}MR^2+\left[\frac{2}{5}mr^2+m(R+r)^2\right]$$

About axis through centre of sphere B,

$$I_B=\left[\frac{2}{5}MR^2+M(R+r)^2\right]+\frac{2}{5}mr^2$$

$I_A - I_B = m(R + r)^2 - M(R + r)^2 = (R + r)^2 (m - M)$

31. (a) : For any stable circular orbit in a hydrogen atom,

$$\frac{mv^2}{r}=\frac{ke^2}{r^2}\quad\text{or}\quad r=\frac{ke^2}{mv^2}$$

Substituting the given values, we get

$$r=\frac{9\times10^9\times(1.6\times10^{-19})^2}{9\times10^{-31}\times\left(\sqrt{25.6}\times10^5\right)^2}=1\times10^{-9}\ \text{m}$$

$\therefore$ The value of x is 1.

32. (a) : For an ideal gas mean free path, $\lambda=\frac{1}{\sqrt{2}\pi d^2 n}$

where d is the molecular diameter and n is the number density.

$$\therefore\quad \lambda\propto\frac{1}{d^2n}$$

Given, $\lambda_A=\frac{1}{2}\lambda_B$ and $d_A = 2d_B$

$$\therefore\quad \frac{\lambda_A}{\lambda_B}=\frac{d_B^2n_B}{d_A^2n_A}=\frac{d_B^2n_B}{(2d_B)^2n_A}\quad\text{or}\quad\frac{1}{2}=\frac{n_B}{4n_A}$$

or $4n_A = 2n_B$ or $n_A=\frac{1}{2}n_B$

33. (a) : Buoyant force, $F = \rho gAx$ (restoring force)
Comparing with equation of SHM, $F = -kx$
$k = \rho gA$
If m is the mass of the cork, then

$$T=2\pi\sqrt{\frac{m}{k}}=2\pi\sqrt{\frac{m}{\rho gA}}\quad\therefore\quad T\propto\frac{1}{\sqrt{\rho}}$$

Given that, $T_1 = T$ for liquid of density ρ_1
$T_2 = 2T$ for liquid of density ρ_2

$$\therefore\quad \frac{T_2}{T_1}=\sqrt{\frac{\rho_1}{\rho_2}}\ \Rightarrow\ 2=\sqrt{\frac{\rho_1}{\rho_2}}$$

$$\Rightarrow\quad \frac{\rho_1}{\rho_2}=4\quad\text{or}\quad\frac{\rho_2}{\rho_1}=\frac{1}{4}$$

34. (d) : For open pipe, number of nodes = 5
For one end closed pipe, only odd harmonics are present.
For 9th harmonic number of nodes, $m=\frac{9+1}{2}=5$

$$\therefore\quad \frac{n}{m}=\frac{5}{5}=1$$

35. (b) : $^{238}\text{U}\longrightarrow{}^{234}\text{Th}+{}^{4}\text{He}$

Mass defect, $\Delta M = M_{\text{initial}} - M_{\text{final}}$
$\Delta m = 238.050 - (234.043 + 4.003)$
$\Delta m = 238.050 - 238.046$
$\Delta m = 0.004$ u
Now, $Q = 0.004 \times 931.5$ MeV $= 3.726$ MeV
$= 3.726 \times 1000$ keV $= 3726$ keV

36. (d) : Index corrections in measurement refer to specific adjustment made to observe data to compensate for zero error, parallax or instrumental offsets.
Focal length measurement using an optical bench requires index correction.

37. (c) : From Kepler's third law, for a planet revolving around the Sun
$T^2 \propto R^3$ or $T \propto R^{3/2}$

38. (b) : Dimensional formula of Stefan-Bultzmann constant,
$[\sigma_s] = [MT^{-3} K^{-4}]$
Dimensional formula of Boltzmann constant,
$[k_B] = [ML^2 T^{-2} K^{-1}]$
Dimensional formula of Wein's displacement law constant,
$[b] = [LK]$
$[\sigma_s k_B^{-1} b] = [MT^{-3}K^{-4}]\ [M^{-1}L^{-2}T^2K]\ [LK] = [L^{-1}T^{-1}K^{-2}]$

39. (b) : Given that, $\lambda_1 < \lambda$, $\lambda_2 > \lambda$ and $\lambda_3 \gg \lambda$
For cell 1, $\lambda_1 > \lambda$, no photoelectric emission occurs, thus $V_1 = 0$
For cell 2, $\lambda < \lambda_2$, photoelectric emission occurs and V_2 is positive.
For cell 3, $\lambda << \lambda_3$, photoelectric emission occurs and V_3 is positive.

Stopping potential, $V_S=\frac{hc}{e}\left(\frac{1}{\lambda}-\frac{1}{\lambda_0}\right)$

Since, $\lambda_3 > \lambda_2$, we have, $\frac{1}{\lambda_3}<\frac{1}{\lambda_2}$

$$\therefore\quad \left(\frac{1}{\lambda}-\frac{1}{\lambda_3}\right)>\left(\frac{1}{\lambda}-\frac{1}{\lambda_2}\right)\ \Rightarrow\ V_3>V_2$$

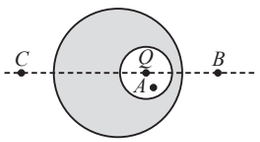
40. (*) : 1 MSD = 1 mm
Number of vernier divisions = 10
For a vernier calliper, 10 VSD = 9 MSD

$$\text{or}\quad 1\ \text{VSD}=\frac{9}{10}\ \text{mm}$$

Least count, LC = 1 MSD – 1 VSD $=1-\frac{9}{10}=0.1\ \text{mm}$

Magnitude of zero error = (10 – 4) × LC = 6 × 0.1 = 0.6 mm
Zero correction = +0.6 mm
Vernier calliper reads the length of the wire as 1 cm = 10 mm
∴ Actual length = 10 + 0.6 = 10.6 mm = 1.06 cm
*None of the given options is correct.

