| SOLVED PAPER	NEET (UG) 05th May 2025	Code T4

Total Time Duration: 180 Minutes **Maximum Marks: 720**

Important Instructions:
1. *The test is of **3 hours** duration and test booklet contains **180** multiple choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**. **45** questions in each subject.*
2. *Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, one mark will be deducted from the total scores. **The maximum marks are 720.***
3. *Use **blue/black ball point pen only** for writing particulars on this page/marking responses on answer Sheet.*
4. *Use of electronic/manual calculator is prohibited.*
5. ***No part of the test booklet and answer sheet shall be detached under any circumstances.***
6. *The candidates will write the correct test booklet code as given in the test booklet/answer sheet in the attendance sheet.*
7. *Compensatory time of one hour five minutes will be provided for the examination of three hours and 20 minutes duration, whether such candidate (having a physical limitation to write) uses the facility of scribe or not.*

PHYSICS

Q. 1. Consider a water tank shown in the figure. It has one wall at $x = L$ and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 ($\theta_0 \ll 1$) with the x-axis at $x = L$. If $y(x)$ is the height of the surface then the equation for $y(x)$ is:
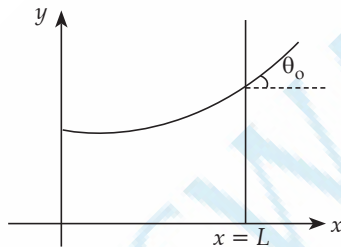
(take $\theta(x) = \sin \theta(x) = \tan \theta(x) = \dfrac{dy}{dx}$, g is the acceleration due to gravity)

(1) $\dfrac{d^2y}{dx^2} = \dfrac{\rho g}{S} x$ **(2)** $\dfrac{d^2y}{dx^2} = \dfrac{\rho g}{S} y$

(3) $\dfrac{d^2y}{dx^2} = \sqrt{\dfrac{\rho g}{S}}$ **(4)** $\dfrac{dy}{dx} = \sqrt{\dfrac{\rho g}{S}} x$

Q. 2. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is:

**(1)** 100   **(2)** 125   **(3)** 150   **(4)** 250

Q. 3. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving with speed $c/100$ (c = speed of light) is injected into a magnetic field $\vec{B}$ of magnitude 9×10^{-4} T perpendicular to its direction of motion. We wish to apply an uniform electric field $\vec{E}$ together with the magnetic field so that the electron does not deflect from its path. Then (speed of light $c = 3 \times 10^8$ m s^{-1})

(1) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

(2) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

(3) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

(4) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

Q. 4. There are two inclined surfaces of equal length (L) and same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down, on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and the rough surface is close to

(1) 0.25   **(2)** 0.40   **(3)** 0.5   **(4)** 0.75

Q. 5. The kinetic energies of two similar cars A and B are 100 J and 225 J, respectively. On applying brakes,

car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B, respectively, then the ratio F_A/F_B is:

(1) $\dfrac{3}{2}$　　(2) $\dfrac{2}{3}$　　(3) $\dfrac{1}{3}$　　(4) $\dfrac{1}{2}$

Q. 6. The current passing through the battery in the given circuit, is:
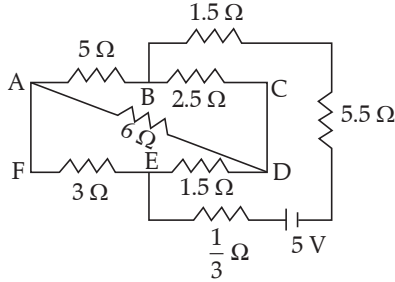

(1) 2.0 A　　(2) 0.5 A　　(3) 2.5 A　　(4) 1.5 A

Q. 7. A bob of heavy mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is:

(1) $(\sin\theta)^{\frac{1}{2}}$

(2) $\left(\dfrac{1}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(3) $\left(\dfrac{\cos\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$
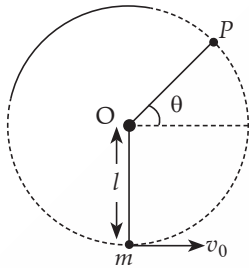
(4) $\left(\dfrac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

Q. 8. The output (Y) of the given logic implementation is similar to the output of an/a _____ gate.
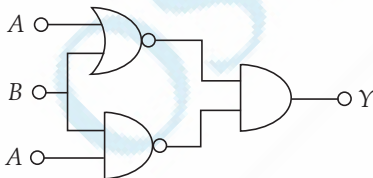
(1) AND　　(2) NAND　　(3) OR　　(4) NOR

Q. 9. The electric field in a plane electromagnetic wave is given by

$E_z = 60\cos(5x + 1.5 \times 10^9 \, t)$ V/m.

Then expression for the corresponding magnetic fields is (here subscripts denote the direction of the field):

(1) $B_y = 2 \times 10^{-7}\cos(5x + 1.5 \times 10^9 \, t)$ T
(2) $B_x = 2 \times 10^{-7}\cos(5x + 1.5 \times 10^9 \, t)$ T
(3) $B_z = 60\cos(5x + 1.5 \times 10^9 \, t)$ T
(4) $B_y = 60\sin(5x + 1.5 \times 10^9 \, t)$ T

Q. 10. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is: (Take $g = 9.8$ m/s^2)

(1) 21 Ns　　(2) 7 Ns　　(3) 0　　(4) 84 Ns

Q. 11. AB is a part of an electrical circuit (see figure). The potential "$V_A - V_B$", at the instant when current $= 2$ A and is increasing at a rate of 1 amp/second is:
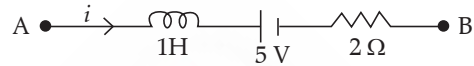
(1) 5 volt　　(2) 6 volt　　(3) 9 volt　　(4) 10 volt

Q. 12. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1:2. The ratio of their respective magnetic moments will be:

(1) 1:4　　(2) 1:2　　(3) 2:1　　(4) 4:1

Q. 13. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact. Then the power of the combination to the power (P) and magnification (m) for each lens will be, respectively:

(1) $4P$ and $4m$　　　　(2) P^4 and $4m$
(3) $4P$ and m^4　　　　(4) P^4 and m^4

Q. 14. An oxygen cylinder of volume 30 litres has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressure at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to:

[Given, $R = \dfrac{100}{12}$ J mol^{-1} K^{-1}, and molecular mass of $O_2 = 32$, 1 atm pressure $= 1.01 \times 10^5$ N/m]

(1) 0.125 kg　　　　(2) 0.144 kg
(3) 0.116 kg　　　　(4) 0.156 kg

Q. 15. In some appropriate units, time (t) and position (x) relation of moving particle is given by $t = x^2 + x$. The acceleration of the particle is:

(1) $-\dfrac{2}{(x+2)^3}$　　　　(2) $-\dfrac{2}{(2x+1)^3}$

(3) $+\dfrac{2}{(x+1)^3}$　　　　(4) $+\dfrac{2}{2x+1}$

Q. 16. To an ac power supply of 220 V at 50 Hz, a resistor of 20 Ω, a capacitor of reactance 25 Ω and an inductor of reactance 45 Ω are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage is respectively:

(1) 7.8 A and 30°　　　　(2) 7.8 A and 45°
(3) 15.6 A and 30°　　　　(4) 15.6 A and 45°

Q. 17. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

(1) 100 days
(2) 105 days
(3) 115 days
(4) 108 days

Q. 18. A model for quantised motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron is $n(h/e)$ where n is an integer, h is Planck's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be (m is the mass of the electron):

(1) $\dfrac{he}{\pi m}$
(2) $\dfrac{he}{2\pi m}$
(3) $\dfrac{heB}{\pi m}$
(4) $\dfrac{heB}{2\pi m}$

Q. 19. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity $2K$ while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature $3T$ and the right end the at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that the right junction is T_2. The ratio T_1/T_2 is:
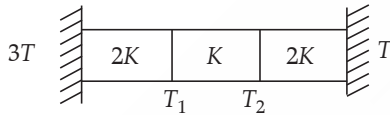
(1) $\dfrac{3}{2}$
(2) $\dfrac{4}{3}$
(3) $\dfrac{5}{3}$
(4) $\dfrac{5}{4}$

Q. 20. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\dfrac{3}{8}d$ and $\dfrac{d}{2}$, respectively, are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates. If $K_1 = 1.25\,K_2$, the value of K_1 is:

(1) 2.66
(2) 2.33
(3) 1.60
(4) 1.33

Q. 21. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 9 min, 40 km/h
(2) 25 min, 100km/h
(3) 10 min, 90 km/h
(4) 15 min, 120 km/h

Q. 22. A uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough

horizontal floor. The friction force that the floor exerts on the rod is (take $g = 10$ m/s^2)

(1) 100 N
(2) $100\sqrt{3}$ N
(3) 200 N
(4) $200\sqrt{3}$ N

Q. 23. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude $A(t)$ of the system change with time t. Which one of the following options schematically depicts these changes correctly?
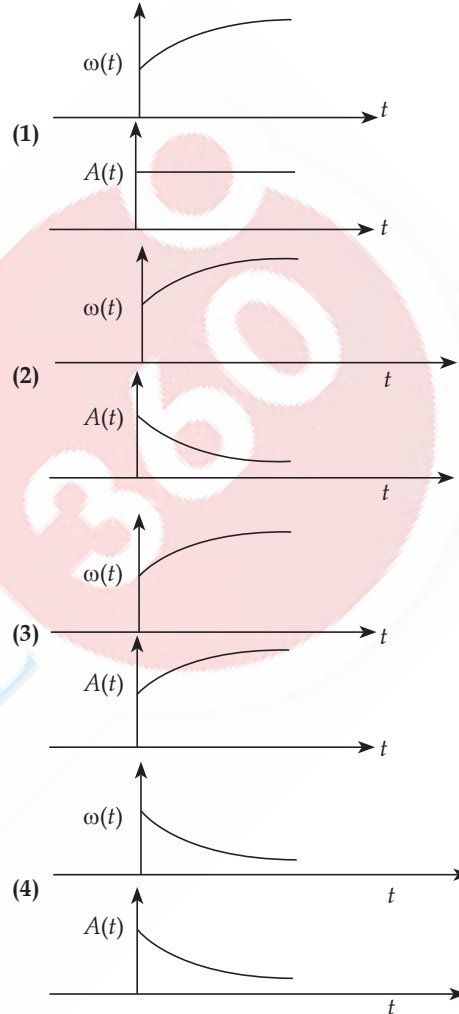
Q. 24. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed $v(r)$ of gas coming out of the balloon depends on r as r^a and $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$ then

(1) $a = \dfrac{1}{2}$, $\alpha = \dfrac{1}{2}$, $\beta = -1$, $\gamma = +1$, $\delta = \dfrac{3}{2}$

(2) $a = -\dfrac{1}{2}$, $\alpha = -\dfrac{1}{2}$, $\beta = -1$, $\gamma = -\dfrac{1}{2}$, $\delta = \dfrac{5}{2}$

(3) $a = -\dfrac{1}{2}, \alpha = -\dfrac{1}{2}, \beta = -1, \gamma = \dfrac{1}{2}, \delta = \dfrac{7}{2}$

(4) $a = \dfrac{1}{2}, \alpha = \dfrac{1}{2}, \beta = -\dfrac{1}{2}, \gamma = \dfrac{1}{2}, \delta = \dfrac{7}{2}$

Q. 25. Consider the diameter of a spherical object being measured with the help of a Vernier callipers. Suppose its 10 Vernier Scale Divisions (V.S.D.) are equal to its 9 Main Scale Divisions (M.S.D.). The least division in the M.S. is 0.1 cm and the zero of V.S. is at $x = 0.1$ cm when the jaws of Vernier callipers are closed.

If the main scale reading for the diameter is $M = 5$ cm and the number of coinciding Vernier division is 8, the measured diameter after zero error correction is

(1) 5.18 cm   (2) 5.08 cm

(3) 4.98 cm   (4) 5.00 cm

Q. 26. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its palates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:

(1) zero at all places.

(2) constant between the plates and zero outside the plates

(3) non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates

(4) zero between the plates and non-zero outside

Q. 27. An unpolarised light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then,

(1) reflected lights is completely polarised and the angle of reflection is close to 60°

(2) reflected light is partially polarised and the angle of reflection is close to 30°

(3) both reflected and transmitted lights are perfectly polarised with angles of reflection and refraction closer to 60° and 30°, respectively.

(4) transmitted light is completely polarised with angle of refraction close to 30°

Q. 28. Two identical charged conducting spheres A and B have their centres separated by a certain distance. Charge on each sphere is q and the force of repulsion between them is F. A third identical uncharged conducting sphere is brought in contact with sphere A first and then with B and finally removed from both. New force of repulsion between spheres A and B (radii of A and B are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charges) is best given as:

(1) $\dfrac{3F}{5}$ (2) $\dfrac{2F}{3}$ (3) $\dfrac{F}{2}$ (4) $\dfrac{3F}{8}$

Q. 29. A container has two chambers of volumes $V_1 = 2$ L and $V_2 = 3$ L separated by a partition made of a thermal insulator. The chambers contain $n_1 = 5$ and $n_2 = 4$

moles of ideal gas at pressures $p_1 = 1$ atm and $p_2 = 2$ atm, respectively. When the partition is removed, the mixture attains an equilibrium pressure of:

(1) 1.3 atm   (2) 1.6 atm

(3) 1.4 atm   (4) 1.8 atm

Q. 30. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius r of the nth orbit and the particle's speed v in the orbit depend on n as

(1) $r \propto n^{1/3}; v \propto n^{1/3}$ (2) $r \propto n^{1/3}; v \propto n^{2/3}$

(3) $r \propto n^{2/3}; v \propto n^{1/3}$ (4) $r \propto n^{4/3}; v \propto n^{-1/3}$

Q. 31. The radius of Martin orbit around the Sun is about 4 times the radius of the orbits of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

(1) 88 Earth days   (2) 225 Earth days

(3) 172 Earth days   (4) 124 Earth days

Q. 32. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is:

(1) 16 N   (2) 27 N   (3) 32 N   (4) 36 N

Q. 33. A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistances are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistances of the combination is:

(1) $\dfrac{R}{64}$ (2) $\dfrac{R}{32}$ (3) $\dfrac{R}{16}$ (4) $\dfrac{R}{8}$
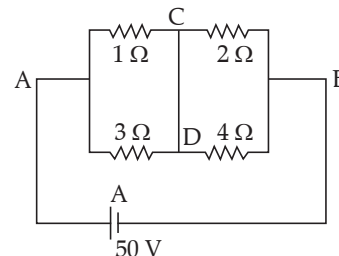
Q. 34. De Broglie wavelength of an electron orbiting in the $n = 2$ state of hydrogen atom is close to (given Bohr radius = 0.052 nm)

(1) 0.067 nm   (2) 0.67 nm

(3) 1.67 nm   (4) 2.67 nm

Q. 35. An electric dipole with dipole moment 5×10^{-6} C m is aligned with the direction of a unifrom electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is:

(1) 0.8 J   (2) 1.0 J   (3) 1.2 J   (4) 1.5 J

Q. 36. A constant voltage of 50 V is maintained between the points A and B of the circuit shown in the figure. The current through the branch CD of the circuit is:
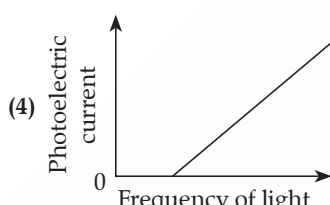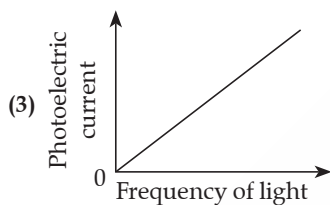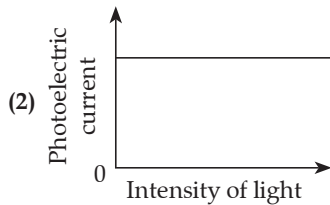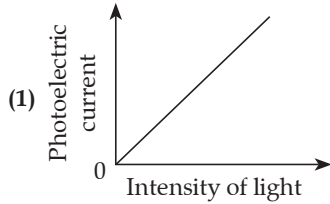

(1) 1.5 A   (2) 2.0 A   (3) 2.5 A   (4) 3.0 A

Q. 37. A photon and an electron (mass m) have the same energy E. The ratio $(\lambda_{photon}/\lambda_{electron})$ of their de Broglie wavelengths is: (c is the speed of light)

(1) $\sqrt{E/2m}$

(2) $c\sqrt{2mE}$

(3) $c\sqrt{\dfrac{2m}{E}}$

(4) $\dfrac{1}{c}\sqrt{E/2m}$

Q. 38. Which of the following options represents the variation of photoelectric current with property of light shown on the x-axis ?

(1)

(2)

(3)

(4)

(1) A only

(2) A and C

(3) A and D

(4) B and D

Q. 39. A sphere of radius R is cut from a larger solid sphere of radius $2R$ as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is:
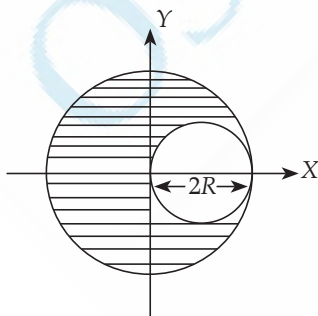
(1) $\dfrac{7}{8}$

(2) $\dfrac{7}{40}$

(3) $\dfrac{7}{57}$

(4) $\dfrac{7}{64}$

Q. 40. A full wave rectifier circuit diodes (D_1) and (D_2) is shown in the figure. If input supply voltage $V_{in} = 220 \sin(100\,\pi t)$ volt, then at $t = 15$ ms
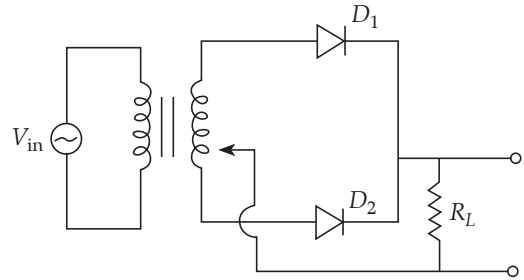
(1) D_1 is forward biased, D_2 is reverse biased

(2) D_1 is reverse biased. D_2 is forward biased

(3) D_1 and D_2 both are forward biased

(4) D_1 and D_2 both are reverse biased

Q. 41. Two gases A and B are filled at the same pressure in separate cylinders with movable pistons of radius r_A and r_B, respectively. On supplying an equal amount of heat to both the systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm, respectively. If the change in their internal energy is the same, then the ratio r_A / r_B is equal to

(1) $\dfrac{4}{3}$

(2) $\dfrac{3}{4}$

(3) $\dfrac{2}{\sqrt{3}}$

(4) $\dfrac{\sqrt{3}}{2}$

Q. 42. A physical quantity P is related to four observations a, b, c and d as follows:

$P = a^3 b^2 / c\sqrt{d}$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2%, and 4%, respectively. The percentage error in the quantity P is

(1) 10%

(2) 2%

(3) 13%

(4) 15%

Q. 43. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the polaroids, is (I_0 is the intensity or polarised light after passing through the first polaroid):

(1) $\dfrac{I_0}{2}$

(2) $\dfrac{I_0}{4}$

(3) $\dfrac{I_0}{8}$

(4) $\dfrac{I_0}{16}$

Q. 44. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (A_Q/A_P) of the amplitude A_Q of mass Q to the amplitude A_P of mass P is:

(1) $\dfrac{k_2}{k_1}$

(2) $\dfrac{k_1}{k_2}$

(3) $\sqrt{\dfrac{k_2}{k_1}}$

(4) $\sqrt{\dfrac{k_1}{k_2}}$

Q. 45. A pipe open at both ends has a fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to:

(1) $\dfrac{f}{2}$

(2) f

(3) $\dfrac{3f}{2}$

(4) $2f$

Booklet Batch Roll Number

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Ⓐ 10+1 Ⓢ ⓪⓪⓪⓪⓪⓪⓪⓪⓪⓪
Ⓑ 10-2 Ⓥ ①①①①①①①①①①
Ⓒ 10-3 Ⓐ ②②②②②②②②②②
Ⓓ Crash Ⓒ ③③③③③③③③③③
Ⓔ ④④④④④④④④④④
Ⓕ Paper ⑤⑤⑤⑤⑤⑤⑤⑤⑤⑤
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Test Date   Invigilator's Signature
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Student's Signature

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

Test Centre
Code

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

Avoid Improper
Marking

◖● ◐ ◓
Partially Filled
●
Lightly Filled
✓ ⊗

⓪⓪
①①
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⑤⑤
⑥⑥
⑦⑦
⑧⑧
⑨⑨

1 ①②③④	6 ①②③④	11 ①②③④	16 ①②③④
2 ①②③④	7 ①②③④	12 ①②③④	17 ①②③④
3 ①②③④	8 ①②③④	13 ①②③④	18 ①②③④
4 ①②③④	9 ①②③④	14 ①②③④	19 ①②③④
5 ①②③④	10 ①②③④	15 ①②③④	20 ①②③④

21 ①②③④	26 ①②③④	31 ①②③④	36 ①②③④
22 ①②③④	27 ①②③④	32 ①②③④	37 ①②③④
23 ①②③④	28 ①②③④	33 ①②③④	38 ①②③④
24 ①②③④	29 ①②③④	34 ①②③④	39 ①②③④
25 ①②③④	30 ①②③④	35 ①②③④	40 ①②③④

| 41 ①②③④ |
| 42 ①②③④ |
| 43 ①②③④ |
| 44 ①②③④ |
| 45 ①②③④ |

Answer Key

| Q. No.	Answer	Topic Name	Chapter Name
Physics			
1	2	Curvature of meniscus	Surface tension
2	2	Microscope	Ray optics
3	2	Force on a charge	Magnetic effects of current
4	4	Friction	Laws of motion
5	2	Work energy theorem	Work, power & energy
6	2	Kirchhoff's laws	Current electricity
7	4	Vertical circular motion	Work, power & energy
8	4	Logic gates	Semiconductors
9	1	Properties of e.m. waves	Electromagnetic waves
10	1	Impulse	Laws of motion
11	4	R-L circuit	Electromagnetic induction
12	1	Magnetic moment	Magnetic effects of current
13	3	Combination of lenses	Ray optics
14	3	General gas equation	Kinetic theory of gases
15	2	Variable acceleration	Motion in a straight line
16	2	A.C. circuit (R-L-C)	Alternating current
17	4	Conservation of angular momentum	Rotation
18	2	Magnetic moment	Magnetic effects of current
19	3	Heat conduction	Thermal properties of matter
20	1	Dielectrics	Capacitance
21	4	Relative motion	Motion in a straight line
22	2	Torque	Rotation
23	2	Damped oscillation	SHM (Oscillations)
24	3	Dimensions	Units and measurements
25	3	Vernier calipers	Units and measurements
26	3	Displacement current	Electromagnetic waves
27	1	Brewster's angle	Wave optics
28	4	Coulomb's law	Electrostatics
29	2	Internal energy	Kinetic theory of gases
30	3	Bohr's theory	Atomic structure
31	1	Kepler's laws	Gravitation
32	2	Variation of 'g'	Gravitation
33	3	Series & parallel combination	Current electricity
34	2	De Broglie wavelength	Dual nature of matter
35	2	P.E. of electric dipole	Electrostatics
36	2	Kirchhoff's laws	Current electricity
37	3	De Broglie wavelength	Dual nature of matter
38	1	Photoelectric effect	Dual nature of matter
39	3	Moment of inertia	Rotation
40	2	Full wave rectifier	Semi conductors
41	2	First law	Thermodynamics
42	3	Percentage error	Units and measurements
43	3	Polarisation	Wave optics
44	4	Spring mass system	SHM (Oscillation)
45	2	Organ pipes	Waves

NEET (UG)
Examination
5th May 2025 Paper

ANSWERS WITH EXPLANATION

PHYSICS

1. Option (2) is correct.
Explanation:
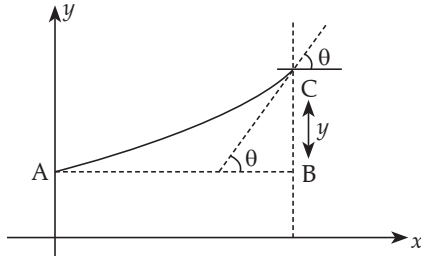
From Pascal's law, $P_A = P_B = P_o$ (atmospheric pressure)

$$P_B = P_o = P_C + y\rho g$$

$$\Rightarrow \quad P_C = P_o - y\rho g = P_o - \frac{S}{r}$$

S = surface tension
r = radius of meniscus at C

$$\therefore \quad y\rho g = \frac{S}{r} \qquad \text{... (i)}$$

$$r = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$$

slope $\frac{dy}{dx} = \tan\theta$

Since, θ is very small, $\frac{dy}{dx}$ is also very small and hence neglected.

Hence, $\quad r = \dfrac{1}{\frac{d^2y}{dx^2}} \qquad \text{...(ii)}$

Putting r in Eq. (i), we get

$$y\rho g = S\frac{d^2y}{dx^2}$$

$$\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$$

2. Option (2) is correct.
Explanation: Given $f_o = 2$ cm, $f_e = 4$ cm, $L = 40$ cm, $D = 25$ cm

For far point case (normal adjustment), the final image is formed at infinity and magnifying power is given as M.P. $= \dfrac{L}{f_o}\dfrac{D}{f_e} = \dfrac{40}{2}\times\dfrac{25}{4} = 125$

3. Option (2) is correct.
Explanation: If electron does not deflect from its path, net force on it should be zero.

$$F_e = F_m$$
$$eE = evB$$
$$v = \frac{E}{B}$$

$$E = \frac{c}{100}\times 9\times 10^{-4} = 27\times 10^2 \text{ V/m}$$

$$\vec{F}_m = e(\vec{v}\times\vec{B})$$

$$\vec{F}_m \perp \vec{B} \text{ and } \vec{F}_m + \vec{F}_e = \vec{0}$$

$$\vec{F}_e = -\vec{F}_m$$

Hence $\vec{E} \perp \vec{B}$.

4. Option (4) is correct.
Explanation:

$a_1 = g\sin\theta \qquad\qquad a_2 = g(\sin\theta - \mu\cos\theta)$

$\quad = \dfrac{g}{\sqrt{2}} \qquad\qquad\qquad = \dfrac{g}{\sqrt{2}}(1-\mu)$
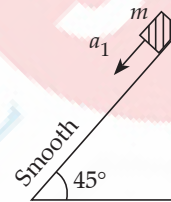
$L = \dfrac{1}{2}a_1 t_1^2 \qquad\qquad L = \dfrac{1}{2}a_2 t_2^2$

Given $\quad t_2 = 2t_1$

$$\frac{1}{2}\frac{g}{\sqrt{2}}t_1^2 = \frac{1}{2}\frac{g}{\sqrt{2}}(1-\mu)4t_1^2$$

$$1 = 4(1-\mu)$$

$$\mu = \frac{3}{4} = 0.75$$
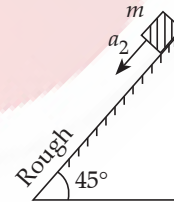
5. Option (2) is correct.
Explanation: For the car to stop, *KE* gets dissipated against friction (due to braking force)

$$\frac{KE_1}{KE_2} = \frac{-F_1 s_1}{-F_2 s_2}$$

$$\frac{F_1}{F_2} = \left(\frac{KE_1}{KE_2}\right)\left(\frac{s_2}{s_1}\right) = \frac{100}{225}\times\frac{1500}{1000} = \frac{2}{3}$$

$$\frac{F_A}{F_B} = \frac{2}{3}$$

6. Option (2) is correct.
Explanation:

Since $\frac{2.5}{5} = \frac{1.5}{3}$ (Condition for balanced

Wheatstone bridge)

$6\,\Omega$ across AD can be removed as $V_A = A_D$

$R_{BE} = (5 + 3)\,\Omega$ is parallel with $(2.5 + 1.5)\,\Omega$

$$= \frac{8 \times 4}{12}$$

$$= \frac{32}{12}$$

$$= \frac{8}{3}\,\Omega$$

The circuit can be redrawn as

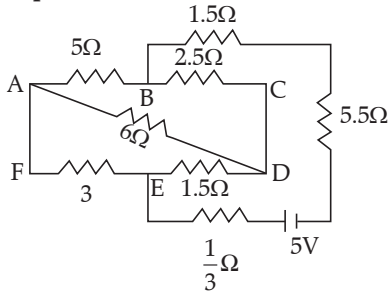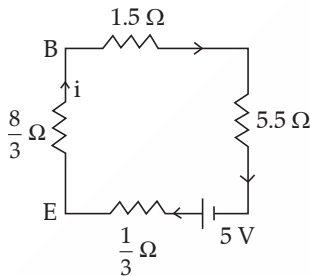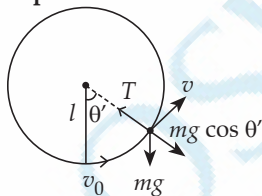$$i = \frac{5}{7 + 3} = \frac{5}{10} = 0.5\ \text{A}$$

7. Option (4) is correct.
Explanation:

COE gives

$$\frac{1}{2}\,mv_0^2 = \frac{1}{2}\,mv^2 + mg(l - l\cos\theta)$$

$$v^2 = v_0^2 + 2gl\cos\theta' - 2gl \qquad \ldots\text{(i)}$$

$$T - mg\cos\theta' = \frac{mv^2}{l}$$

Putting values for v^2, we get

$$T = \frac{m}{l}[v_0^2 + 3gl\cos\theta' - 2gl] \qquad \ldots\text{(ii)}$$

Here $\theta' = 90° + \theta$

When string slacks $T = 0$

$$\Rightarrow \cos(90° + \theta) = \frac{2gl - v_0^2}{3gl} = -\sin\theta \qquad \ldots\text{(iii)}$$

From (i)

$$v^2 = v_0^2 + 2gl\cos(90° + \theta) - 2gl$$

$$= v_0^2 - 2gl\sin\theta - 2gl$$

$$= v_0^2 + 2gl\left(\frac{2gl - v_0^2}{3gl}\right) - 2gl$$

$$= \left(v_0^2 - \frac{2}{3}v_0^2\right) + \left(\frac{4}{3} - 2\right)gl$$

$$= \frac{v_0^2}{3} - \frac{2}{3}gl \qquad \ldots\text{(iv)}$$

From (iii) $gl = \dfrac{v_0^2}{2 + 3\sin\theta}$

putting gl in (iv)

$$v^2 = \frac{v_0^2}{3} - \frac{2}{3}\left(\frac{v_0^2}{2 + 3\sin\theta}\right)$$

$$\frac{v^2}{v_0^2} = \frac{1}{3} - \frac{2}{3(2 + 3\sin\theta)} = \frac{1}{3}\left(1 - \frac{2}{2 + 3\sin\theta}\right)$$

$$= \frac{\sin\theta}{(2 + 3\sin\theta)}$$

$$\frac{v}{v_0}\sqrt{\frac{\sin\theta}{(2 + 3\sin\theta)}}$$

8. Option (4) is correct.
Explanation:
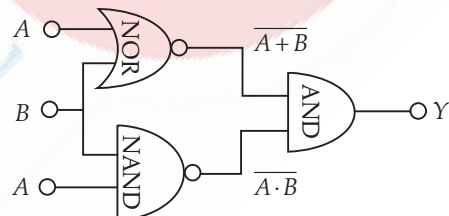
$$Y = (\overline{A + B})\cdot(\overline{A\cdot B})$$

$$= (\bar{A}\cdot\bar{B})\cdot(\bar{A} + \bar{B}) \quad \text{De Morgan's theorem}$$

$$= \bar{A}\cdot(\bar{A}\cdot\bar{B}) + \bar{B}\cdot(\bar{A}\cdot\bar{B})$$

$$= \bar{A}\cdot\bar{B} + \bar{A}\cdot\bar{B}$$

$$= \bar{A}\cdot\bar{B} \qquad (\bar{A}\cdot\bar{A} = \bar{A} \text{ and } \bar{B}\cdot\bar{B} = \bar{B})$$

$$= \overline{A + B} \qquad\qquad\qquad \text{(Nor gate)}$$

9. Option (1) is correct.
Explanation: In an e.m. wave, the phase of the oscillating electric and magnetic field is same

$$\frac{E_0}{c} = \frac{60}{3 \times 10^8} = 2 \times 10^{-7}\ \text{T}$$

Given $E_z = 60\cos(5x + 1.5 \times 10^9 t)$ V/m

We see that the wave propagates in –X direction.

The directions of $\vec{E}$, $\vec{B}$ and $\vec{c}$ are related as

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

$\hat{k} \times \hat{j} = -\hat{i}$

$\therefore \vec{B}$ is along Y-direction as $\hat{k} \times \hat{j} = -\hat{i}$

$\therefore B_y = 2 \times 10^{-7} \cos(5x + 1.5 \times 10^9 t)(T)$

10. Option (1) is correct.

Explanation: Let u = velocity of ball striking the ground

$$= \sqrt{2gh}$$
$$= \sqrt{2 \times 9.8 \times 40}$$
$$= 28 \text{ m/s}$$

Let v = rebound velocity

$$= \sqrt{2gh'}$$
$$= \sqrt{2 \times 9.8 \times 10}$$
$$= 14 \text{ m/s}$$

Impulse $\vec{J}$ = change in momentum

$$= \vec{P}_f - \vec{P}_i$$
$$= m(\vec{v} - \vec{u})$$
$$= 0.5(14\hat{j} - 28(-\hat{j})]$$
$$= 21\hat{j}$$
$$|\vec{J}| = 21 \text{ (Ns)}$$

11. Option (4) is correct.
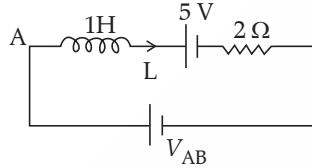
Explanation:

Applying KVL in the loop above, we get

$$V_{AB} - L\frac{di}{dt} - 5 - iR = 0$$
$$V_{AB} = 1(1) + 5 + 2(2)$$
$$= 10 \text{ V}$$

12. Option (1) is correct.

Explanation: Magnetic moment $|\vec{m}| = iA = i(\pi r^2)$

$$\frac{|\vec{m}_1|}{|\vec{m}_2|} = \frac{r_1^2}{r_2^2} = \frac{1}{4}$$

13. Option (3) is correct.

Explanation: Since four identical lenses are kept in contact, equivalent power of the combination is given by $P' = P + P + P + P = 4P$

and magnification $m' = m \times m \times m \times m = m^4$

14. Option (3) is correct.

Explanation: From general gas equation $pV = nRT$

$$n = \frac{pV}{RT}$$

where p = absolute (final) pressure = gauge pressure + atmospheric pressure

$p = (11+1) = 12$ atm

$\therefore n$ = no. of moles remaining

$$= \frac{12 \times 1.01 \times 10^5 \times 30 \times 10^{-3}}{\dfrac{100}{2} \times 300}$$

$$= 14.54$$

No. of moles removed $= 18.20 - 14.54$
$$= 3.66$$

Mass removed $= 3.66 \times$ Molar mass

$$= 3.66 \times \frac{32}{1000} \text{ kg} = 0.117 \text{ kg}$$

15. Option (2) is correct.

Explanation: Given $t = x^2 + x$

Differentiating on both sides wrt t

$$1 = 2x\frac{dx}{dt} + 1\frac{dx}{dt}$$

$$\frac{dx}{dt} = v = \frac{1}{2x+1}$$

$$a = \frac{dv}{dt} = \frac{-2}{(2x+1)^2} \cdot \frac{dx}{dt} = \frac{-2}{(2x+1)^2} \times \frac{1}{(2x+1)}$$

$$= \frac{-2}{(2x+1)^3}$$

16. Option (2) is correct.

Explanation: $i_V = \dfrac{e_V}{Z}$

$$e_V = 220 \text{ V (rms)}$$

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

$$= \sqrt{20^2 + (45 - 25)^2}$$

$$= 20\sqrt{2}\,\Omega$$

$$i_V = \frac{220}{20\sqrt{2}} = \frac{11}{\sqrt{2}} = 7.8A$$

$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} = \frac{20}{20} = 1$$

$$\phi = 45°$$

17. Option (4) is correct.

Explanation: In the absence of external torque, angular momentum is conserved.