41. (c) : At point *A* (Inside the cavity): Electric field is non-zero as point *A* is located inside the cavity near the point charge *Q*. According to Coulomb's law, the charge *Q* produces an electric field inside the cavity space.



Hence, $E_A \neq 0$.
At point *B* and point *C* (Outside the conducting sphere): As the points *B* and *C* are outside the conducting sphere at the same distance from its centre, their electric fields must be the same.

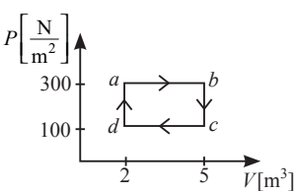
The electric field is given by, $E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$
As, $r_B = r_C$
So, $E_B = E_C$
Option (c) is correct.

42. (d) : In Geiger–Marsden experiment, the number of scattered α-particles $N(\theta)$ is related to the scattering angle (θ) by,

$$N(\theta) \propto \frac{1}{\sin^4\left(\frac{\theta}{2}\right)}$$

Option (a): This graph shows a distribution which does not match the inverse fourth power law.
Option (b): This graph shows linear distribution which does not match the inverse fourth power law.
Option (c): This shows a curve that doesn't follow the inverse fourth power law.
Option (d): This graph correctly shows the variation of $N(\theta)$ with (θ), starting very high at small angles and dropping off rapidly towards zero as the angle increases.
Hence, option (d) is correct.

43. (d) :



From the given cyclic process:
Change in pressure, $\Delta P = 300\text{ Pa} - 100\text{ Pa} = 200\text{ Pa}$
Change in volume, $\Delta V = 5\text{ m}^3 - 2\text{ m}^3 = 3\text{ m}^3$
$W_{net} = \Delta P \times \Delta V$
$W_{net} = 200 \times 3 = 600\text{ J}$
Hence, option (d) is correct.

44. (c) : Two parallel wires carrying current in the same direction experience attractive magnetic force. The magnetic force per unit length between two long parallel wires separated by height (*h*) is

$$\frac{F_m}{l} = \frac{\mu_0 I_1 I_2}{2\pi h}$$

As, $I_1 = I$ and $I_2 = 2I$,

$$\frac{F_m}{l} = \frac{\mu_0 (I)(2I)}{2\pi h} = \frac{\mu_0 I^2}{\pi h} \quad ...(i)$$

As, wire *A* has a uniform mass per unit length λ. So the downward gravitational force per unit length is, $\frac{F_g}{l} = \lambda g$ ...(ii)

For wire A to remain insulated on ground, the downward gravitational force should be equal to or greater than upward magnetic force,

$$\frac{F_g}{l} \geq \frac{F_m}{l}$$

Substituting values from eqn (i) and (ii),

$$\lambda g \geq \frac{\mu_0 I^2}{\pi h} \Rightarrow h \geq \frac{\mu_0 I^2}{\pi \lambda g}$$

The minimum magnitude of *h* is therefore, $h = \frac{\mu_0 I^2}{\pi \lambda g}$.
Hence, option (c) is correct.

45. (c) : For a spring mass system, the total mechanical energy *E* is conserved and the sum of the kinetic energy and potential energy.

$$E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$$

We can rearrange it as, $\frac{v^2}{\frac{2E}{m}} + \frac{x^2}{\frac{2E}{k}} = 1$

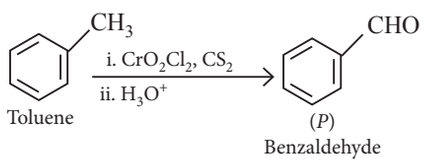
This is the general equation of an ellipse of the form,

$$\frac{v^2}{b^2} + \frac{x^2}{a^2} = 1$$

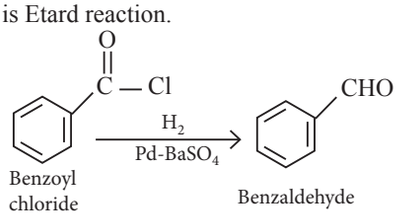
For the graph of *v* as a function *x*, as a circle the coefficient of v^2 and x^2 must be equal *i.e.*,

$$\frac{m}{2E} = \frac{k}{2E} \Rightarrow m = k$$

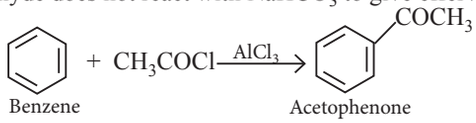
46. (a) :



This reaction is Etard reaction.



This reaction is Rosenmund reduction.
Benzaldehyde does not react with $NaHCO_3$ to give effervescence.



This reaction is Friedel-Craft reaction.
Benzaldehyde on reaction with bromine water does not form white precipitate since benzaldehyde contains an electron withdrawing group.

47. (a) : The formula of tetraammineaquachloridocobalt(III) chloride is $[Co(NH_3)_4(H_2O)Cl]Cl_2$.

48. (a) : The electronic configurations are as follows:
$Ho^{3+} = [Xe]4f^{10}$; 4 unpaired electrons
$Nd^{3+} = [Xe]4f^{3}$; 3 unpaired electrons
$Ce^{3+} = [Xe]4f^{1}$; 1 unpaired electron
$Tb^{3+} = [Xe]4f^{8}$; 6 unpaired electrons.

49. (d) : Given: $E_a = 6.64$ kJ mol^{-1} = 6640 J mol^{-1}
$R = 8.3$ J K^{-1} mol^{-1}, $k = e^2$ min^{-1}

Arrhenius equation, $\ln k = \ln A - \frac{E_a}{RT}$ ...(i)
$\ln k = \ln(e^2) = 2$
Since, $\ln k$ *vs* $1/T$ is a straight line with intercept, so, $\ln A = 6$
Now putting value of $\ln k$ and $\ln A$ in equation (i), we get

$$2 = 6 - \frac{E_a}{RT};\ \frac{E_a}{RT} = 6 - 2 = 4$$

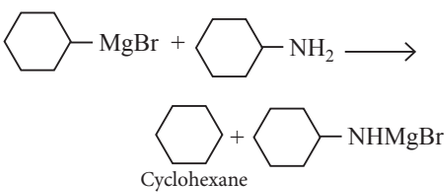
$$T = \frac{E_a}{4R} = \frac{6640\ \text{J mol}^{-1}}{4 \times 8.3\ \text{J K}^{-1}\ \text{mol}^{-1}} = 200\ \text{K}$$

50. (b) : On heating $KMnO_4$ at 513 K, K_2MnO_4, MnO_2 and O_2 are produced.

$$2KMnO_4 \xrightarrow[513\,K]{\Delta} \underset{\text{(Green)}\ \text{(Paramagnetic)}}{K_2MnO_4} + \underset{\text{(Black)}}{MnO_2} + O_2$$

51. (a) : Addition of Br_2 to *trans*-but-2-ene gives *meso*-2, 3-dibromo butane and the reaction occurs *via* formation of bromonium ion (anti-addition). Thus statement I is incorrect.
cis-But-2-ene upon treatment with alkaline $KMnO_4$ gives *meso* butan-2, 3-diol *via syn* addition. Thus, statement II is correct.

52. (a) : Compounds having active hydrogen atom converts Grignard reagent into alkane.



Cyclohexane

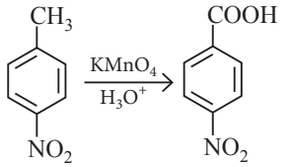
53. (a) : (I) $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow 4NaHSO_4 + MnCl_2 + 2H_2O + Cl_2$
(II) $2NaI + MnO_2 + 2H_2SO_4 \rightarrow 2Na_2SO_4 + MnSO_4 + 2H_2O + I_2$
In both the reaction MnO_2 is acting as an oxidising agent *i.e.*, itself gets reduced.

54. (d) : The electron gain enthalpy order is Cl > F > Br > I.

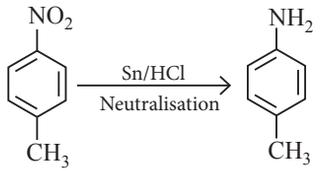
55. (d) : $[Fe(ox)_3]^{3-}$ being $[M(AA)_3]$ type of complex is chiral.
trans-$[Cr(H_2O)_2(ox)_2]^-$ is not chiral as there is plane of symmetry in the complex.

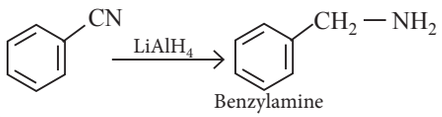
56. (d) : In β-pleated sheet structures, peptide chains are held together by intermolecular hydrogen bonds.

57. (b) : Oxidation of *p*-nitrotoluene with acidic $KMnO_4$ gives *p*-nitrobenzoic acid which is stronger acid than benzoic acid.

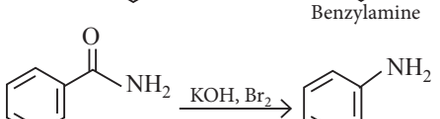


Reduction of *p*-nitrotoluene with Sn/HCl followed by neutralisation produces *p*-toluidine which is more basic than aniline.

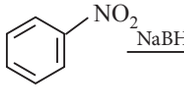


58. (c) : A. 

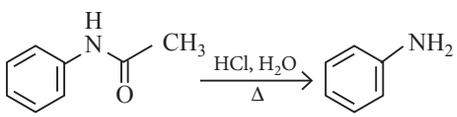
Benzylamine

B. 

Aniline

C. 

No reaction as $NaBH_4$ is too weak to reduce $–NO_2$ to $–NH_2$.

D. 