$$I_1\omega_1 = I_2\omega_2$$

$$\left(\frac{2}{5}MR_1^2\right)\left(\frac{2\pi}{T_1}\right) = \left(\frac{2}{5}MR_2^2\right)\left(\frac{2\pi}{T_2}\right)$$

$$T_2 = T_1\left(\frac{R_2}{R_1}\right)^2$$

$$= 27 \times \left(\frac{2R_1}{R_1}\right)^2$$

$$= 27 \times 4$$

$$T_2 = 108 \text{ days}$$

18. Option (2) is correct.

Explanation: Magnetic flux $\phi_B = B(\pi r^2) = \dfrac{nh}{e}$ ... (i)

Magnetic moment $|\vec{M}| = i(\pi r^2)$

$$= \frac{e}{T}(\pi r^2)$$

$$= \frac{ev}{2\pi r}(\pi r^2)$$

$$= \frac{ev(\pi r^2)}{2\pi\left(\dfrac{mv}{eB}\right)} = \frac{e^2 B(\pi r^2)}{2\pi m}$$

$$= \frac{e^2}{2\pi m} \times \frac{nh}{e}$$

From (i)

putting $n = 1$

$$|\vec{M}| = \frac{eh}{2\pi m}$$

19. Option (3) is correct.

Explanation: In steady state, rate of flow of heat is same through each rod.

$$\frac{\Delta Q}{\Delta t} = \frac{2KA(3T - T_1)}{l} = \frac{KA(T_1 - T_2)}{l} = \frac{2KA(T_2 - T_1)}{l}$$

$$2(2T - T_1) = (T_1 - T_2) = 2(T_2 - T)$$

Considering, $2(2T - T_1) = (T_1 - T_2)$

$$6T = 3T_1 - T_2$$

Considering, $(T_1 - T_2) = 2(T_2 - T)$

$$2T = 3T_2 - T_1$$
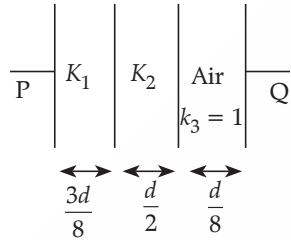
So, $\dfrac{3T_1 - T_2}{6} = \dfrac{3T_2 - T_1}{2}$

$$\Rightarrow \quad 3T_1 - T_2 = 9T_2 - 3T_1$$

$$6T_1 = 10T_2$$

$$\frac{T_1}{T_2} = \frac{5}{3}$$

20. Option (1) is correct.

Explanation:

$$C_1 = K_1 \frac{\varepsilon_0 A}{3d/8} = \frac{\varepsilon_0 A}{d}\left(\frac{8K_1}{3}\right)$$

$$C_2 = K_2 \frac{\varepsilon_0 A}{d/2} = \frac{\varepsilon_0 A}{d}(2K_2)$$

$$C_3 = \frac{\varepsilon_0 A}{d/8} = \frac{\varepsilon_0 A}{d}(8)$$

C_1, C_2 and C_3 are in series

$$\frac{1}{C_{PQ}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$= \frac{d}{\varepsilon_0 A}\left(\frac{3}{8K_1} + \frac{1}{2K_2} + \frac{1}{8}\right)$$

given $K_1 = 1.25 K_2$

$$\frac{1}{C_{PQ}} = \frac{d}{\varepsilon_0 A}\left(\frac{3}{10K_2} + \frac{1}{2K_2} + \frac{1}{8}\right)$$

$$= \frac{d}{\varepsilon_0 A}\left(\frac{8}{10K_2} + \frac{1}{8}\right)$$

$$= \frac{d}{\varepsilon_0 A}\left(\frac{64 + 10K_2}{80K_2}\right)$$

$$C_{PQ} = \frac{\varepsilon_0 A}{d}\left(\frac{80K_2}{64 + 10K_2}\right) = 2\frac{E_0 A}{d} \text{ (given)}$$

$$40 K_2 = 64 + 10 K_2$$

$$K_2 = \frac{64}{30}$$

$$K_1 = 1.25 K_2 = \frac{5}{4} \times \frac{64}{30} \approx 2.67$$

21. Option (4) is correct.

Explanation: Let v_b = velocity of bus

v_g = velocity of girl = 60 km/h

When moving in the same direction, a bus crosses her every 30 min = $\dfrac{1}{2}$ h.

When moving in the opposite direction, a bus crosses her every 10 min = $\dfrac{1}{6}$ h.

Since buses are equispaced

$$d = (v_b - 60)\frac{1}{2} = (v_b - 60)\frac{1}{6}$$

$$3v_b = 180 = v_b + 60$$

$$2v_b = 240$$

$$v_b = 120 \text{ km/h}$$

$$\therefore \quad d = 30 \text{ km}$$

Time interval between two successive buses

$$T = \frac{d}{v_b} = \frac{30}{120} = \frac{1}{4} \text{ h} = 15 \text{ min.}$$

22. Option (2) is correct.
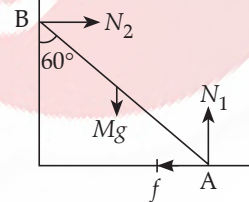
Explanation:

Since rod is in equilibrium

$$\Sigma F_Y = 0 \Rightarrow N_1 = Mg = 200 \text{ N}$$

$$\Sigma F_X = 0 \Rightarrow N_2 = f$$

$$\Sigma T_A = 0$$

$$Mg\left(\frac{1}{2}\cos 30°\right) = N_2 (L \cos 60°)$$

$$\frac{Mg}{2}\frac{\sqrt{3}}{2} = \frac{N_2}{2}$$

$$N_2 = \frac{\sqrt{3}}{2} \times 200 = 100\sqrt{3} = f$$

23. Option (2) is correct.

Explanation: Angular frequency $\omega = \sqrt{\dfrac{K}{m}}$

As sand leaks, m decreases, ω increases with time

As sand leaks, energy of the system decreases

Since $E = \dfrac{1}{2}KA^2$, amplitude decreases with time

24. Option (3) is correct.

Explanation: Surface tension $S = \dfrac{F}{l}$

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

$$T \propto S^\alpha A^\beta \rho^\gamma R^\delta$$
$$[T^1] = [M^1T^{-2}]^\alpha [L^2]^\beta [M^1L^{-3}]^\gamma [L]^\delta$$
$$= [M]^{\alpha+\gamma} [L]^{2\beta-3\gamma+\delta} [T]^{-2\alpha}$$

Comparing the powers, we get
$$\alpha + \gamma = 0, \quad 2\beta - 3\gamma + \delta = 0, \quad -2\alpha = 1$$
$$\Rightarrow \alpha = -\frac{1}{2} \text{ and } \gamma = -\alpha = \frac{1}{2}$$
$$2\beta - 3\left(\frac{1}{2}\right) + \delta = 0$$
$$2\beta + \gamma = \frac{3}{2}$$

$\beta = -1$ and $\delta = \frac{7}{2}$ satisfy the above equation.

25. **Option (3) is correct.**
Explanation: given 10 VSD = 9 MSD
$$1 \text{ VSD} = \frac{9}{10} \text{ MSD}$$
Least Count (LC) = 1 MSD – 1 VSD
$$= 1 \text{ MSD} - \frac{9}{10} \text{ MSD}$$
$$= \frac{1}{10} \text{ MSD}$$
$$= \frac{1}{10} \times 0.1 \text{ cm}$$
$$= 0.01 \text{ cm}$$
Reading = 5 + 8 (LC) – zero error
$$= 5 + 8 (0.01) - 0.1$$
$$= 5 + 0.08 - 0.1$$
$$= 4.98 \text{ cm}$$

26. **Option (3) is correct.**
Explanation: Displacement Current
$$I_d = \varepsilon_0 \frac{d\phi_E}{dt} = \varepsilon_0 \frac{d}{dt}(EA\cos 0°)$$
$$= \varepsilon_0 A \frac{dE}{dt}$$
$$= \varepsilon_0 A \frac{d}{dt}\left(\frac{\sigma}{\varepsilon_0}\right)$$
$$= A\frac{d\sigma}{dt}$$
$$= \text{Constant}$$
Considering the imaginary cylinder connecting the two circular plates of the capacitor, for $r < R$,
$$B = \frac{\mu_o I_d r}{2\pi R^2}, r \geq R, \; B = \frac{\mu_o I_d}{2\pi r}$$

When $r = R$, $B_{mx} = \frac{\mu_o I}{2\pi R}$

27. **Option (1) is correct.**
Explanation: When unpolarised light is incident at polarising (Baewster's) angle, the reflected light is completely polarised and the transmitted light is partially polarised.
From theory $\tan i_p = \sqrt{3} = 1.73$

$$i_p = 60°$$
According to law of reflection, $r = i_p = 60°$

28. **Option (4) is correct.**
Explanation: Let the separation between the centres of the two spheres be d
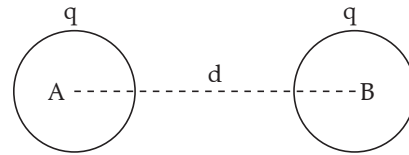
$$F = \frac{Kq^2}{d^2}$$

When the third identical uncharged sphere C is brought in contact with sphere A, both share equal charges
$$\Rightarrow \qquad V_A = V_C$$
$$q_A = q_C = \frac{q}{2}$$

Now when the third sphere (with charge $\frac{q}{2}$) is brought into contact with sphere B, again both share equal charges
$$\Rightarrow \qquad V_B = V_C$$
$$q_B = q_c = \frac{q + \frac{q}{2}}{2} = \frac{3q}{4}$$
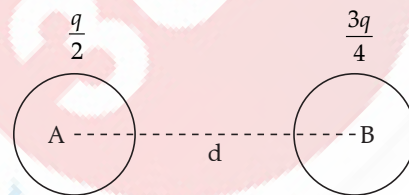
The value of F' between spheres A and B is given by $F' = \dfrac{K\left(\dfrac{q}{2}\right)\left(\dfrac{3q}{4}\right)}{d^2} = \dfrac{3}{8}F$.

29. **Option (2) is correct.**
Explanation: On removing the partition, the gases in two chambers mix and acquire an equilibrium pressure
Applying COE
$$E_1 + E_2 = E$$
$$n_1\left[\frac{1}{2} f_1 RT_1\right] + n_2\left[\frac{1}{2} f_2 RT_2\right] = (n_1 + n_2)\left(\frac{1}{2} fRT\right)$$
Here $f_1 = f_2 = f$
Since the same gas is present in each chamber.
From general gas equation $pV = nRT$, we get
$$\frac{1}{2} f_1(p_1 v_1) + \frac{1}{2} f_2(p_2 v_2) = \frac{1}{2} f(pV)$$
$$p = \frac{p_1 V_1 + p_2 V_2}{V} = \frac{p_1 V_1 + p_2 V_2}{V_1 + V_2}$$
$$= \frac{1(2) + 2(3)}{2+3}$$

$$= \frac{8}{5}$$

$$= 1.6 \text{ atm}$$

30. Option (3) is correct.

Explanation: $F = \frac{mv^2}{r}$ constant (given) ... (i)

From Bohr's quantisation condition,

$$mvr = \frac{nh}{2\pi} \qquad \text{... (ii)}$$

$$r = \frac{nh}{2\pi mv}$$

putting value of r in (i), we get

$$F = \frac{mv^2}{nh} \times 2\pi mv$$

$$= \frac{2\pi m^2 v^3}{nh}$$

$$v^3 \propto n$$

$$v \propto n^{1/3}$$

From (ii) $r \propto \frac{n}{v} \propto \frac{n}{n^{1/3}} = n^{2/3}$

31. Option (1) is correct.

Explanation: From Kepler's law of periods

$$T^2 \propto r^3 \rightarrow T \propto r^{3/2}$$

$$\frac{T_{\text{Mercury}}}{T_{\text{Mars}}} = [r_{\text{Mercury}} / r_{\text{Mars}}]^{3/2} = \left(\frac{1}{4}\right)^{3/2} = \frac{1}{8}$$

$$T_{\text{Mercury}} = \frac{T_{\text{Mars}}}{8} = \frac{687}{8} = 85.87 \approx 88 \text{ Earth days}$$

32. Option (2) is correct.

Explanation: $g' = g\left(\frac{R}{R+h}\right)^2$ = acceleration due to

gravity at a height h

$$mg' = mg\left(\frac{R}{R+h}\right)^2$$

$$= 48\left(\frac{R}{R+\frac{R}{3}}\right)^2$$

$$= 48 \times \frac{9}{16}$$

$$mg' = 27 \text{ N}$$

33. Option (3) is correct.

Explanation: When a resistance R is cut into 8

equal pieces, each piece has a resistance $R' = \frac{R}{8}$

Four of each pieces are connected in parallel to

give $R_1 = \frac{R'}{4} = \frac{R}{32}$.

Two such sets are connected now in series to give

$R_2 = 2R_1 = \frac{R}{16}$.

34. Option (2) is correct.

Explanation: De Broglie wavelength $\lambda = \frac{h}{mv}$

$v = 2.18 \times 10^6 \frac{Z}{n}$ From Bohr's theory

given $Z = 1$, $n = 2$

$v = 1.09 \times 10^6$ m/s

$$\lambda = \frac{6.625 \times 10^{-34}}{9.1 \times 10^{-31} \times 1.09 \times 10^6} = 0.67 \text{ nm}$$

35. Option (2) is correct.

Explanation: $\Delta U = pE(\cos\theta_1 - \cos\theta_2)$

$$= 5 \times 10^{-6} \times 4 \times 10^5 (\cos\theta° - \cos 60°)$$

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

$$= 1 \text{ J}$$

36. Option (2) is correct.
Explanation:
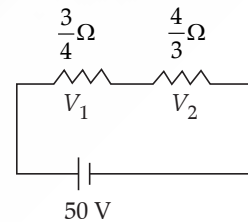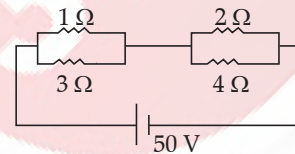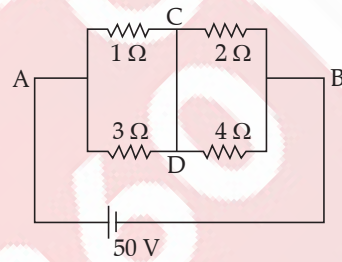
$$\Rightarrow \quad V_1 = \frac{50 \times \frac{3}{4}}{\frac{3}{4} + \frac{4}{3}}$$

$$= \frac{50 \times 9}{25}$$

$$= 18 \text{ V}$$

$$V_2 = 50 - 18 = 32 \text{ V}$$

$$i_{1\Omega} = \frac{18}{1} = 18 \text{ A}$$

$$i_{2\Omega} = \frac{32}{2} = 16 \text{ A}$$

$$i_{CD} = 18 - 16 = 2 \text{ A}$$

37. Option (3) is correct.

Explanation: For photon

$$E = \frac{hc}{\lambda_{ph}} \rightarrow \lambda_{ph} = \frac{hc}{E}$$

For electron

$$\lambda_e = \frac{h}{\sqrt{2mE}}$$

$$\frac{\lambda_{ph}}{\lambda_e} = c\sqrt{\frac{2m}{E}}$$

38. Option (1) is correct.

Explanation: Photoelectric current
• Numbers of electrons emitted per second per unit
• Intensity of incident light
The current does not depend on frequency

39. Option (3) is correct.

Explanation: Let M' be the mass of the sphere being removed

$$M' = \frac{M}{\frac{4}{3}\pi(2R)^3} \times \frac{4}{3}\pi R^3 = \frac{M}{8}$$

M.I. of the smaller sphere about Y-axis

$$= \frac{2}{5}\left(\frac{M}{8}\right)R^2 + \frac{M}{8}R^2$$

$$= \frac{7}{5}\frac{M}{8}R^2$$

$$I_1 = \frac{7MR^2}{40}$$

M.I. of the remaining sphere about Y-axis

$$= \frac{2}{5}M(2R)^2 - \frac{7}{40}MR^2$$

$$= MR^2\left(\frac{8}{5} - \frac{7}{40}\right)$$

$$= MR^2\left(\frac{64-7}{40}\right)$$

$$I_2 = \frac{57}{40}MR^2$$

$$\frac{I_1}{I_2} = \frac{7}{57}$$

40. Option (2) is correct.

Explanation: Given input supply voltage.

$V_M = 220\sin(100\pi t)$

$V_M(t = 15\text{ ms}) = 220\sin(100\pi \times 15 \times 10^{-3})$

$$= 220\sin\left(\frac{3\pi}{2}\right)$$

$= -220$ V

Hence, diode D_1 is reverse biased and D_2 is forward biased.