Aniline

59. (a) : For free expansion into vacuum, $w = 0$ as $P_{ext} = 0$.
For ideal gas, internal energy depends only on T, since T is constant $\Delta U = 0$. Then $q = 0$ from first law.

$$\text{So, } \Delta S_{\text{surroundings}} = \frac{-q_{\text{surroundings}}}{T} = 0$$

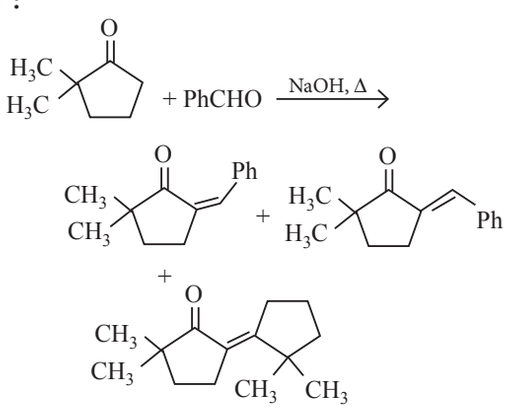
$q = 0$, because no heat exchange is taking place

$$\Delta S_{\text{system}} = nR\ln\left(\frac{V_2}{V_1}\right) = 2R\ln\left(\frac{100}{10}\right)$$

$$= 2 \times R \times \ln 10 = 4.606R$$

$\Delta S_{\text{system}} = 4.606R$; $\Delta S_{\text{surroundings}} = 0$

60. (b) :



61. (b) : Among the given complexes, $[Cr(Py)_3Cl_3]$ shows facial and meridional isomerism.

62. (d) : If the digit to be rounded off is equal to 5, the preceding number is not changed if it is even and increased by one, if it is odd.

63. (b) : $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
2 moles of C_4H_{10} give 8 moles of CO_2.
Molar mass of $C_4H_{10} = 58$ g mol^{-1}
and molar mass of $CO_2 = 44$ g mol^{-1}

$$\text{Moles of } C_4H_{10} = \frac{116}{58} = 2 \text{ moles}$$

Moles of CO_2 produced = 8 moles
Mass of CO_2 = 8 moles × 44 g mol^{-1} = 352 g

64. (d) : Figure (*C*) represents two radial nodes in the orbital.

65. (b)

66. (d) : $[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$
Complex $[Co(NH_3)_6]Cl_3$ is 1 : 3 electrolyte in an aqueous solution.

67. (c) : Given, $Fe^{3+} + 3e^- \rightarrow Fe$; $E^\circ_1 = -0.04$ V
$Fe^{2+} + 2e^- \rightarrow Fe$; $E^\circ_2 = -0.44$ V
Required equation is
$Fe^{3+} + e^- \rightarrow Fe^{2+}$; $E^\circ_3 = ?$
Applying $\Delta G^\circ = -nFE^0$ $\therefore$ $\Delta G^\circ_3 = \Delta G^\circ_1 - \Delta G^\circ_2$
$-n_3FE^\circ_3 = -n_1FE^\circ_1 - (-n_2\,FE^\circ_2)$
$-FE^\circ_3 = -3 \times F \times (-0.04) + 2 \times F \times (-0.44)$
$-E^\circ_3 = 0.12$ V $- 0.88$ V
$-E^\circ_3 = -0.76$ V
$E^\circ_3 = 0.76$ V

68. (b) : Potash alum : $KAl(SO_4)_2.12H_2O$
Hence, the ratio of K^+ and SO_4^{2-} in potash alum is 1 : 2.

69. (b) : Mixture of aniline and phenol shows negative deviation from Raoult's law.

70. (b) : According to Debye-Huckel Onsager equation,
$\Lambda_m = \Lambda^\circ_m - A\sqrt{c}$
$\sqrt{c} = \sqrt{0.01} = 0.1$
$145 = \Lambda^\circ_m - (90 \times 0.1)$
$145 = \Lambda^\circ_m - 9$
$\Lambda^\circ_m = 145 + 9 = 154$ S cm^2 mol^{-1}
Now applying Kohlrausch's law
$\Lambda^\circ_m(XY) = \lambda^\circ_{X^+} + \lambda^\circ_{Y^-}$
$154 = 74 + \lambda^\circ_{Y^-}$
$\lambda^\circ_{Y^-} = 154 - 74 = 80$ S cm^{2}mol^{-1}

71. (a) : Among the given compounds, ethanoic acid is most polar followed by ethanol, acetone and diethyl ether. Hence, the correct order is A < C < B < D.

72. (b) : According to spectrochemical series, the correct decreasing order of the ligand field strength is
$CO > NH_3 > H_2O > Cl^-$.

73. (d) : Among the given amino acids, methionine contains of sulphur atom and its sodium fusion extract on treatment with sodium nitroprusside gives blood-red colour.

74. (b) : In an acidic medium, $KMnO_4$ acts as a strong oxidising agent. It reacts with oxalic acid ($H_2C_2O_4$) according to the following redox half reaction.
Reduction half-reaction : $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$
n factor = 5
Oxidation half-reaction : $C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$;
n factor = 2
$M_1 \times n_1 \times V_1\,(KMnO_4) = M_2 \times n_2 \times V_2\,(C_2H_2O_4)$
$M_1 \times 5 \times 10 = 0.25 \times 2 \times 10$
$M_1 = 0.1$ M or 0.1 mol/L

75. (b) : Among the given statements, statement given in option (b), boron has a maximum covalency of four is correct remaining statements are incorrect.

76. (b) : Conjugated double bonds are observed in hepta–1,3-diene.

$$CH_2 = CH - CH = CH - CH_2 - CH_2 - CH_3$$
Hepta-1, 3-diene

77. (c) : For a zero-order reaction
$[A]_t = [A]_0 - 2kt$
Given, $[A]_0 = 2$ M
75% reaction completed means 25% of *A* left
$[A]_t = 0.25 \times 2 = 0.5$ M
Substituting in the zero-order rate equation
$0.5 = 2 - 2(1.0)t$
$2t = 2 - 0.5 = 1.5$ min
$\therefore$ $t = 0.75$ min

78. (a) : (i) Solubility of AgBr (*AB* type salt)

$$AgBr_{(s)} \rightleftharpoons \underset{s}{Ag^+} + \underset{s}{Br^-}$$

$K_{sp} = s^2$
$s = \sqrt{K_{sp}} = \sqrt{5.0 \times 10^{-13}} = \sqrt{50 \times 10^{-14}} \approx 7.07 \times 10^{-7}$ M

(ii) Solubility of $Zn(OH)_2$ (AB_2 type salt)

$$Zn(OH)_2 \rightleftharpoons \underset{s}{Zn^{2+}} + \underset{2s}{2OH^-}$$

$K_{sp} = s \times (2s)^2 = 4s^3$
$s = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{1.0 \times 10^{-15}}{4}} = \sqrt[3]{0.25 \times 10^{-15}} \approx 6.3 \times 10^{-6}$ M

(iii) Solubility of Hg_2Cl_2 (A_2B_2 salt) :

$$Hg_2Cl_2 \rightleftharpoons \underset{s}{Hg_2^{2+}} + \underset{2s}{2Cl^-}$$

$K_{sp} = s \times (2s)^2 = 4s^3$
$s = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{1.3 \times 10^{-18}}{4}} = \sqrt[3]{0.325 \times 10^{-18}} \approx 6.87 \times 10^{-7}$ M

Thus, the order will be $Zn(OH)_2 > AgBr > Hg_2Cl_2$.

79. (c) : In N_2O_5, $2x + 5(-2) = 0 \Rightarrow x = +5$; O.N. of N = +5
In Al_2O_3 ; $2x + 3(-2) = 0 \Rightarrow x = +3$; O.N. of Al = +3
In H_2S ; $2(+1) + x = 0 \Rightarrow x = -2$; O.N. of S = –2

80. (b) : For reversible isothermal process

$$w = -nRT\ln\left(\frac{V_{final}}{V_{initial}}\right)$$

Given : $n = 1.0$ mol, $R = 2$ cal K^{-1} mol^{-1}

Work done in process 1(w_1)

$$w_1 = -2T_1 \ln\left(\frac{V_2}{V_1}\right)$$

Work done in process 3 (w_3)

$$w_3 = -2T_2 \ln\left(\frac{V_4}{V_3}\right)$$

Total work = $w_1 + w_3 = -2T_1 \ln\left(\frac{V_2}{V_1}\right) - 2T_2 \ln\left(\frac{V_4}{V_3}\right)$

81. (d) : An ideal solution obey Raoult's law at all concentrations. When pure liquid *P* and *Q* mix to form an ideal solution, no heat is evolved or absorbed ($\Delta_{mix}H = 0$) and there is no expansion in volume ($\Delta_{mix}V = 0$).

Interaction exist between *P* and *Q*. For a solution to be ideal, the new *P* – *Q* intermolecular interaction must be identical in strength to the original *P* – *P* and *Q* – *Q* interactions.

82. (b) : The spin-only magnetic moment is given by the formula,

$$\mu = \sqrt{n(n+2)}\ \text{B.M.}$$

Higher the number of unpaired electrons, higher is its magnetic moment.

$[Ti(H_2O)_6]^{3+}$; $Ti^{3+}(3d^1) \rightarrow$ 1 unpaired electron

$[Mn(CN)_6]^{3-}$; $Mn^{3+}(3d^4) \rightarrow$ With strong field ligand CN^-, 2 unpaired electrons (highest)

$[Fe(CN)_6]^{3-}$; $Fe^{3+}(3d^5) \rightarrow$ With strong field ligand CN^-, 1 unpaired electron

$[Co(NH_3)_6]^{3+}$; $Co^{3+}(3d^6) \rightarrow$ With strong field ligand NH_3, 0 unpaired electrons

83. (b) : At equilibrium [N] = [*D*]

$$K = \frac{[D]}{[N]} = 1$$

$\Delta G° = -RT\ln K$

Since $K = 1$

$\Delta G° = 0$

$\Delta G° = \Delta H° - T\Delta S°$

Hence, $0 = \Delta H° - T\Delta S°$

$$\Delta S° = \frac{\Delta H°}{T}$$

$$\Delta S° = \frac{666}{333} = 2.0\ \text{kJ K}^{-1}\ \text{mol}^{-1}$$

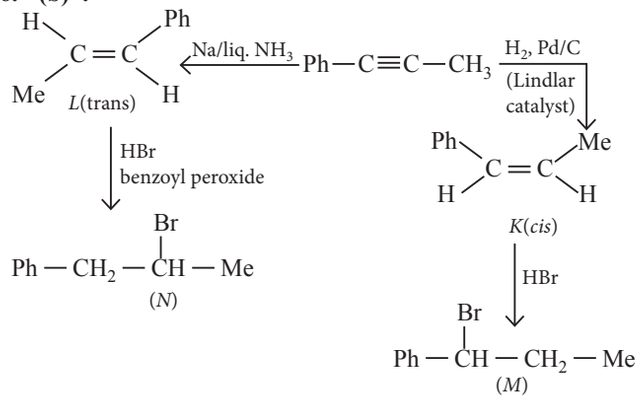
84. (b) : The 3*d* transition series elements generally have high melting and boiling points.