41. Option (2) is correct.

Explanation: From first law of thermodynamics

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

Since ΔQ and ΔU are same for both gases,

$$\Delta W_1 = \Delta W_2$$

For constant pressure, $\Delta W = (PA)x = P(\pi r^2)x$

$$\therefore \quad PA_1x_1 = PA_2x_2$$

$$r_1^2 x_1 = r_2^2 x_2$$

$$\frac{r_1}{r_2} = \sqrt{\frac{x_2}{x_1}} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

$$\frac{r_A}{r_B} = \frac{3}{4}$$

42. Option (3) is correct.

Explanation: Given $P = \dfrac{a^3 b^2}{c\sqrt{d}}$

$$\frac{\Delta P}{P} \times 100 = \left(\frac{3\Delta a}{a} + \frac{2\Delta b}{b} + \frac{\Delta c}{c} + \frac{1}{2}\frac{\Delta d}{d}\right) \times 100$$

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

$$= (3 + 6 + 2 + 2)\%$$

$$= 13\%$$

43. Option (3) is correct.

Explanation:

$$(I_0\cos^2\theta)\cos^2(90° - \theta)$$
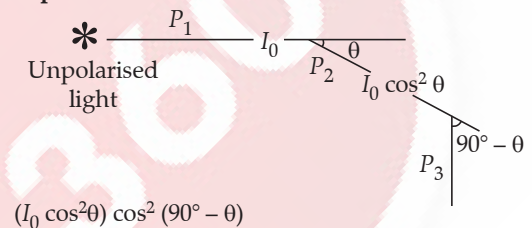
$$= \frac{I_0}{4}\sin^2(2\theta)$$

$$= \frac{I_0}{4}\sin^2(2 \times 22.5°)$$

$$= \frac{I_0}{4}\sin^2 45°$$

$$= \frac{I_0}{8}$$

44. Option (4) is correct.

Explanation: $v_{1(\max)} = v_{2(\max)}$

$$A_1\omega_1 = A_2\omega_2$$

$$A_1\sqrt{\frac{k_1}{m}} = A_2\sqrt{\frac{k_2}{m}}$$

$$\frac{A_2}{A_1} = \sqrt{\frac{k_1}{k_2}}$$

$$\frac{A_Q}{A_P} = \sqrt{\frac{k_1}{k_2}}$$

45. Option (2) is correct.

Explanation: Given $f = \dfrac{v}{2l}$

$$f' = \frac{v}{4\left(\dfrac{l}{2}\right)} = \frac{v}{2l} = f$$

■■■

Total Time Duration: 45 Minutes **Maximum Marks: 180**

CHEMISTRY

Q. 46. The ratio of the wavelengths of the light absorbed by a hydrogen atom when it undergoes $n = 2 \to n = 3$ and $n = 4 \to n = 6$ transitions, respectively, is

(1) $\dfrac{1}{36}$ (2) $\dfrac{1}{16}$ (3) $\dfrac{1}{9}$ (4) $\dfrac{1}{4}$

Q. 47. Which of the following statements are true?

A. Unlike Ga that has a very high melting point, Cs has a very low melting point.
B. On Pauling scale, the electronegativity values of N and Cl are not the same.
C. Ar, K^+, Cl^-, Ca^{2+} and S^{2-} are all isoelectronic species.
D. The correct order of the first ionisation enthalpies of Na, Mg, Al, and Si is Si > Al > Mg > Na.
E. The atomic radius of Cs is greater than that of Li and Rb.

Choose the **correct** answer from the options given below:

(1) A, B and E only (2) C and E only
(3) C and D only (4) A, C and E only

Q. 48. Match **List-I** with **List-II**.
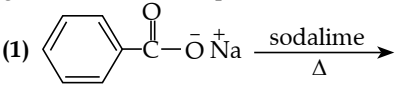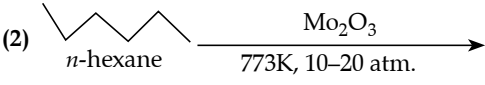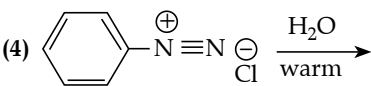
List-I (Ion)		List-II (Group number in cation analysis)
A. Co^{2+}	I.	Group-I
B. Mg^{2+}	II.	Group-III
C. Pb^{2+}	III.	Group-IV
D. Al^{3+}	IV.	Group-VI

Choose the **correct** answer from the options given below:

(1) A-III, B-IV, C-II, D-I
(2) A-III, B-IV, C-I, D-II
(3) A-III, B-II, C-IV, D-I
(4) A-III, B-II, C-I, D-IV

Q. 49. Predict the major product 'P' in the following sequence of reactions-

(1)

(2)

(3)

(4)
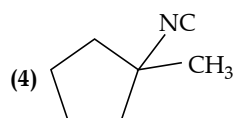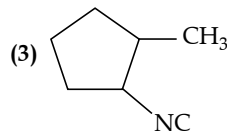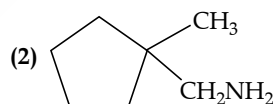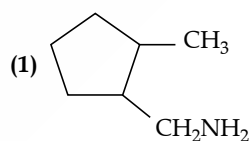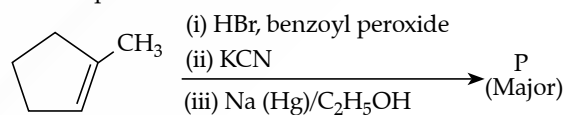
Q. 50. Energy and radius of first Bohr orbit of He^+ and Li^{2+} are

[Given R_H = 2.18 × 10^{-18} J, a_0 = 52.9 pm]

(1) $E_n (Li^{2+})$ = –19.62 × 10^{-18} J;
   $r_n (Li^{2+})$ = 17.6 pm
   $E_n (He^+)$ = –8.72× 10^{-18} J;
   $r_n (He^+)$ = 26.4 pm

(2) $E_n (Li^{2+})$ = –8.72 × 10^{-18} J;
   $r_n (Li^{2+})$ = 26.4 pm
   $E_n (He^+)$ = –19.62 × 10^{-18} J;
   $r_n (He^+)$ = 17.6 pm

(3) $E_n (Li^{2+})$ = –19.62 × 10^{-16} J;
   $r_n (Li^{2+})$ = 17.6 pm
   $E_n (He^+)$ = –8.72 × 10^{-16} J;
   $r_n (He^+)$ = 26.4 pm

(4) $E_n (Li^{2+})$ = –8.72 × 10^{-16} J;
   $r_n (Li^{2+})$ = 17.6 pm
   $E_n (He^{2+})$ = –19.62 × 10^{-16} J;
   $r_n (He^+)$ = 17.6 pm

Q. 51. Which of the following are paramagnetic?

A. $[NiCl_4]^{2-}$ B. $Ni(CO)_4$
C. $[Ni(CN)_4]^{2-}$ D. $[Ni(H_2O)_6]^{2+}$
E. $Ni(PPh_3)_4$

Choose the **correct** answer from the options given below:

(1) A and C only   (2) B and E only
(3) A and D only   (4) A, D and E only

Q. 52. Given below are two statements:

Statement I: Like nitrogen that can form ammonia, arsenic can form arsine.

Statement II: Antimony cannot form antimony pentoxide.

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

(1) Both statement I and statement II are correct.
(2) Both statement I and statement II are incorrect.
(3) Statement I is correct but Statement II is incorrect.
(4) Statement I is incorrect but Statement II is correct.

Q. 53. Which among the following electronic configurations belong to main group elements?

A. $[Ne]3s^1$ B. $[Ar]3d^34s^2$
C. $[Kr]4d^{10}5s^25p^5$ D. $[Ar]3d^{10}4s^1$
E. $[Rn]5f^06d^27s^2$

Choose the **correct** answer from the options given below:

(1) B and E only   (2) A and C only
(3) D and E only   (4) A, C and D only

Q. 54. Dalton's Atomic theory could not explain which of the following?

(1) Law of conservation of mass
(2) Law of constant proportion
(3) Law of multiple proportion
(4) Law of gaseous volume

Q. 55. Consider the following compounds:

$\underline{K}O_2$, $H_2\underline{O}_2$ and $H_2\underline{S}O_4$

The oxidation states of the underlined elements in them are, respectively,

(1) +1, –1, and +6   (2) +2, –2, and +6
(3) +1, –2, and +4   (4) +4, –4, and +6

Q. 56. If the half-life ($t_{1/2}$) for a first order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to:

(1) 2 minutes   (2) 4 minutes
(3) 5 minutes   (4) 10 minutes

Q. 57. The correct order of the wavelength of light absorbed by the following complexes is,

A. $[Co(NH_3)_6]^{3+}$ B. $[Co(CN)_6]^{3-}$
C. $[Cu(H_2O)_4]^{2+}$ D. $[Ti(H_2O)_6]^{3+}$

Choose the **correct** answer from the options given below:

(1) B < D < A < C   (2) B < A < D < C
(3) C < D < A < B   (4) C < A < D < B

Q. 58. Which one of the following compounds can exist as cis-trans isomers?

(1) Pent-1-ene
(2) 2-Methylhex-2-ene
(3) 1,1-Dimethylcyclopropane
(4) 1,2-Dimethylcyclohexane

Q. 59. Phosphoric acid ionises in three steps with their ionisation constant values K_{a_1}, K_{a_2} and K_{a_3}, respectively, while K is the overall ionisation constant. Which of the following statements are true?

A. $\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

B. H_3PO_4 is stronger acid than $H_2PO_4^-$ and HPO_4^{2-}.

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = \dfrac{K_{a_3}+K_{a_2}}{2}$

Choose the **correct** answer from the options given below:

(1) A and B only   (2) A and C only
(3) B, C and D only   (4) A, B and C only

Q. 60. Which one of the following reactions does **NOT** give benzene as the product?

(1) $\xrightarrow{\text{sodalime}, \Delta}$

(2) n-hexane $\xrightarrow[\text{773K, 10–20 atm.}]{Mo_2O_3}$

(3) $H-C\equiv C-H$ $\xrightarrow[\text{at 873 K}]{\text{red hot iron tube}}$

(4) $\xrightarrow[\text{warm}]{H_2O}$

Q. 61. If the molar conductivity (Λ_m) of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be [Assume $\Lambda_+^\circ = 349.6$ S cm^2 mol^{-1} and $\Lambda_-^\circ = 50.4$ S cm^2 mol^{-1}.]

(1) 0.115   (2) 0.125   (3) 0.225   (4) 0.215

Q. 62. Given below are two statements:

Statement I: A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II: As bond order increases, the bond length increases.

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

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

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

(3) Statement I is true but Statement II is false.

(4) Statement I is false but Statement II is true.

Q. 63. Out of the following complex compounds, which of the compound will be having the minimum conductance in solution?

(1) $[Co(NH_3)_3Cl_3]$ (2) $[Co(NH_3)_4Cl_2]$

(3) $[Co(NH_3)_6]Cl_3$ (4) $[Co(NH_3)_5Cl]Cl$

Q. 64. Match **List-I** with **List-II.**

List-I		List-II	
A.	XeO_3	I.	sp^3d; linear
B.	XeF_2	II.	sp^3; pyramidal
C.	$XeOF_4$	III.	sp^3d^3; distorted octahedral
D.	XeF_6	IV.	sp^3d^2; square pyramidal

Choose the **correct** answer from the options given below:

(1) A-II, B-I, C-IV, D-III   (2) A-II, B-I, C-III, D-IV

(3) A-IV, B-II, C-III, D-I   (4) A-IV, B-II, C-I, D-III

Q. 65. $C(s) + 2H_2(g) \rightarrow CH_4(g)$; $\Delta H = -74.8$ kJ mol^{-1}

Which of the following diagrams gives an accurate representation of the above reaction?

[R → reactants; P → products]

(1)

(2)

(3)

(4)
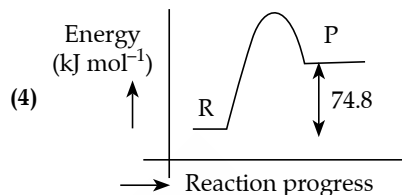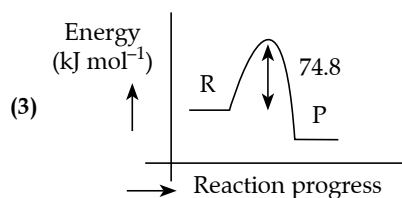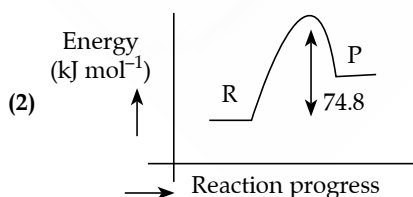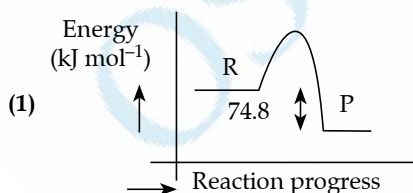
Q. 66. Match **List-I** with **List-II.**

List-I (Example)		List-II (Type of Solution)	
A.	Humidity	I.	Solid in solid
B.	Alloys	II.	Liquid in gas
C.	Amalgams	III.	Solid in gas
D.	Smoke	IV.	Liquid in solid

Choose the **correct** answer from the options given below:

(1) A-II, B-IV, C-I, D-III

(2) A-II, B-I, C-IV, D-III

(3) A-III, B-I, C-IV, D-II

(4) A-III, B-II, C-I, D-IV

Q. 67. The correct order of decreasing basic strength of the given amines is:

(1) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine

(2) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline

(3) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine

(4) Benzenamine > ethanamine > N-methylaniline > N-ethylethanamine

Q. 68. Among the following, choose the ones with equal number of atoms.

A. 212 g of Na_2CO_3 (s) [molar mass = 106 g]

B. 248 g of Na_2O (s) [molar mass = 62 g]

C. 240 g of NaOH (s) [molar mass = 40 g]

D. 12 g of $H_2(g)$ [molar mass = 2 g]

E. 220 g of $CO_2(g)$ [molar mass = 44 g]

Choose the **correct** answer from the options given below:

(1) A, B, and C only   (2) A, B, and D only

(3) B, C, and D only   (4) B, D, and E only

Q. 69. Match **List-I** with **List-II.**

List-I (Name of vitamin)		List-II (Deficiency disease)	
A.	Vitamin B_{12}	I.	Cheilosis
B.	Vitamin D	II.	Convulsions
C.	Vitamin B_2	III.	Rickets
D.	Vitamin B_6	IV.	Pernicious anaemia

Choose the **correct** answer from the options given below:

(1) A-I, B-III, C-II, D-IV

(2) A-IV, B-III, C-I, D-II

(3) A-II, B-III, C-I, D-IV

(4) A-IV, B-III, C-II, D-I

Q. 70. The correct order of decreasing acidity of the following aliphatic acids is:

(1) $(CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH > HCOOH$

(2) $CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH > HCOOH$

(3) $HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

(4) $HCOOH > (CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH$

Q. 71. Given below are two statements:

Statement I: Ferromagnetism is considered as an extreme form of paramagnetism.

Statement II: The number of unpaired electrons in a Cr^{2+} ion (Z=24) is the same as that of a Nd^{3+} ion (Z= 60).

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

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

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

(3) Statement I is true but Statement II is false.

(4) Statement I is false but Statement II is true.

Q. 72. Match **List-I** with **List-II**.

|	List-I (Mixture)		List-II (Method of separation)
A.	CHCl$_3$ + C$_6$H$_5$NH$_2$	I.	Distillation under reduced pressure
B.	Crude oil in petroleum industry	II.	Steam distillation
C.	Glycerol from spent-lye	III.	Fractional distillation
D.	Aniline-water	IV.	Simple distillation

Choose the **correct** answer from the options given below:

(1) A-IV, B-III, C-I, D-II

(2) A-IV, B-III, C-II, D-I

(3) A-III, B-IV, C-I, D-II

(4) A-III, B-IV, C-II, D-I

Q. 73. For the reaction $A(g) \rightleftharpoons 2B(g)$ the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K. [Given: R = 0.0831 L atm mol^{-1} K^{-1}]

K_P for the reaction at 1000 K is:

(1) 83.1

(2) 2.077×10^5

(3) 0.033

(4) 0.021

Q. 74. Given below are two statements:

Statement I: Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273–278 K. It decomposes easily in the dry state.

Statement II: Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI.

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

(1) Both Statement I and Statement II are correct.

(2) Both Statement I and Statement II are incorrect.

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

Q. 75. How many products (including stereoisomers) are expected from monochlorination of the following compound?
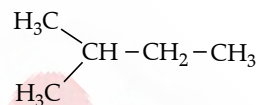
(1) 2
(2) 3
(3) 5
(4) 6

Q. 76. Among the given compounds I–III, the correct order of bond dissociation energy of C–H bond marked with * is:
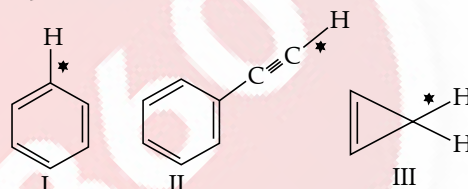
(1) II > I > III

(2) I > II > III

(3) III > II > I

(4) II > III > I

Q. 77. Which one of the following compounds **does not** decolourise bromine water?
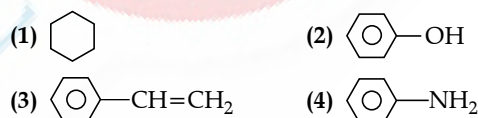
Q. 78. The major product of the following reaction is:
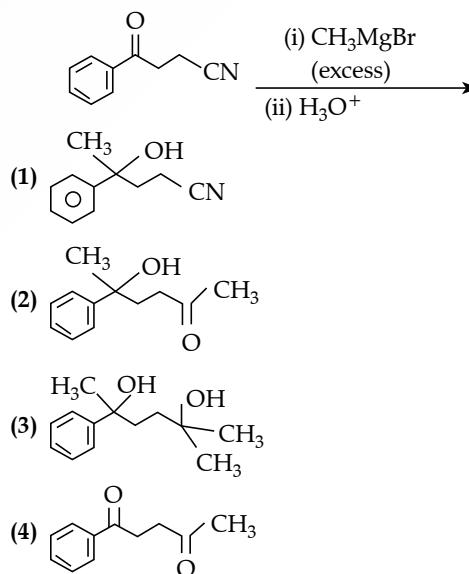
Q. 79. Which of the following aqueous solution will exhibit highest boiling point?

(1) 0.01 M Urea   (2) 0.01 M KNO_3

(3) 0.01 M Na_2SO_4 (4) 0.015 M $C_6H_{12}O_6$

Q. 80. Match **List-I** with **List-II.**

List-I		List-II	
A.	Haber process	**I.**	Fe catalyst
B.	Wacker oxidation	**II.**	$PdCl_2$
C.	Wilkinson catalyst	**III.**	$[(PPh_3)_3RhCl]$
D.	Ziegler catalyst	**IV.**	$TiCl_4$ with $Al(CH_3)_3$

Choose the **correct** answer from the options given below:

(1) A-I, B-II, C-IV, D-III

(2) A-II, B-III, C-I, D-IV

(3) A-I, B-II, C-III, D-IV

(4) A-I, B-IV, C-III, D-II

Q. 81. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapour pressure of 70 torr. The vapour pressures of pure X and Y are 63 torr and 78 torr respectively. Which of the following is true regarding the described solution?

(1) The solution shows positive deviation.

(2) The solution shows negative deviation.

(3) The solution is ideal.

(4) The solution has volume greater than the sum of individual volumes.

Q. 82. Sugar 'X'

A. is found in honey.

B. is a keto sugar.

C. exists in α and β – anomeric forms.

D. is laevorotatory

'X' is:

(1) D-Glucose   (2) D-Fructose

(3) Maltose   (4) Sucrose

Q. 83. Identify the suitable reagent for the following conversion.
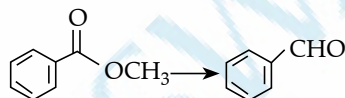
(1) (i) $LiAlH_4$, (ii) H^+/H_2O

(2) (i) $AlH(iBu)_2$ (ii) H_2O

(3) (i) $NaBH_4$, (ii) H^+/H_2O

(4) (i) $H_2/Pd\text{-}BaSO_4$

Q. 84. Given below are two statement: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R):**

Assertion (A): $\sim\!\!\sim\!\!$I undergoes S_N^2 reaction faster than $\sim\!\!\sim\!\!$Cl.

Reason (R): Iodine is a better leaving group because of its large size.

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

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are true but **R** is not the correct explanation of **A**.

(3) **A** is true but **R** is false.

(4) **A** is false but **R** is true.

Q. 85. The standard heat of formation, in kcal/mol of Ba^{2+} is:

[Given: standard heat of formation of SO_4^{2-} ion (aq) = – 216 kcal/mol, standard heat of crystallisation of $BaSO_4(s)$ = – 4.5 kcal/mol, standard heat of formation of $BaSO_4(s)$ = – 349 kcal/mol]

(1) –128.5   (2) –133.0   (3) +133.0   (4) +220.5

Q. 86. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is:

(1) 6   (2) 8   (3) 10   (4) 11

Q. 87. Identify the correct orders against the property mentioned

A. $H_2O > NH_3 > CHCl_3$ - dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O–H > C–H > N–O – bond length

D. $N_2 > O_2 > H_2$ – bond enthalpy

Choose the **correct** answer from the options given below:

(1) A, D only   (2) B, D only

(3) A, C only   (4) B, C only

Q. 88. Higher yield of NO in

$N_2(g) + O_2 \rightleftharpoons 2NO(g)$ can be obtained at

[ΔH of the reaction = + 180.7 kJ mol^{-1}]

A. higher temperature

B. lower temperature

C. higher concentration of N_2

D. higher concentration of O_2

Choose the **correct** answer from the options given below:

(1) A, D only   (2) B, C only

(3) B, C, D only   (4) A, C, D only

Q. 89. If the rate constant of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1}? (Given: log 2 = 0.301)

(1) 69.3 s   (2) 23.1 s   (3) 210 s   (4) 21.0 s

Q. 90. Which one of the following reactions does **NOT** belong to "Lassaigne's test"?

(1) $Na + C + N \xrightarrow{\Delta} NaCN$

(2) $2Na + S \xrightarrow{\Delta} Na_2S$

(3) $Na + X \xrightarrow{\Delta} +NaX$

(4) $2CuO + C \xrightarrow{\Delta} 2Cu + CO_2$

Booklet Batch Roll Number

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

Name

Test Date   Invigilator's Signature

Student's Signature

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

Test Centre Code

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

Avoid Improper Marking

Partially Filled

Lightly Filled

46 ① ② ③ ④	51 ① ② ③ ④	56 ① ② ③ ④	61 ① ② ③ ④
47 ① ② ③ ④	52 ① ② ③ ④	57 ① ② ③ ④	62 ① ② ③ ④
48 ① ② ③ ④	53 ① ② ③ ④	58 ① ② ③ ④	63 ① ② ③ ④
49 ① ② ③ ④	54 ① ② ③ ④	59 ① ② ③ ④	64 ① ② ③ ④
50 ① ② ③ ④	55 ① ② ③ ④	60 ① ② ③ ④	65 ① ② ③ ④

66 ① ② ③ ④	71 ① ② ③ ④	76 ① ② ③ ④	81 ① ② ③ ④
67 ① ② ③ ④	72 ① ② ③ ④	77 ① ② ③ ④	82 ① ② ③ ④
68 ① ② ③ ④	73 ① ② ③ ④	78 ① ② ③ ④	83 ① ② ③ ④
69 ① ② ③ ④	74 ① ② ③ ④	79 ① ② ③ ④	84 ① ② ③ ④
70 ① ② ③ ④	75 ① ② ③ ④	80 ① ② ③ ④	85 ① ② ③ ④

| 86 ① ② ③ ④ |
| 87 ① ② ③ ④ |
| 88 ① ② ③ ④ |
| 89 ① ② ③ ④ |
| 90 ① ② ③ ④ |

Answer Key

Q. No.	Answer	Topic's Name	Chapter Name
Chemistry			
46	4	Hydrogen spectra	Structure of atom
47	2	Periodic properties	Modern periodic table
48	2	Qualitative analysis	Practical chemistry
49	1	Anti-Markonikov addition,substitution reaction	Hydrocarbons
50	1	Bohr's atomic model	Structure of atom
51	3	Magnetic properties	Coordination compounds
52	3	Types of oxides	Nitrogen family
53	2	Electronic configuration	Modern periodic table
54	4	Dalton's atomic theory	Structure of atom
55	1	Oxidation state	Redox reactions
56	4	Order of reaction	chemical kinetics
57	2	Physical properties	Co-ordination compounds
58	4	Isomerism	Hydrocarbons
59	4	Acidic characters	Ionic equilibria
60	4	Aromatic compounds	Hydrocarbons
61	3	Molar conductivity	Electrochemistry
62	2	Bond order	Chemical bonding
63	1	Conductivity	Co-ordination compounds
64	1	Shape of molecules	Chemical bonding
65	1	Rate of reaction	Chemical kinetics
66	2	Classification	Solutions
67	3	Physical properties	Amines
68	2	Avogadro's number	Basic concept of chemistry
69	2	Vitamins	Biomolecules
70	3	Chemical properties	Carboxylic acids
71	3	Magnetic properties	Co-ordination compounds
72	1	Methods of separation	Some basic principles and techniques
73	3	Rate constant	Equilibrium
74	1	Chemical properties	Amines
75	4	Optical activity	Halogen derivatives
76	1	Bond fission	Chemical bonding and molecular structure
77	1	Chemical properties	Hydrocarbons
78	2	Chemical properties	Aldehyde, ketone and carboxylic acid
79	3	Elevation of boiling point	Solutions
80	3	Catalyst	Practical chemistry
81	2	Roult's law	Solutions
82	2	Properties of fructose	Biomolecules
83	2	Chemical properties	Aldehyde, ketone and carboxylic acid
84	1	Nucleophilic substitution reaction	Halogen derivatives
85	1	Heat of formation	Thermodynamic
86	3	Isomerism	Alcohols, phenols and ethers

Q. No.	Answer	Topic's Name	Chapter Name
87	1	Physical properties	Chemical bonding
88	4	Factors affecting on reactions	Chemical kinetics
89	1	Order of reaction	Chemical kinetics
90	4	Lassaigne's test	Some basic principles and techniques

ANSWERS WITH EXPLANATION

CHEMISTRY

46. Option (4) is correct.

Explanation: $\dfrac{1}{\lambda} = RZ^2\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$

For $2 \to 3 \Rightarrow \dfrac{1}{\lambda_1} = R \times (1)^2 \left(\dfrac{1}{2^2} - \dfrac{1}{3^2}\right)$ ... (1)

For $4 \to 6 \Rightarrow \dfrac{1}{\lambda_2} = R \times (1)^2 \left(\dfrac{1}{4^2} - \dfrac{1}{6^2}\right)$ ... (2)

Divide (1) & (2)

$$\dfrac{\lambda_2}{\lambda_1} = \dfrac{\dfrac{1}{2^2} - \dfrac{1}{3^2}}{\dfrac{1}{4^2} - \dfrac{1}{6^2}}$$

$$\dfrac{\lambda_2}{\lambda_1} = \dfrac{4}{1}$$

$\therefore$ $\dfrac{\lambda_1}{\lambda_2} = \dfrac{1}{4}$

47. Option (2) is correct.

Explanation: Statement C and E are correct statements.

Statement -C

Ca^{2+}, K^+, Ar, Cl^- and S^{2-} have 18 electrons so these all are isoelectronic species.

Statement -E

The statement is true. Cesium (Cs) has a larger atomic radius than both lithium (Li) and rubidium (Rb). This is because atomic radius generally increases on moving down the group in the periodic table. Cs is last element in the group 1 than both Li and Rb.

The order of atomic radius in group I is as below

Cs>Rb>K>Na>Li

48. Option (2) is correct.

Explanation:

	List I		List II
A.	Co^{2+}	**III.**	Group IV
B.	Mg^{2+}	**IV.**	Group VI
C.	Pb^{2+}	**I.**	Group I
D.	Al^{3+}	**II.**	Group III

49. Option (1) is correct.
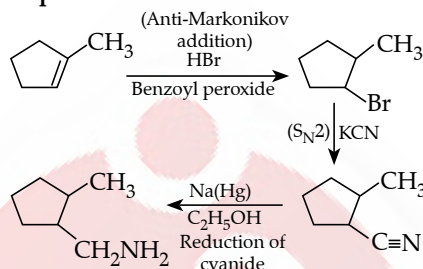
Explanation:

50. Option (1) is correct.

Explanation: $E_n = -2.18 \times 10^{-18}\,(Z^2/n^2)$ J

For He^+

$E_1 = -2.18 \times 10^{-18}\,(2^2/1^2)$ J

$= -8.72 \times 10^{-18}$ J

$r_n = 52.9\,(n^2/Z)$ pm

$r_1 = 52.9\,(1^2/2)$ pm

$= 26.4$ pm

For Li^{+2}

$E_1 = -2.18 \times 10^{-18}(3^2/1^2)$ J

$= -19.62 \times 10^{-18}$ J

$r_1 = 52.9\,(1^2/3)$ pm

$= 17.6$ pm

51. Option (3) is correct.

Explanation: Cl^- and H_2O are weak field ligand; Ni^{2+} (d^8) therefore remains high spin: $[NiCl_4]^{2-}$ is tetrahedral, $[Ni(H_2O)_6]^{2+}$ octahedral, each retaining two unpaired electrons and hence paramagnetic. CO and PPh_3 give Ni(0) d^{10} $Ni(CO)_4$, $Ni(PPh_3)_4$ $\Rightarrow$ diamagnetic. Strong field CN^- forces square planar low spin d^8 in $[Ni(CN)^4]^{2-}$, also diamagnetic. Thus only A and D are clearly paramagnetic.

$[NiCl_4]^{2-}$

Oxidation state - $+2$

Outermost electronic configuration - $3d^8$, $4s^2$

Cl^- is weak field ligand.

Number of unpaired electrons-2.

Hence it is paramagnetic.

$[Ni(CO)_4]$
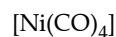
Oxidation state - 0

Outermost electronic configuration - $3d^{10}$, $4s^0$

CO is strong field ligand.

Number of unpaired electrons – 0.

Hence it is not paramagnetic.

$[Ni(CN_4)]^{2-}$

Oxidation state - +2

Outermost Electronic Configuration – $3d^8$, $4s^2$

CN is strong field ligand.

Number of unpaired electrons 0.

Hence it is not paramagnetic.

$[Ni(H_2O)_6]^{2+}$

Oxidation state - +2

Outermost electronic configuration – $3d^8$

Water is weak field ligand.

Number of unpaired electrons – 2.

Hence it is paramagnetic.

$[Ni(PPh_3)_4]$

Oxidation state - +2

Outermost electronic configuration – $3d^8$

PPh_3 is strong field ligand.

Number of unpaired electrons – 0.

Hence it is not paramagnetic.

52. Option (3) is correct.

Explanation: Like NH_3, AsH_3 is possible.

Hence statement I is correct statement.

All elements of N family can form two types of oxides E_2O_3 and E_2O_5.

Hence statement II is incorrect.

53. Option (2) is correct.

Explanation: The main group elements, also known as the representative elements, consist of elements belonging to the *s*-block and *p*-block of the periodic table and are most abundant on Earth and space. Many elements in the main group are necessary to life on Earth, specifically oxygen, carbon, nitrogen and hydrogen.

Hence A and C electronic configurations belongs to main group elements.

54. Option (4) is correct.

Explanation: Dalton's atomic theory, based on the laws of conservation of mass, law of constant proportion, and multiple proportions.

Dalton's atomic theory couldn't explain law of gaseous volume.

55. Option (1) is correct.

Explanation: Oxidation state of K in KO_2 –

K is alkali metal always shows +1 oxidation state in compounds.

Oxidation state of O in H_2O_2

$$2(+1) + 2x = 0$$
$$x = -1$$

Oxidation state of S in H_2SO_4

$$2(+1) + x + 4(-2) = 0$$
$$x = +6$$

56. Option (4) is correct.

Explanation: For first order reaction

$$t_{99.9\%} = 10 \times t^{1/2}$$
$$= 10 \times 1$$
$$= 10 \text{ min}$$

57. Option (2) is correct.

Explanation: Wavelength of light absorbed is inversely proportional to strength of the ligand.

Hence correct order is B < A < D < C.

$[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3-} > [Ti(H_2O)_6]^{3+} > [Cu(H_2O)_4]^{2+}$
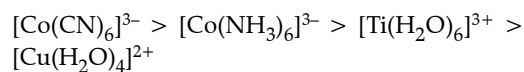
58. Option (4) is correct.

Explanation: *Cis* and *trans* are geometric isomers. For geometric isomers in alkene each doubly bonded carbon must have different groups or atoms attached to it.

For geometric isomers in cycloalkane at least two sp^3 carbon of the ring must have different groups or atoms attached to it.

Pent-1-ene can't exist cis and trans isomers because same H atom on doubly bonded carbon atom.
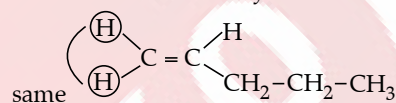
2-methylhex-2-ene have two methyl groups on same doubly bonded carbon atom so can't show geometric isomers.
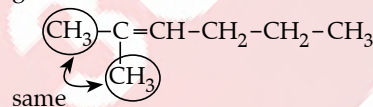
1,1-dimethyl cyclopropane have two same hydrogen atoms / methyl groups on each carbon atom.
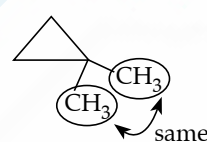
1,2-dimethylcyclohexane shows geometric isomerism

59. Option (4) is correct.

Explanation:

$H_3PO_4 \rightleftharpoons H^{\oplus} + H_2PO_4^-$; Ka_1

$H_2PO_4^- \rightleftharpoons H^{\oplus} + HPO_4^{2-}$; Ka_2

$HPO_4^{2-} \rightleftharpoons H^{\oplus} + PO_4^{3-}$; Ka_3

$H_3PO_4 \rightleftharpoons 3H^{\oplus} + PO_4^{3-}$
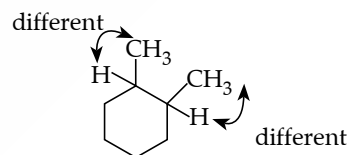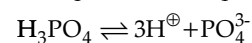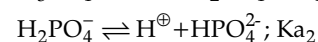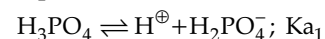
$K = Ka_1 + Ka_2 + Ka_3$

For polybasic acid order of ionisation constant is $Ka_1 > Ka_2 > Ka_3$. Because with increasing

negative charge tendency to loose H^+ ion decreases.

Overall $K = K_{a_1} + K_{a_2} + K_{a_3}$

Taking log on both side

$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$.

60. Option (4) is correct.
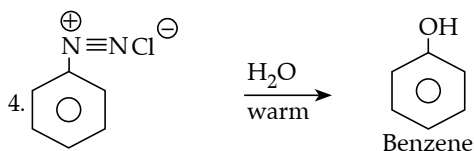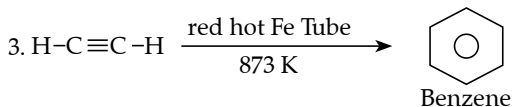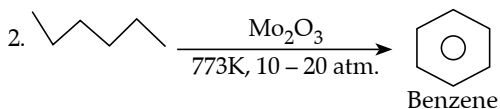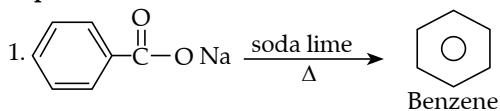
Explanation:

61. Option (3) is correct.

Explanation: Degree of Dissociation $(\alpha) = \dfrac{\wedge_m}{\wedge^\circ_m}$

$$\wedge^\circ_m = \wedge^\circ_+ + \wedge^\circ_-$$
$$= 349.6 + 50.4$$

400 S cm^2.mol^{-1}.

$$\alpha = \frac{\wedge_m}{\wedge^\circ_m} = \frac{90}{400} = 0.225$$

62. Option (2) is correct.

Explanation: Statement I is incorrect, a hypothetical diatomic molecule with a bond order of zero would not be stable. A bond order of zero indicates that there is no net bonding interaction between the two atoms, meaning the molecule would not exist. The statement II is incorrect. Bond length decreases as bond order increases. This is because a higher bond order means a stronger bond, resulting in the atoms being held closer together.

63. Option (1) is correct.

Explanation: Here, all 3Cl$^-$ ligands are within the coordination sphere, meaning no chloride ions are free.

This is a neutral complex.

Upon dissolving in water, it stays intact — no dissociation, thus only 1 species (non-ionic).