The energy gap between 3*d* and 4*s* orbitals is very small. Because of this, both the outer 4*s* electrons and the unpaired inner 3*d* electrons can participate in metallic bonding.

85. (b) : $IE_1(O) < IE_1(N)$ because nitrogen has symmetrically half-filled valence shell configuration ($2p^3$). So it is difficult to remove an electron from N.

The ground-state electronic configuration of oxygen is $1s^2\ 2s^2\ 2p^4$. When it loses its first electron, it transforms to a stable half filled $2p^3$ configuration.

86. (b) :



87. (a) : Total number of electrons in Ne_2 is 20.

For the molecular orbitals (for Z > 7)

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

($\pi^* 2p_x^2 = \pi^* 2p_y^2$) $\sigma^* 2p_z^2$

88. (c) : A. PCl_5 with sp^3d hybridisation gives trigonal bipyramidal geometry (III).

B. BrF_5 with sp^3d^2 hybridisation gives square pyramidal geometry (IV).

C. BF_4^- with sp^3 hybridisation gives tetrahedral geometry (I).

D. $[Ni(CN)_4]^{2-}$ with dsp^2 hybridisation gives square planar geometry (II).

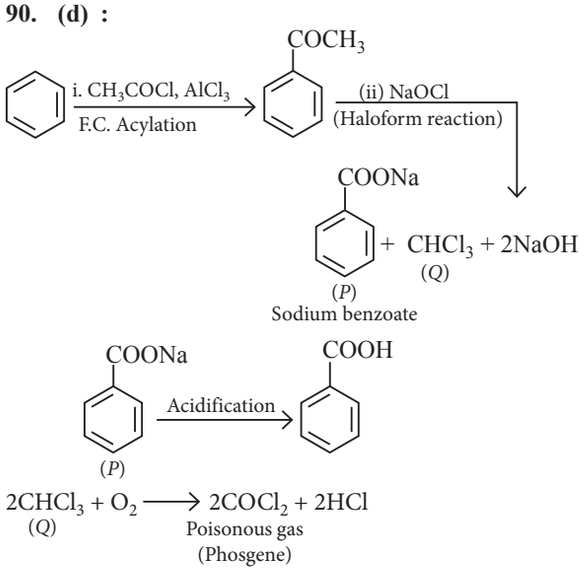
89. (c) : A. Vitamin A is present in carrots (IV).

B. Vitamin B_{12} is present in meat (I)

C. Vitamin E is present in vegetable oils like sunflower oil(II)

D. Vitamin K is present in green leafy vegetables(III).

90. (d) :



$2CHCl_3 + O_2 \longrightarrow 2COCl_2 + 2HCl$

(Q) Poisonous gas (Phosgene)

91. (d) : All organisms belonging to Class Reptilia do not have a three-chambered heart, for example, crocodiles possess a four-chambered heart.

92. (a) : To produce one molecule of glucose, the Calvin cycle must turn 6 times (fixing 6 molecules of CO_2). For three molecules of glucose : 6 × 3 = 18 turns of Calvin cycle are required.

93. (c) : In the photorespiration pathway (C_2 cycle), RuBisCO binds with oxygen (O_2) instead of (CO_2). The reaction is:

$RuBP + O_2 \xrightarrow{RuBisCO}$ 3-Phosphoglycerate (3C) + 2-Phosphoglycolate (2C).

Thus, *X* represents 2-Phosphoglycolate.

94. (b)

95. (a) : Glycolysis produces 2 molecules of pyruvic acid for every one molecule of glucose. Hence, for 206 molecules, 206 × 2 = 412 pyruvic acids are produced.

96. (b) : Fusion of protoplasms between gametes = Plasmogamy; Fusion of two nuclei = Karyogamy; Generation of haploid spores = Meiosis.

97. (b) : The innermost space of the mitochondria is called the matrix.

98. (b) : Phyllotaxy is the pattern of arrangement of leaves.

99. (b) : Prions are infectious misfolded proteins responsible for BSE, Bovine Spongiform Encephalopathy (mad cow disease).

100. (b) : Schleiden and Schwann proposed cell theory and stated that all living beings are composed of cells.

101. (c) : Gibberellins promote "bolting" or rapid stem elongation that causes internode elongation prior to flowering in rosette plants like cabbage.

102. (c)

103. (a) : Sphenopsida (horsetails) is a class within the Pteridophyta.

104. (d)

105. (b) : 2,4-dichlorophenoxyacetic acid is a common synthetic auxin used as herbicide.

106. (d) : Genus comprises group of related species which has more characters in common in comparison to species of other genera.

107. (c) : Based on the types of pigments the plastids can be classified as chloroplasts, leucoplasts and chromoplasts. In chromoplasts, fat soluble pigments like carotenoids, xanthophylls and others are present.