64. Option (1) is correct.

Explanation:

	List I		List II
A.	XeO$_3$	II.	Pyramidal
B.	XeF$_2$	I.	Linear
C.	XeOF$_4$	IV.	Square Pyramidal
D.	XeF$_6$	III.	Distorted octahedral

65. Option (1) is correct.

Explanation: For Exothermic reaction

$\Delta H = H_P - H_R = -ve$

$H_R > H_P$
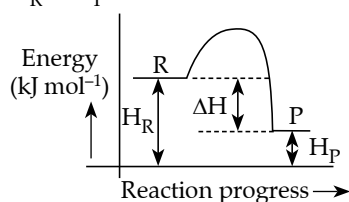
66. Option (2) is correct.

Explanation:

	List I		List II
A.	Humidity	II.	Liquid in gas
B.	Alloy	I.	Solid in gas
C.	Amalgam	IV.	Liquid in solid
D.	Smoke	III.	Solid in gas

67. Option (3) is correct.

Explanation: The basic strength of amines depends on the availability of the lone pair of electrons on the nitrogen atom and the stability of the conjugate acid formed after protonation. Factors like inductive effect, steric effect and solvation effects in aqueous solutions play a role in influencing the basicity. Alkyl groups increases the basic strength of amines while the phenyl group decreases the basicity of amine through resonance. So, the correct order of decreasing basics strength of amines is

N-ethylethanamine > Ethanamine > N-methylaniline > Benzenamine.

68. Option (2) is correct.

Explanation: Number of atoms = Atomicity × Mole × N_A

(A) Number of atoms = $6 \times (212/106)N_A = 12N_A$

(B) Number of atoms = $3 \times (248/62)N_A = 12N_A$

(C) Number of atoms = $3 \times (240/40)N_A = 18N_A$

(D) Number of atoms = $2 \times (12/2)N_A = 12N_A$

(E) Number of atoms = $3 \times (220/44)N_A = 15N_A$

69. Option (2) is correct.

Explanation:

	List I		List II
A.	Vitamin B$_{12}$	IV.	Pernicious Anaemia
B.	Vitamin D	III.	Rickets
C.	Vitamin B$_2$	I.	Cheilosis
D.	Vitamin B$_6$	II.	Convulsions

70. Option (3) is correct.

Explanation: Acidic strength is inversely proportional to +I effect.

Hence the correct decreasing order of acidity is

HCOOH > CH$_3$COOH > (CH$_3$)$_2$CHCOOH > (CH$_3$)$_3$CCOOH

71. Option (3) is correct.

Explanation: Statement I is correct. Ferromagnetism can be considered an extreme form of paramagnetism. While both involve magnetic moments within a material, ferromagnetism exhibits a much stronger and more organised alignment of these moments, leading to a strong, persistent magnetism. In contrast, paramagnetism is a weaker form of magnetism where alignment is only noticeable in the presence of an external magnetic field.

Statement II is incorrect. Because

Outermost electronic configuration of $Cr^{+2} = 3d^4$. Number of unpaired electrons = 4.

$Nd^{+3} = 4f^3$. Number of unpaired electrons = 3.

72. Option (1) is correct.

Explanation:

List I	List II
A. $CHCl_3 + C_6H_5NH_2$	IV. Simple Distillation
B. Crude oil in petroleum industry	III. Fractional Distillation
C. Glycerol from spent-lye	I. Distillation under reduced pressure
D. Aniline water	II. Steam distillation

73. Option (3) is correct.

Explanation: $K_C = \dfrac{K_f}{K_b}$

$$= \dfrac{K_f}{2500\ K_f}$$

$$= \dfrac{1}{2500}$$

$$K_P = K_C(RT)^{\Delta n_g}$$

$$\dfrac{1}{2500}\ (0.0831 \times 1000)$$

$$K_P = 0.033$$

74. Option (1) is correct.

Explanation: Benzene diazonium salt, specifically benzenediazonium chloride, is prepared by reacting aniline with nitrous acid at a temperature range of 273–278 Kelvin (0–5 degrees Celsius). This process, called diazotisation, converts primary aromatic amines into diazonium salts. The diazonium salt decomposes easily in the dry state, making it unstable and not typically stored

Aniline → (HNO₂/HCl, 0–5°C, Diazotisation, –2H₂O) → Benzene diazonium chloride
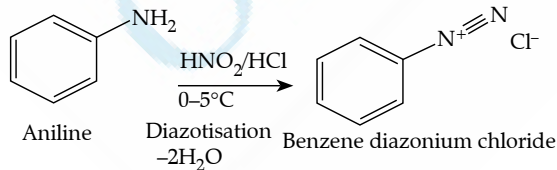
Statement II is correct.

Iodine insertion into the benzene ring is generally difficult, so iodobenzene is typically synthesised through the reaction of benzenediazonium salt with potassium iodide (KI).

Iodobenzene
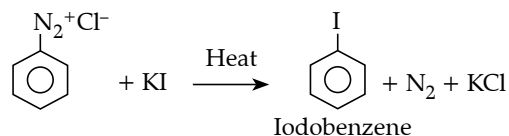
75. Option (4) is correct.

Explanation:

List I	List II
Monochlorination Product	Monochlorination Product quantity
$ClCH_2-\overset{*}{CH}-CH_2-CH_3$, CH_3	2
$CH_3-\underset{CH_3}{\overset{Cl}{C}}-CH_2-CH_3$	1
$CH_3-\underset{CH_3}{CH}-\underset{Cl}{\overset{*}{CH}}-CH_3$	2
$CH_3-\underset{CH_3}{CH}-CH_2-CH_2Cl$	1
Total Products	6

76. Option (1) is correct.

Explanation: Bond dissociation energy is inversely proportional to stability of free radical formed after breaking of C–H bond fission homolytically.

77. Option (1) is correct.

Explanation: Alkenes and alkynes are compounds that decolorise bromine water. Bromine water is typically an orange solution, and when it reacts with alkenes or alkynes, the orange colour fades away, indicating the compound has been decolourised. Cyclohexane is not alkene or alkyne hence it does decolorise bromine water. Similarly, phenol and aniline also decolourise the bromine water through electrophilic substitution reaction.

78. Option (2) is correct.
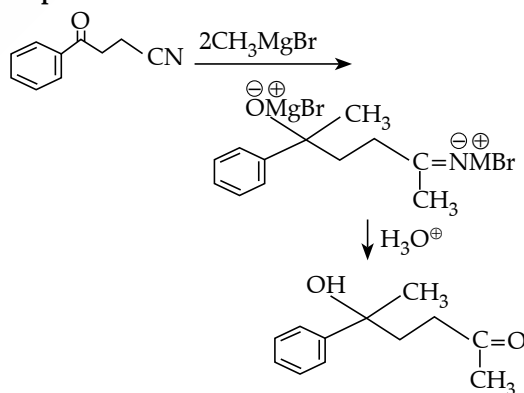
Explanation:

79. Option (3) is correct.

Explanation: $\Delta T_b = i \times K_b \times m$

Assume that $m = M$

K_b is constant for all.

1. $i \times M = 1 \times 0.01 = 0.01$

2. $i \times M = 2 \times 0.01 = 0.02$

3. $i \times M = 3 \times 0.01 = 0.03$

4. $i \times M = 1 \times 0.015 = 0.015$

80. Option (3) is correct.

Explanation:

List I		List II	
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PbCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D.	Ziegler Catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

81. Option (2) is correct.

Explanation:

X   Y

$n_x = 5$ $n_y = 10$

$p_x^o = 63$ $p_y^o = 78$

Ps(calculated) $= n_x \times p_x^o + n_y \times p_y^o$

$= [(63 \times 5)/15] + [(78 \times 10)/15]$

$= 21 + 52$

$= 73$

P_s (observed) $= 70$

Hence negative deviation.

82. Option (2) is correct.

Explanation: D-fructose is a keto sugar that exists in α and β anomeric form and laevorotatory form found in honey.

83. Option (2) is correct.

Explanation:

$$R - \overset{O}{\underset{||}{C}} - OR \xrightarrow[\text{(DIBAL-H)}]{AlH\,(iBu)_2} R - \overset{O}{\underset{||}{C}} - H + ROH$$

(ester)   (Aldehyde)
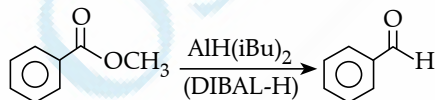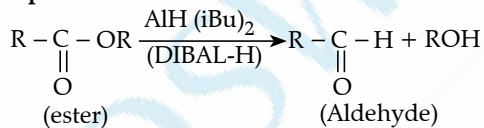
84. Option (1) is correct.

Explanation: Both assertion(A) and reason(R) are correct and reason (R) is correct explanation of Assertion(A).

Rate of S_N^2 reaction is directly proportional to leaving tendency of leaving group. I^- is better leaving group than Cl due to it's bigger size.

85. Option (1) is correct.

Explanation:

$$Ba^{+2}_{(aq.)} + SO^{2-}_{4(aq.)} \rightarrow BaSO_4,$$
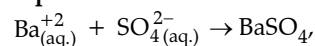
$\Delta Hr = \Delta H_{Crys.(BaSO_4)} = -4.5 \text{ kCal mol}^{-1}$

↓   ↓   ↓

$\Delta H_f(Ba^{2+})$ ΔH_f SO^{2-} $\Delta H_{f\,(BaSO_4)}$

↓   ↓   ↓

$= ?$ $= -216$ $= -349$

$\Delta H_{Crys.}(BaSO_4) = \Delta H_f(BaSO_4) - [\Delta H_f(Ba^{2+}) + \Delta H_f(SO_4^{2-})]$

$-4.5 = [-349] - [\Delta H_{f(Ba^{+2})} + (-216)]$

$\Delta H_f(Ba^{+2}) = -128.5 \text{ kCal mol}^{-1}$

86. Option (3) is correct.

Explanation:

List I	List II
Structure	**Number of isomers**
	1
	1
	2
	2
	1
	3
Total isomers	10

87. **Option (1) is correct.**

    Explanation: (A) $H_2O > NH_3 > CHCl_3$

    It is correct order of dipole moment.

    (D) $N_2 > O_2 > H_2$

    It is correct order of bond enthalpy.

88. **Option (4) is correct.**

    Explanation: (A) As the temperature increases reaction shifts forward.

    (B) As the temperature decreases reaction shifts backward.

    (C) As the concentration of N_2 increases reaction shift forward.

    (D) As the concentration of O_2 increases reaction shift forward.

89. **Option (1) is correct.**

    Explanation: $K = 0.03 \text{ s}^{-1}$ (first order reaction)

    $A_0 = 7.2$ mol/L

    $A_t = 0.9$ mol/L

    $7.2 \times \frac{1}{2} = 3.6 \times \frac{1}{2} = 1.8 \times \frac{1}{2} = 0.9$

    $t = 3 \times t_{1/2} = (3 \times 0.693)/0.03 = 69.3$ s

90. **Option (4) is correct.**

    Explanation: Lassaigne's test is used to detect halogen, nitrogen, phosphorus and sulphur. Lassaigne's test does not detect carbon.

    ■■■

Total Time Duration: 90 Minutes **Maximum Marks: 360**

Important Instructions:

1. The test is of **3 hours** duration and test booklet contains **180** multiple choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**. **45** questions in each subject. Note: This instruction is applicable for complete NEET (UG) Paper.

2. Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, one mark will be deducted from the total scores. **The maximum marks are 720.**

3. Use **blue/black ball point pen only** for writing particulars on this page/marking responses on answer Sheet.

4. Use of electronic/manual calculator is prohibited.

5. **No part of the test booklet and answer sheet shall be detached under any circumstances.**

6. The candidates will write the correct test booklet code as given in the test booklet/answer sheet in the attendance sheet.

7. Compensatory time of one hour five minutes will be provided for the examination of three hours and 20 minutes duration, whether such candidate (having a physical limitation to write) uses the facility of scribe or not.

BIOLOGY (Botany and Zoology)

Q. 91. The complex II of mitochondrial electron transport chain is also known as
(1) Cytochrome bc_1
(2) Succinate dehydrogenase
(3) Cytochrome c oxidase
(4) NADH dehydrogenase

Q. 92. Polymerase chain reaction (PCR) amplifies DNA following the equation.
(1) N^2 (2) 2^n
(3) $2n + 1$ (4) $2N^2$

Q. 93. What are the potential drawbacks in adoption of the IVF method?
A. High fatality risk to mother.
B. Expensive instruments and reagents.
C. Husband/wife necessary for being donors.
D. Less adoption of orphans.
E. Not available in India.
F. Possibility that the early embryo does not survive.
Choose the **correct** answer from the options given below:
(1) B, D, F only   (2) A, C, D, F only
(3) A, B, C, D only   (4) A, B, C, E, F only

Q. 94. What is the name of the blood vessel that carries deoxygenated blood from the body to the heart in a frog?
(1) Aorta
(2) Pulmonary artery
(3) Pulmonary vein
(4) Vena cava

Q. 95. Which one of the following statements refers to Reductionist Biology?
(1) Physico-chemical approach to study and understand living organisms.
(2) Physiological approach to study and understand, living organisms.
(3) Chemical approach to study and understand living organisms.
(4) Behavioural approach to study and understand living organisms.

Q. 96. Given below are two statements:
Statement I: In the RNA world, RNA is considered the first genetic material evolved to carry out essential life processes. RNA acts as a genetic material and also as a catalyst for some important biochemical reactions in living systems. Being reactive, RNA is unstable.
Statement II: DNA evolved from RNA and is a more stable genetic material. Its double helical strands being complementary, resist changes by evolving repairing mechanism.
In the light of the above statements, choose the **most appropriate** answer from the options given below:
(1) Both statement I and statement II are correct.
(2) Both statement I and statement II are incorrect.
(3) Statement I is correct but statement II is incorrect.

(4) Statement I is incorrect but statement II is correct.

Q. 97. Epiphytes that are growing on a mango branch is an example of which of the following?

(1) Commensalism   (2) Mutualism

(3) Predation   (4) Amensalism

Q. 98. From the statements given below choose the **correct** option:

A. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S.

B. Each ribosome has two sub-units.

C. The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

D. The two sub-units of 80S ribosome are 60S and 20S and that of 70S are 50S and 20S.

E. The two sub-units of 80S are 60S and 30S and that of 70S are 50S and 30S

(1) A, B, C are true   (2) A, B, D are true

(3) A, B, E are true   (4) B, D, E are true

Q. 99. Which one of the following is an example of ex-situ conservation?

(1) National Park

(2) Wildlife Sanctuary

(3) Zoos and botanical gardens

(4) Protected areas.

Q. 100. Given below are two statements:

Statement I: The primary source of energy in an ecosystem is solar energy.

Statement II: The rate of production of organic matter during photosynthesis in an ecosystem is called net primary productivity (NPP).

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

(1) Both statement I and statement II are correct.

(2) Both statement I and statement II are incorrect.

(3) Statement I is correct but statement II is incorrect.

(4) Statement I is incorrect but statement II is correct.

Q. 101. Match **List-I** with **List-II**.

	List-I		List-II
A.	Emphysema	I.	Rapid spasms in muscle due to low Ca^{++} in body fluid
B.	Angina Pectoris	II.	Damaged alveolar walls and decreased respiratory surface
C.	Glomerulo-nephritis	III.	Acute chest pain when not enough oxygen is reaching to heart muscle
D.	Tetany	IV.	Inflammation of glomeruli of kidney

Choose the correct answer from the options given below:

(1) A-III, B-I, C-IV, D-II

(2) A-III, B-I, C-II, D-IV

(3) A-II, B-IV, C-III, D-I

(4) A-II, B-III, C-IV, D-I

Q. 102. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A): Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Reason (R): The flowers produce enormous amount of pollen grains in wind and water pollinated flowers.

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

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**.

(3) **A** is true but **R** is false.

(4) **A** is false but **R** is true.

Q. 103. Which of the following is an example of non-distilled alcoholic beverage produced by yeast?

(1) Whisky   (2) Brandy

(3) Beer   (4) Rum

Q. 104. Given below are two statements:

Statement I: In a floral formula ⊕ stands for zygomorphic nature of the flower, and $\underline{G}$ stands for inferior ovary.

Statement II: In a floral formula ⊕ stands for actinomorphic nature of the flower and $\underline{G}$ stands for superior ovary.

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

(1) Both statement I and statement II are correct.

(2) Both statement I and statement II are incorrect.

(3) Statement I is correct but statement II is incorrect.

(4) Statement I is incorrect but statement II is correct.

Q. 105. Streptokinase produced by bacterium *Streptococcus* is used for

(1) Curd production

(2) Ethanol production

(3) Liver disease treatment

(4) Removing clots from blood vessels

Q. 106. Which chromosome in the human genome has the highest number of genes?

(1) Chromosome X   (2) Chromosome Y

(3) Chromosome 1   (4) Chromosome 10

Q. 107. Which of the following statement is **correct** about location of the male frog copulatory pad?

(1) First and second digit of fore limb

(2) First digit of hind limb

(3) Second digit of fore limb

(4) First digit of the fore limb

Q. 108. Which one of the following phytohormones promotes nutrient mobilisation which helps in the delay of leaf senescence in plants?

(1) Ethylene   **(2)** Abscisic acid

(3) Gibberellin   **(4)** Cytokinin

Q. 109. While trying to find out the characteristic of a newly found animal, a researcher did the histology of adult animal and observed a cavity with presence of mesodermal tissue towards the body wall but no mesodermal tissue was observed towards the alimentary canal. What could be the possible coelom of that animal?

(1) Acoelomate   **(2)** Pseudocoelomate

(3) Schizocoelomate   **(4)** Spongocoelomate

Q. 110. **Match List-I with List-II.**

List-I		List-II	
A.	Head	**I.**	Enzymes
B.	Middle piece	**II.**	Sperm motility
C.	Acrosome	**III.**	Energy
D.	Tail	**IV.**	Genetic material

Choose the **correct** answer from the options given below:

(1) A-IV, B-III, C-I, D-II

(2) A-IV, B-III, C-II, D-I

(3) A-III, B-IV, C-II, D-I

(4) A-III, B-II, C-I, D-IV

Q. 111. Given below are the stages in the life cycle of pteridophytes. Arrange the following stages in the correct sequence.

A. Prothallus stage

B. Meiosis in spore mother cells

C. Fertilisation

D. Formation of archegonia and antheridia in gametophyte.

E. Transfer of antherozoids to the archegonia in presence of water.

Choose the **correct** answer from the options given below:

(1) B, A, D, E, C   **(2)** B, A, E, C, D

(3) D, E, C, A, B   **(4)** E, D, C, B, A

Q. 112. Cardiac activities of the heart are regulated by:

A. Nodal tissue

B. A special neural centre in the medulla oblongata

C. Adrenal medullary hormones

D. Adrenal cortical hormones

Choose the **correct** answer from the options given below:

(1) A, B and C only   **(2)** A, B, C and D

(3) A, C and D only   **(4)** A, B and D only

Q. 113. Which of following organisms cannot fix nitrogen?

A. *Azotobacter*   **B.** *Oscillatoria*

C. *Anabaena*   **D.** *Volvox*

E. *Nostoc*

Choose the **correct** answer from the options given below:

(1) A only   **(2)** D only

(3) B only   **(4)** E only

Q. 114. Given below are two statements:

Statement I: Transfer RNAs and ribosomal RNA do not interact with mRNA.

Statement II: RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

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

(1) Both statement I and statement II are correct.

(2) Both statement I and statement II are incorrect.

(3) Statement I is correct but statement II is incorrect.

(4) Statement I is incorrect but statement II is correct.

Q. 115.
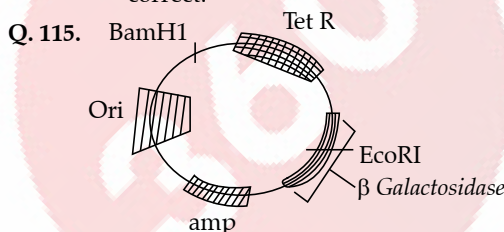
In the above represented plasmid an alien piece of DNA is inserted at EcoRI site. Which of the following strategies will be chosen to select the recombinant colonies?

(1) Using ampicillin and tetracyclin containing medium plate.

(2) Blue colour colonies will be selected.

(3) White colour colonies will be selected.

(4) Blue colour colonies grown on ampicillin plates can be selected.

Q. 116. Which of the following genetically engineered organisms was used by Eli Lilly to prepare human insulin?

(1) Bacterium   **(2)** Yeast

(3) Virus   **(4)** Phage

Q. 117. Name the class of enzyme that usually catalyse the following reaction:

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

where, $G \rightarrow$ a group other than hydrogen

$S \rightarrow$ a substrate

$S^{\#} \rightarrow$ another substrate

(1) Hydrolase   **(2)** Lyase

(3) Transferase   **(4)** Ligase

Q. 118. Find the statement that is **NOT** correct with regard to the structure of monocot stem.

(1) Hypodermis is parenchymatous.

(2) Vascular bundles are scattered.

(3) Vascular bundles are conjoint and closed.

(4) Phloem parenchyma is absent.

Q. 119. The correct sequence of events in the life cycle of bryophytes is

A. Fusion of antherozoid with egg.

B. Attachment of gametophyte to substratum.

C. Reduction division to produce haploid spores.

D. Formation of sporophyte.

E. Release of antherozoids into water.

Choose the **correct** answer from the option given below:

(1) D, E, A, C, B

(2) B, E, A, C, D

(3) B, E, A, D, C

(4) D, E, A, B, C

Q. 120. Which are correct:

A. Computed tomography and magnetic resonance imaging detect cancers of internal organs.

B. Chemotherapeutics drugs are used to kill noncancerous cells.

C. α-interferon activate the cancer patients' immune system and helps in destroying the tumour.

D. Chemotherapeutic drugs are biological response modifiers.

E. In the case of leukaemia blood cells counts are decreased.

Choose the **correct** answer from the option given below:

(1) B and D only

(2) D and E only

(3) C and D only

(4) A and C only

Q. 121. Match **List-I** with **List-II**.

	List-I		List-II
A.	Centromere	**I.**	Mitochondrion
B.	Cilium	**II.**	Cell division
C.	Cristae	**III.**	Cell movement
D.	Cell membrane	**IV.**	Phospholipid Bilayer

Choose the **correct** answer from the options given below:

(1) A-I, B-II, C-III, D-IV

(2) A-II, B-I, C-IV, D-III

(3) A-IV, B-II, C-III, D-I

(4) A-II, B-III, C-I, D-IV

Q. 122. Match **List-I** with **List-II**.

	List-I		List-II
A.	Chlorophyll a	**I.**	Yellow-green
B.	Chlorophyll b	**II.**	Yellow
C.	Xanthophylls	**III.**	Blue-green
D.	Carotenoids	**IV.**	Yellow to Yellow-orange

Choose the option with all **correct** matches.

(1) A-III, B-IV, C-II, D-I

(2) A-III, B-I, C-II, D-IV

(3) A-I, B-II, C-IV, D-III

(4) A-I, B-IV, C-III, D-II

Q. 123. Find the correct statements:

A. In human pregnancy, the major organ systems are formed at the end of 12 weeks.

B. In human pregnancy, the major organ systems are formed at the end of 8 weeks.

C. In human pregnancy, heart is formed after one month of gestation.

D. In human pregnancy, limbs and digits develop by the end of second month.

E. In human pregnancy, the appearance of hair usually observed in the fifth month.

Choose the **correct** answer from the options given below:

(1) A and E only

(2) B and C only

(3) B, C, D and E only

(4) A, C, D and E only

Q. 124. In the seeds of cereals, the outer covering of endosperm separates the embryo by a protein-rich layer called:

(1) Coleoptile

(2) Coleorhiza

(3) Integument

(4) Aleurone layer

Q. 125. Which of the following diagrams is correct with regard to the proximal (P) and distal (D) tubule of the Nephron.
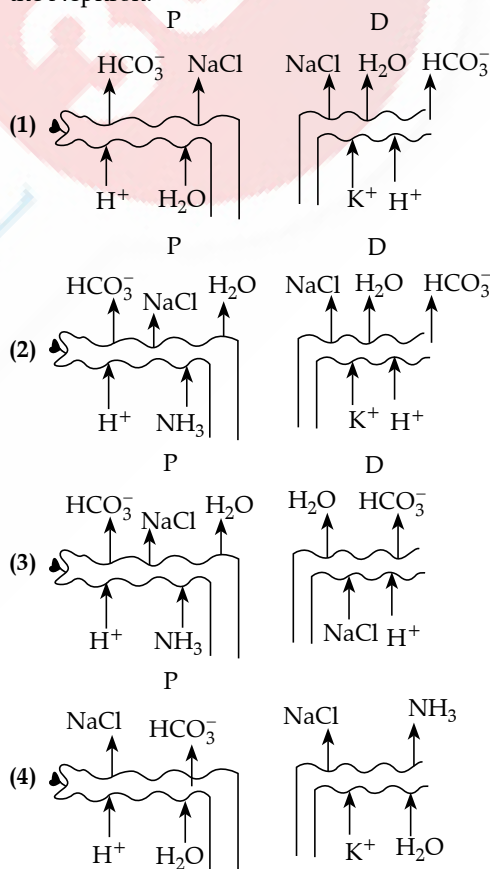
Q. 126. Identify the part of a bio-reactor which is used as a foam braker from the given figure.
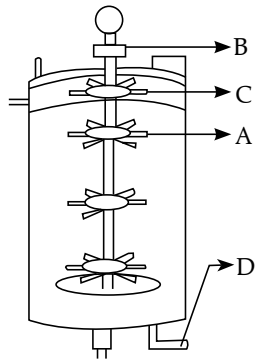
(1) A   **(2)** B
(3) D   **(4)** C

Q. 127. Given below are two statements: one is labelled as **Assertion(A)** and the other is labelled as **Reason (R)**.
Assertion (A): A typical unfertilised, angiosperm embryo sac at maturity is 8 nucleate and 7-celled.
Reason (R): The egg apparatus has 2 polar nuclei.
In the light of the above statements, choose the correct answer from the options given below:
In the light of the above statements, choose the **correct** answer from the options given below:
    (1) Both A and R are true and R is the correct explanation of A.
    (2) Both A and R are true but R is NOT the correct explanation of A.
    (3) A is true but R is false.
    (4) A is false but R is true.

Q. 128. A specialised membranous structure in a prokaryotic cell which helps in cell wall formation, DNA replication and respiration is:
    (1) Mesosome
    (2) Chromatophores
    (3) Cristae
    (4) Endoplasmic reticulum

Q. 129. Which of the following are the post-transcriptional events in an eukaryotic cell?
    A. Transport of pre-mRNA to cytoplasm prior to splicing.
    B. Removal of introns and joining of exons.
    C. Addition of methyl group at 5′ end of hnRNA.
    D. Addition of adenine residues at 3′ end of hnRNA.
    E. Base pairing of two complementary RNAs.
Choose the **correct** answer from the options given below:
    (1) A, B, C only   **(2)** B, C, D only
    (3) B, C, E only   **(4)** C, D, E only

Q. 130. What is the pattern of inheritance for polygenic trait?
    (1) Mendelian inheritance pattern
    (2) Non-mendelian inheritance pattern
    (3) Autosomal dominant pattern
    (4) X-linked recessive inheritance pattern

Q. 131. Which one of the following enzymes contains 'Haem' as the prosthetic group?
    (1) RuBisCo
    (2) Carbonic anhydrase
    (3) Succinate dehydrogenase
    (4) Catalase

Q. 132. Each of the following characteristics represent a Kingdom proposed by Whittaker. Arrange the following in increasing order of complexity of body organisation.
    A. Multicellular heterotrophs with cell wall made of chitin.
    B. Heterotrophs with tissue/organ/organ system level of body organisation.
    C. Prokaryotes with cell wall made of polysaccharides and amino acids.
    D. Eukaryotic autotrophs with tissue/organ level of body organisation.
    E. Eukaryotes with cellular body organisation.
Choose the **correct** answer from the options given below:
    (1) A, C, E, B, D   **(2)** C, E, A, D, B
    (3) A, C, E, D, B   **(4)** C, E, A, B, D

Q. 133. Who is known as the Father of Ecology in India?
    (1) S. R. Kashyap   **(2)** Ramdeo Misra
    (3) Ram Udar   **(4)** Birbal Sahni

Q. 134. Match **List-I** with **List-II**.

List-I		List-II	
A.	Alfred Hershey and Martha Chase	**I.**	*Streptococcus pneumoniae*
B.	Euchromatin	**II.**	Densely packed and dark-stained
C.	Frederick Griffith	**III.**	Loosely packed and light-stained
D.	Heterochromatin	**IV.**	DNA as genetic material confirmation

Choose the **correct** answer from the options given below:
    (1) A-II, B-IV, C-I, D-III
    (2) A-IV, B-II, C-I, D-III
    (3) A-IV, B-III, C-I, D-II
    (4) A-III, B-II, C-IV, D-I

Q. 135. Neoplastic characteristics of cells refer to:
    A. A mass of proliferating cell.
    B. Rapid growth of cells.
    C. Invasion and damage to the surrounding tissue.
    D. Those confined to original location.
Choose the **correct** answer from the options given below:
    (1) A, B only   **(2)** A, B, C only
    (3) A, B, D only   **(4)** B, C, D only

Q. 136. Given below are two statements:

Statement I: The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II: Smaller size DNA fragments are observed near anode while larger fragments are found near the wells in an agarose gel.

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

(1) Both statement I and statement II are correct.

(2) Both statement I and statement II are incorrect.

(3) Statement I is correct but statement II is incorrect.

(4) Statement I is incorrect but statement II is correct.

Q. 137. Match **List-I** with **List-II**.

List-I		List-II	
A.	Adenosine	I.	Nitrogen base
B.	Adenylic acid	II.	Nucleotide
C.	Adenine	III.	Nucleoside
D.	Alanine	IV.	Amino acid

Choose the option with all **correct** matches.

(1) A-III, B-IV, C-II, D-I

(2) A-III, B-II, C-IV, D-I

(3) A-III, B-II, C-I, D-IV

(4) A-II, B-III, C-I, D-IV

Q.138. Consider the following:

A. The reductive division for the human female gametogenesis starts earlier than that of the male gametogenesis.

B. The gap between the first meiotic division and the second meiotic division is much shorter for males compared to females.

C. The first polar body is associated with the formation of the primary oocyte.

D. Luteinising Hormone (LH) surge leads to disintegration of the endometrium and onset of menstrual bleeding.

Choose the **correct** answer from the options given below:

(1) A and B are true

(2) A and C are true

(3) B and D are true

(4) B and C are true

Q. 139. All living members of the class Cyclostomata are:

(1) Free living

(2) Endoparasite

(3) Symbiotic

(4) Ectoparasite

Q. 140. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A): The primary function of the Golgi apparatus is to package the materials made by the endoplasmic reticulum and deliver it to intracellular targets and outside the cell.

Reason (R): Vesicles containing materials made by the endoplasmic reticulum fuse with the cis face of the Golgi apparatus, and they are modified and released from the trans face of the Golgi apparatus.

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

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**.

(3) **A** is true but **R** is false.

(4) **A** is false but **R** is true.

Q. 141. Match **List-I** with **List-II**.

List-I		List-II	
A.	Scutellum	I.	Persistent nucellus
B.	Non-albuminous seed	II.	Cotyledon of Monocot seed
C.	Epiblast	III.	Groundnut
D.	Perisperm	IV.	Rudimentary cotyledon

Choose the option with all **correct** matches.

(1) A-II, B-III, C-IV, D-I

(2) A-IV, B-III, C-II, D-I

(3) A-IV, B-III, C-I, D-II

(4) A-II, B-IV, C-III, D-I

Q. 142. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A): All vertebrates are chordates but all chordates are not vertebrate.

Reason (R): The members of subphylum vertebrata possess notochord, during the embryonic period, the notochord is replaced by a cartilaginous or bony vertebral column in adults.

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

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**.

(3) **A** is true but **R** is false.

(4) **A** is false but **R** is true.

Q. 143. Identify the statement that is **NOT** correct.

(1) Each antibody has two light and two heavy chains.

(2) The heavy and light chains are held together by disulfide bonds.

(3) Antigen binding site is located at C-terminal region of antibody molecules.

(4) Constant region of heavy and light chains are located at C-terminus of antibody molecules.

Q. 144. Silencing of specific mRNA is possible via RNAi because of—

(1) Complementary dsRNA

(2) Inhibitory ssRNA

(3) Complementary tRNA

(4) Non-complementary ssRNA

Q. 145. Genes R and Y follow independent assortment. If RRYY produce round yellow seeds and rryy produce wrinkled green seeds, what will be the phenotypic ratio of the F_2 generation?

(1) Phenotypic ratio - 1: 2: 1
(2) Phenotypic ratio - 3: 1
(3) Phenotypic ratio - 9: 3: 3: 1
(4) Phenotypic ratio - 9: 7

Q. 146. Histones are enriched with—
   (1) Lysine and Arginine
   (2) Leucine and Lysine
   (3) Phenylalanine and Leucine
   (4) Phenylalanine and Arginine

Q. 147. The first menstruation is called:
   (1) Menopause   **(2)** Menarche
   (3) Diapause   **(4)** Ovulation

Q. 148. Match **List-I** with **List-II**.

	List-I		List-II
A.	Heart	**I.**	Erythropoietin
B.	Kidney	**II.**	Aldosterone
C.	Gastro-intestinal tracts	**III.**	Atrial natriuretic factor
D.	Adrenal cortex	**IV.**	Secretin

   Choose the **correct** answer from the options given below:
   (1) A-II, B-I, C-III, D-IV   **(2)** A-IV, B-III, C-II, D-I
   (3) A-I, B-III, C-IV, D-II   **(4)** A-III, B-I, C-IV, D-II

Q. 149. The protein portion of an enzyme is called:
   (1) Cofactor   **(2)** Coenzyme
   (3) Apoenzyme   **(4)** Prosthetic group

Q. 150. Which of the following is the unit of productivity of an Ecosystem?
   (1) gm^{-2} **(2)** $KCal\ m^{-2}$
   (3) $KCal\ m^{-3}$ **(4)** $(KCal\ m^{-2})yr^{-1}$

Q. 151. Sweet potato and potato represent a certain type of evolution. Select the correct combination of terms to explain the evolution.
   (1) Analogy, convergent
   (2) Homology, divergent
   (3) Homology, convergent
   (4) Analogy, divergent

Q. 152. With the help of given pedigree, find out the probability for the birth of a child having no disease and being a carrier (has the disease mutation in one allele of the gene) in F_3 generation.

   ☐ Unaffected male   ○ Unaffected female
   ■ Affected male   ● Affected female
   ⊙ Carrier female
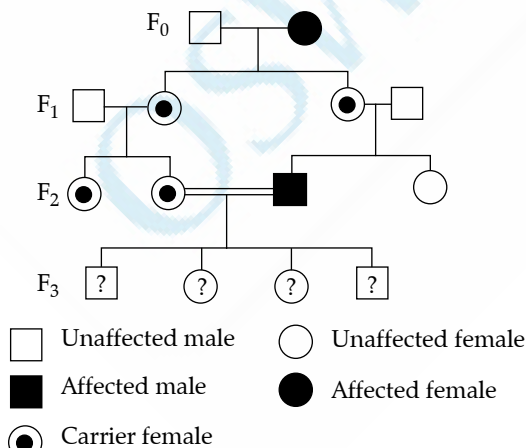
   (1) 1/4   **(2)** 1/2   **(3)** 1/8   **(4)** Zero

Q. 153. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A): Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

Reason (R): Presence of more than one nucleus in the tapetum increases the efficiency of nourishing the developing microspore mother cells.

In the light of the above statements, choose the **most appropriate** answer from the options given below:
   (1) Both **A** and **R** are true and **R** is the correct explanation of **A**.
   (2) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**.
   (3) **A** is true but **R** is false.
   (4) **A** is false but **R** is true.