108. (b) : In water, skin acts as respiratory organ (cutaneous respiration) where dissolved oxygen in water is exchanged through it by diffusion.

109. (d) : Phylum Chordata is fundamentally characterised by the presence of notochord, a dorsal hollow nerve cord , post-anal tail and paired pharyngeal gill slits.

110. (c) : The smooth endoplasmic reticulum is the major site of lipid synthesis.

111. (a) : Prokaryotes possess 70S ribosomes which are composed of 50S and 30S subunits. They often contain plasmids (extra-chromosomal DNA) and mesosomes (extensions of plasma membrane). They also contain inclusion bodies where reserve material is stored, *e.g.*, phosphate granules, cyanophycean granules and glycogen granules.

112. (c) : Cristae – Infoldings of mitochondria
Cisternae – Disc shaped sacs in the Golgi apparatus
Thylakoids – Flat membrane sacs in stroma of chloroplast
Phospholipids – Cell membrane

113. (c) : Pituitary gland anatomically divided into adenohypophysis (anterior) and neurohypophysis (posterior). Anterior pituitary further consists of two portions pars distalis and pars intermediate. FSH(follicle stimulating hormone) and prolactin are secreted by anterior pituitary while pars intermediate secretes MSH (melanocyte stimulating hormone).

114. (c) : Photorespiration results in formation of phosphoglycolate (2C) and involves no synthesis of ATP or NADPH. It is a wasteful process where CO_2 is released and O_2 is consumed, occurring specifically in C_3 plants.

115. (a) : Fibrinogen is a soluble precursor that is converted into insoluble fibrin threads during blood clotting.

116. (b)

117. (c)

118. (c) : Starch – Energy storage
Antibody – Fights infection
Concanavalin A – Lectin
GLUT-4 – Glucose transport

119. (d) : Vertebral column is humans is formed by 26 serially arranged units called vertebrae.

120. (b) : Endomembrane system includes endoplasmic reticulum, Golgi apparatus, lysosomes and vacuoles. These organelles are grouped together because their functions are coordinated.

121. (d) : The expression for arithmetic growth:

$L_t = L_0 + rt$

L_t = length at time 't'

L_0 = length at time 'zero'

r = growth rate / elongation per unit time.

As per question,

L_0 =20 cm, r = 30 cm/day, t = 7

Substituting the values in the equation

$L_t = 20 + 30 \times 7 = 20 + 210 = 230$ cm

So, the length at the end of 7^{th} day will be 230 cm.

122. (a) : Spherical – Cocci
Rod - Bacilli
Comma - Vibrio
Spirillum - Spirilla

123. (c) : The SAN can generate the maximum number of action potentials, *i.e.*, 70-75 min^{-1}, and is responsible for initiating and maintaining the rhythmic contractile activity of the heart.

124. (a)

125. (a) : Pericardium is a double walled membranous bag, enclosing the pericardial fluid that protects the heart.
The lumen central neural system includes the brain and the spinal cord and is the site of information processing and control.

126. (d) : Meiosis II resembles mitosis.

127. (a) : Marginal placentation – Pea
Axile placentation – Tomato
Parietal placentation – *Argemone*
Free central placentation - *Primrose*

128. (b) : Lichens are symbiotic associations, *i.e*., mutually useful associations, between algae and fungi.

129. (a) : Members of Kingdom Fungi are eukaryotic. While bacteria, blue green algae and mycoplasma are prokaryotes.

130. (b) :

Element	Percentage weight of human body
Oxygen	65.0
Carbon	18.5
Hydrogen	9.5
Nitrogen	3.3

131. (c) : The α-cells of pancreas secrete a hormone called glucagon, while the β-cells of pancreas secrete insulin.

132. (b) : Ovary is superior in case of family Solanaceae.

133. (d) : The adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical.

134. (d) : The correct sequence of adult cell cycle phases is $G_1 – S – G_2 – M$.

135. (d) : In frogs, there are ten pairs of cranial nerves arising from the brain.

136. (b) : In order to cut the genetic material (DNA) with restriction enzymes, it needs to be in pure form, freefrom other macro-molecules. Since the DNA is enclosed within the membranes, the cell has to be break open to release DNA along with other macromolecules such as RNA, proteins, polysaccharides and also lipids. This can be achieved by treating the bacterial cells/plant or animal tissue with enzymes such as lysozyme (bacteria), cellulase (plant cells) and chitinase (fungus).

137. (d) : Intra cytoplasmic sperm injection (ICSI) is a specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum.

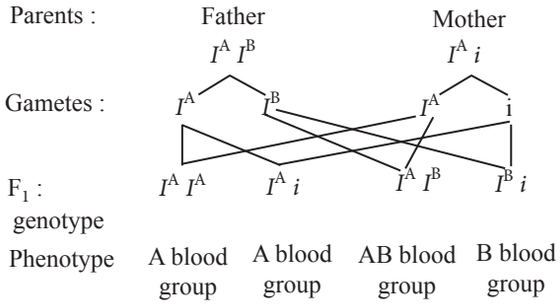
138. (c)

139. (b)

140. (c) : The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth. It is home to more than 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles and of more than 1,25,000 invertebrates.

141. (b) : Lower invertebrates like sponges, coelenterates, flatworms, etc., exchange O_2 with CO_2 by simple diffusion over their entire body surface.

142. (a) : In humans, ABO blood groups are controlled by the gene *I*. The plasma membrane of the red blood cells has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene. The gene (*I*) has three alleles I^A, I^B and *i*. Because humans are diploid organisms, each person possesses any two of the three *I* gene alleles. I^A and I^B are completely dominant over *i*, in other words when I^A and *i* are present only I^A expresses (because *i* does not produce any sugar), and when I^B and *i* are present I^B expresses. For a person with blood group O, the genotype must be *ii*. Therefore, each parent must contribute an *i* allele.
If parents blood group are I^AI^B and I^Ai, thus, O blood group cannot occur in progeny. This can be explained as follows:



143. (a) : *Homo sapiens* arose in Africa and moved across the continents and developed into distinct races. During ice age, between 75,000-10,000 years ago, modern *Homo sapiens* arose.

144. (d) : Morphine is a very effective sedative and painkiller, and is very useful in patients who have undergone surgery.

145. (a) : Wheat, maize, barley and castor produce albuminous seeds, that retain a part of endosperm as it is not completely used up during embryo development.

146. (b) : Abingdon tortoise in Galapagos Islands became extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats. This is the evidence for the occurrence of competitive exclusion.

147. (d)

148. (b) : Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

149. (a) : The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. Infundibulum is the funnel-shaped segment of the oviduct located closest to the ovaries in female reproductive system.

150. (d) : During the middle of menstrual-cycle, rapid secretion of LH leading to its maximum level called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation). The ovulation (ovulatory phase) is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the corpus luteum. The corpus luteum secretes large amounts of progesterone.

151. (c) : The opening between the right atrium and the right ventricle is guarded by a valve formed of three muscular flaps or cusps, the tricuspid valve.

152. (d)

153. (b) : The Bt toxin protein exists as inactive *protoxin* but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilises the crystals.

154. (d) : The yellowish fluid colostrum secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant.

155. (c) : The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which plays an important role in guiding the pollen tubes into the synergid.

156. (c) : Tuberculosis (TB) is a contagious, air-borne bacterial infection primarily affecting the lungs, caused by *Mycobacterium tuberculosis*.

157. (b) : The repressor of the operon is synthesised (all-the-time – constitutively) from the *i* gene. The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon. In the presence of an inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds. Glucose or galactose cannot act as inducers for *lac* operon.

158. (b)

159. (b) : If the frequency of allele (A) is 0.1 in a population at Hardy-Weinberg equilibrium, the frequency of the genotype (AA) would be (0.01)

$A = p = 0.1$

$AA = p^2 = 0.01$

160. (b) : Flagellar movement helps in the swimming of spermatozoa.

161. (d)

162. (b) : Whales, bats, cheetah and humans (all mammals) share similarities in the pattern of bones of forelimbs . Though these forelimbs perform different functions in these animals, they have similar anatomical structure – all of them have humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs. Hence, these structures are homologous.

163. (b) : Muscle contraction is initiated by a signal sent by the central nervous system (CNS) via a motor neuron. A motor neuron along with the muscle fibres connected to it constitute a motor unit. The junction between a motor neuron and the sarcolemma of the muscle fibre is called the neuromuscular junction or motor-end plate. A neural signal reaching this junction releases a neurotransmitter (Acetylcholine) which generates an action potential in the sarcolemma.

164. (a) : Luteinising hormone (LH) is secreted by anterior lobe of pituitary gland.

165. (a) : In *Plasmodium*, stages of life cycle of gametocytes develop in RBCs. Female mosquito take up gametocytes with blood meal and fertilisation and development takes place in insect's gut.

166. (d) : In a food chain, producers make their own food. primary consumers feed directly on producers. Animals that eat plants are called herbivores,so they are the primary consumers.

167. (a) : Water is reabsorbed mainly in the descending limb,while sodium is reabsorbed in the ascending limb, which is impermeable to water.

168. (b) : The logistic growth model incorporates carrying capacity(K) because resources are limited, making it more realistic.

169. (a) : The vertebral column is arranged as:
Cervical- Thoracic- Lumbar-Sacrum- Coccyx

170. (a)

171. (d) : Diploid chromosome number ($2n$) = 36
Therefore, haploid number = 18
Due to triple fusion, endosperm is triploid ($3n$),
hence, $3n = 3 \times 18 = 54$
So, the number of chromosomes in endosperm will be 54.

172. (c) : In eukaryotes, the RNA polymerase I transcribes *r*RNAs(28S, 18S, and 5.8S), whereas the RNA polymerase III is responsible for transcription of *t*RNA, 5srRNA, and snRNAs (small nuclear RNAs). The RNA polymerase II transcribes precursor of *m*RNA, the heterogeneous nuclear RNA (hnRNA).

173. (b)

174. (b) : A typical angiosperm anther is bilobed. It has two thecae (one in each lobe). Each theca contains two microsporangia, making four pollen sacs in total.

175. (c) : Natural selection can result in stabilising selection, directional selection and disruptive selection. Genetic drift is not a result of natural selection.

176. (c) : Transfer of energy follows the ten percent law.

177. (c)

178. (c) : The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes. After maturation the lymphocytes migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix.

179. (d)

180. (c) : Down's syndrome results in the gain of extra copy of chromosome 21. Similarly, Turner's syndrome results due to loss of an X chromosome in human females.

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