Q. 154. How many meiotic and mitotic divisions need to occur for the development of a mature female gametophyte from the megaspore mother cell in an angiosperm plant?
   (1) 2 meiosis and 3 mitosis
   (2) 1 meiosis and 2 mitosis
   (3) 1 meiosis and 3 mitosis
   (4) No meiosis and 2 mitosis

Q. 155. Which of the following is an example of a zygomorphic flower?
   (1) Petunia   **(2)** Datura
   (3) Pea   **(4)** Chilli

Q. 156. After maturation, in primary lymphoid organs, the lymphocytes migrate for interaction with antigens to secondary lymphoid organ(s)/tissue(s) like:
   A. Thymus   **B.** Bone marrow
   C. Spleen   **D.** Lymph nodes
   E. Peyer's patches

   Choose the *correct* answer from the options given below:
   (1) B, C, D only   **(2)** A, B, C only
   (3) E, A, B only   **(4)** C, D, E only

Q. 157. Given below are two statements:

Statement I: Fig fruit is a non-vegetarian fruit as it has enclosed fig wasps in it.

Statement II: Fig wasp and fig tree exhibit mutual relationship as fig wasp completes its life cycle in fig fruit and fig fruit gets pollinated by fig wasp.

In the light of the above statements, choose the **most appropriate** answer from the options given below:
   (1) Both statement I and statement II are correct.
   (2) Both statement I and statement II are incorrect.
   (3) Statement I is correct but statement II is incorrect.
   (4) Statement I is incorrect but statement II is correct.

Q. 158. What is the main function of the spindle fibres during mitosis?
   (1) To separate the chromosomes
   (2) To synthesise new DNA
   (3) To repair damaged DNA
   (4) To regulate cell growth

Q. 159. Which one of the following is the characteristic feature of gymnosperms?
  (1) Seeds are enclosed in fruits.
  (2) Seeds are naked.
  (3) Seeds are absent.
  (4) Gymnosperms have flowers for reproduction.

Q. 160. Consider the following statements regarding function of adrenal medullary hormones:
  A. It causes pupilary constriction.
  B. It is a hyperglycemic hormone.
  C. It causes piloerection.
  D. It increases the strength of heart contractions.
  Choose the **correct** answer from the options given below:
  (1) C and D only
  (2) B, C and D only
  (3) A, C and D only
  (4) D only

Q. 161. Why can't insulin be given orally to diabetic patients?
  (1) Human body will elicit strong immune response.
  (2) It will be digested in Gastro-Intestinal (GI) tract.
  (3) Because of structural variation.
  (4) Its bioavailability will be increased.

Q. 162. Match **List-I** with **List-II**.

List-I		List-II	
A.	Pteridophyte	**I.**	*Salvia*
B.	Bryophyte	**II.**	*Ginkgo*
C.	Angiosperm	**III.**	*Polytrichum*
D.	Gymnosperm	**IV.**	*Salvinia*

Choose the option with all **correct** matches.
  (1) A-III, B-IV, C-II, D-I
  (2) A-IV, B-III, C-I, D-II
  (3) A-III, B-IV, C-I, D-II
  (4) A-IV, B-III, C-II, D-I

Q. 163. Who proposed that the genetic code for amino acids should be made up of three nucleotides?
  (1) George Gamow
  (2) Francis Crick
  (3) Jacque Monod
  (4) Franklin Stahl

Q. 164. Match **List-I** with **List-II**.

List-I		List-II	
A.	The Evil Quartet	**I.**	Cryopreservation
B.	*Ex-situ* conservation	**II.**	Alien species invasion
C.	*Lantana camara*	**III.**	Causes of biodiversity losses
D.	Dodo	**IV.**	Extinction

Choose the option with all **correct** matches.
  (1) A-III, B-II, C-I, D-IV
  (2) A-III, B-I, C-II, D-IV
  (3) A-III, B-IV, C-II, D-I
  (4) A-III, B-II, C-IV, D-I

Q. 165. Which of the following hormones released from the pituitary is actually synthesised in the hypothalamus?
  (1) Luteinising hormone (LH)
  (2) Anti-diuretic hormone (ADH)
  (3) Follicle-stimulating hormone (FSH)
  (4) Adenocorticotrophic hormone (ACTH)

Q. 166. Role of water vascular system in Echinoderms is:
  A. Respiration and Locomotion
  B. Excretion and Locomotion
  C. Capture and transport of food
  D. Digestion and Respiration
  E. Digestion and Excretion
  Choose the **correct** answer from the options given below:
  (1) A and B only
  (2) A and C only
  (3) B and C only
  (4) B, D and E only

Q. 167. Which of the following type of immunity is present at the time of birth and is a non-specific type of defence in the human body?
  (1) Acquired immunity
  (2) Innate immunity
  (3) Cell-mediated immunity
  (4) Humoral immunity

Q. 168. In bryophytes, the gemmae help in which one of the following?
  (1) Sexual reproduction
  (2) Asexual reproduction
  (3) Nutrient absorption
  (4) Gaseous exchange

Q. 169. In frog, the renal portal system is a special venous connection that acts to link:
  (1) Liver and intestine
  (2) Liver and kidney
  (3) Kidney and intestine
  (4) Kidney and lower part of body

Q. 170. Given below are two statements:
  Statement I: In ecosystem, there is unidirectional flow of energy of sun from producers to consumers.
  Statement II: Ecosystems are exempted from 2nd law of thermodynamics.
  In the light of the above statements, choose the **most appropriate** answer from the options given below:
  (1) Both statement I and statement II are correct.
  (2) Both statement I and statement II are incorrect.
  (3) Statement I is correct but statement II is incorrect.
  (4) Statement I is incorrect but statement II is correct.

Q. 171. Which of the following statements about RuBisCO is true?
  (1) It is active only in the dark.
  (2) It has higher affinity for oxygen than carbon dioxide.
  (3) It is an enzyme involved in the photolysis of water.
  (4) It catalyses the carboxylation of RuBP.

Q. 172. Which of the following enzyme(s) are **NOT** essential for gene cloning?

- **A.** Restriction enzymes
- **B.** DNA ligase
- **C.** DNA mutase
- **D.** DNA recombinase
- **E.** DNA polymerase

Choose the **correct** answer from the options given below:

- **(1)** C and D only
- **(2)** A and B only
- **(3)** D and E only
- **(4)** B and C only

Q. 173. Read the following statements on plant growth and development.

- **A.** Parthenocarpy can be induced by auxins.
- **B.** Plant growth regulators can be involved in promotion as well as inhibition of growth.
- **C.** Dedifferentiation is a pre-requisite for redifferentiation.
- **D.** Abscisic acid is a plant growth promoter.
- **E.** Apical dominance promotes the growth of lateral buds.

Choose the option with all correct statements.

- **(1)** A, B, C only
- **(2)** A, C, E only
- **(3)** A, D, E only
- **(4)** B, D, E only

Q. 174. Which factor is important for termination of transcription?

- **(1)** α (alpha)
- **(2)** σ (sigma)
- **(3)** ρ (rho)
- **(4)** γ (gamma)

Q. 175. Frogs respire in water by skin and buccal cavity and on land by skin, buccal cavity and lungs.
Choose the **correct** answer from the following:

- **(1)** The statement is true for water but false for land.
- **(2)** The statement is true for both the environment.
- **(3)** The statement is false for water but true for land.
- **(4)** The statement is false for both the environment.

Q. 176. Twins are born to a family that lives next door to you. The twins are a boy and a girl. Which of the following must be true?

- **(1)** They are monozygotic twins.
- **(2)** They are fraternal twins.
- **(3)** They were conceived through *in-vitro* fertilisation.
- **(4)** They have 75% identical genetic content.

Q. 177. Which of the following microbes is **NOT** involved in the preparation of household products?

- **A.** *Aspergillus niger*
- **B.** *Lactobacillus*
- **C.** *Trichoderma polysporum*
- **D.** *Saccharomyces cerevisiae*
- **E.** *Propionibacterium sharmanii*

Choose the **correct** answer from the options given below:

- **(1)** A and B only
- **(2)** A and C only
- **(3)** C and D only
- **(4)** C and E only

Q. 178. Match **List-I** with **List-II**.

	List-I		List-II
A.	Progesterone	**I.**	Pars intermedia
B.	Relaxin	**II.**	Ovary
C.	Melanocyte stimulating hormone	**III.**	Adrenal Medulla
D.	Catecholamines	**IV.**	Corpus luteum

Choose the correct answer from the options given below:

- **(1)** A-IV, B-II, C-I, D-III
- **(2)** A-IV, B-II, C-III, D-I
- **(3)** A-II, B-IV, C-I, D-III
- **(4)** A-III, B-II, C-IV, D-I

Q. 179. The blue and white selectable markers have been developed which differentiate recombinant colonies from non-recombinant colonies on the basis of their ability to produce colour in the presence of a chromogenic substrate.

Given below are two statements about this method:

Statement I: The blue coloured colonies have DNA insert in the plasmid and they are identified as recombinant colonies.

Statement II: The colonies without blue colour have DNA insert in the plasmid and are identified as recombinant colonies.

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

- **(1)** Both statement I and statement II are correct.
- **(2)** Both statement I and statement II are incorrect.
- **(3)** Statement I is correct but statement II is incorrect.
- **(4)** Statement I is incorrect but statement II is correct.

Q. 180. Which one of the following equations represents the Verhulst-Pearl Logistic Growth of population?

- **(1)** $\dfrac{dN}{dt} = r\left(\dfrac{K-N}{K}\right)$
- **(2)** $\dfrac{dN}{dt} = rN\left(\dfrac{K-N}{K}\right)$
- **(3)** $\dfrac{dN}{dt} = rN\left(\dfrac{N-K}{N}\right)$
- **(4)** $\dfrac{dN}{dt} = N\left(\dfrac{r-K}{K}\right)$

Booklet Batch Roll Number

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

Name

Test Date

Invigilator's Signature

Student's Signature

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

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

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Centre Code

91 ① ② ③ ④	96 ① ② ③ ④	101 ① ② ③ ④	106 ① ② ③ ④
92 ① ② ③ ④	97 ① ② ③ ④	102 ① ② ③ ④	107 ① ② ③ ④
93 ① ② ③ ④	98 ① ② ③ ④	103 ① ② ③ ④	108 ① ② ③ ④
94 ① ② ③ ④	99 ① ② ③ ④	104 ① ② ③ ④	109 ① ② ③ ④
95 ① ② ③ ④	100 ① ② ③ ④	105 ① ② ③ ④	110 ① ② ③ ④

111 ① ② ③ ④	116 ① ② ③ ④	121 ① ② ③ ④	126 ① ② ③ ④
112 ① ② ③ ④	117 ① ② ③ ④	122 ① ② ③ ④	127 ① ② ③ ④
113 ① ② ③ ④	118 ① ② ③ ④	123 ① ② ③ ④	128 ① ② ③ ④
114 ① ② ③ ④	119 ① ② ③ ④	124 ① ② ③ ④	129 ① ② ③ ④
115 ① ② ③ ④	120 ① ② ③ ④	125 ① ② ③ ④	130 ① ② ③ ④

131 ① ② ③ ④	136 ① ② ③ ④	141 ① ② ③ ④	146 ① ② ③ ④
132 ① ② ③ ④	137 ① ② ③ ④	142 ① ② ③ ④	147 ① ② ③ ④
133 ① ② ③ ④	138 ① ② ③ ④	143 ① ② ③ ④	148 ① ② ③ ④
134 ① ② ③ ④	139 ① ② ③ ④	144 ① ② ③ ④	149 ① ② ③ ④
135 ① ② ③ ④	140 ① ② ③ ④	145 ① ② ③ ④	150 ① ② ③ ④

151 ① ② ③ ④	156 ① ② ③ ④	161 ① ② ③ ④	166 ① ② ③ ④
152 ① ② ③ ④	157 ① ② ③ ④	162 ① ② ③ ④	167 ① ② ③ ④
153 ① ② ③ ④	158 ① ② ③ ④	163 ① ② ③ ④	168 ① ② ③ ④
154 ① ② ③ ④	159 ① ② ③ ④	164 ① ② ③ ④	169 ① ② ③ ④
155 ① ② ③ ④	160 ① ② ③ ④	165 ① ② ③ ④	170 ① ② ③ ④

171 ① ② ③ ④	176 ① ② ③ ④
172 ① ② ③ ④	177 ① ② ③ ④
173 ① ② ③ ④	178 ① ② ③ ④
174 ① ② ③ ④	179 ① ② ③ ④
175 ① ② ③ ④	180 ① ② ③ ④

Answer Key

Q. No.	Answer	Topic's Name	Chapter Name
Biology (Botany and Zoology)			
91	2	Electron Transport System	Respiration in Plant
92	2	Amplification of Gene Using PCR	Biotechnology: Principle and Processes
93	1	IVF	Reproductive Health
94	4	Anatomy of Frog	Structural Organisation in Animals
95	1	Reductionist biology	Molecular Basis of Inheritance
96	1	RNA World	Molecular Basis of Inheritance
97	1	Population interactions	Organisms and Environment
98	1	Ribosomes	Cell: The Unit of Life
99	3	Ex-Situ Conservation	Biodiversity and its conservation
100	3	Productivity	Ecosystem
101	4	Emphysema	Breathing and Exchange of Gases
102	2	Pollination	Sexual Reproduction in Flowering Plants
103	3	Microbes in industrial products	Microbes in Human Welfare
104	4	Floral diagram	Morphology of Flowering Plants
105	4	Microbes in household products	Microbes in Human Welfare
106	3	Human Genome Project	Molecular basis of Inheritance
107	4	Anatomy of Frog	Structural Organisation in Animals
108	4	Plant hormones	Plant Growth and Development
109	2	Coelomates	Animal Kingdom
110	1	Structure of sperm	Human Reproduction
111	1	Pteridophytes	Plant Kingdom
112	1	Cardiac Cycle	Body Fluids and Circulation
113	2	Biofertilisers	Microbes in human welfare
114	4	Types of RNA	Molecular Basis of Inheritance
115	3	Plasmids	Biotechnology: Principle and Processes
116	1	Recombinant human insulin	Biotechnology and its Applications
117	3	Enzymes	Biomolecules
118	1	Monocot stem	Anatomy of Flowering Plants
119	3	Bryophytes	Plant Kingdom
120	4	Cancer	Human Health and Disease
121	4	Cell Organelles	Cell: The Unit of Life
122	2	Chlorophyll pigments	Photosynthesis in Higher Plants
123	4	Pregnancy	Human Reproduction
124	4	Structure of Mnocot Seed	Morphology of Flowering Plants
125	2	Urine formation	Excretory Products and their Elimination
126	4	Bioreactors	Biotechnology: Principle and Processes
127	3	Egg apparatus	Sexual Reproduction in Flowering Plants
128	1	Cell Organelles	Cell: The Unit of Life

Q. No.	Answer	Topic's Name	Chapter Name
129	2	Post transcriptional modifications	Molecular Basis of Inheritance
130	2	Polygenic inheritance	Principles of Inheritance and Variation
131	4	Respiratory enzymes	Respiration in Plants
132	2	Biological Classification	Biological Classification
133	2	Ecology	Organisms and Environment
134	3	Packaging of DNA	Molecular basis of Inheritance
135	2	Cancer	Human Health and Disease
136	1	Agarose gel electrophoresis	Biotechnology: Principle and Processes
137	3	Nucleic acids	Molecular Basis of Inheritance
138	1	Meiosis	Cell Cycle and Cell Division
139	4	Cyclostomata	Animal Kingdom
140	1	Cell Organelles	Cell: The Unit of Life
141	1	Monocots	Morphology of Flowering plants
142	1	Vertebrates	Animal Kingdom
143	3	Antibodies	Human Health and Disease
144	1	Pest registant plant	Biotechnology and its Applications
145	3	Dihybrid crosss	Principles of Inheritance and Variation
146	1	Histones	Molecular Basis of Inheritance
147	2	Menarche	Human Reproduction
148	4	Hormones	Chemical Coordination and Integration
149	3	Enzymes	Biomolecules
150	4	Productivity	Ecosystem
151	1	Root modifications	Morphology of Flowering Plants
152	2	Pedigree Analysis	Principles of Inheritance and Variation
153	1	Pollen grains	Sexual Reproduction in Flowering Plants
154	3	Megaspores	Sexual Reproduction in Flowering Plants
155	3	Flower	Morphology of Flowering Plants
156	4	Lymphoid system	Human Health and Disease
157	4	Population interactions	Organisms and Environment
158	1	Mitosis	Cell Cycle and Cell Division
159	2	Gymnosperms	Plant Kingdom
160	2	Hormones	Chemical Coordination and Integration
161	2	Hormones	Chemical Coordination and Integration
162	2	Plant kingom	Plant Kingdom
163	1	Genetic Code	Molecular Basis of Inheritance
164	2	Biodiversity loss	Biodiversity and its Conservation
165	2	Hormones	Chemical Coordination and Integration
166	2	Non-chordates	Animal Kingdom
167	2	Immunity	Human Health and Disease
168	2	Bryophytes	Plant Kingdom
169	4	Anatomy of Frog	Structural Organisation in Animals

Q. No.	Answer	Topic's Name	Chapter Name
170	3	Energy Flow	Ecosystem
171	4	Light reaction	Photosynthesis in Higher Plants
172	1	Gene cloning	Biotechnology: Principle and Processes
173	1	Parthenocarpy	Sexual Reproduction in Flowering Plants
174	3	RNA World	Molecular Basis of Inheritance
175	3	Anatomy of Frog	Structural Organisation in Animals
176	2	Sex determination in twins	Principles of Inheritance and Variation
177	2	Microbes in household products	Microbes in Human Welfare
178	1	Hormones in human reproduction	Human Reproduction
179	4	Recombinant DNA	Biotechnology: Principle and Processes
180	2	Carrying capacity	Organisms and Environment

ANSWERS WITH EXPLANATION

BIOLOGY (Botany & Zoology)

91. Option (2) is correct.

Explanation: The Electron Transport Chain (ETC) in mitochondria has 5 complexes (I to V). Each complex has a specific role in transferring electrons and pumping protons.

- Complex I = NADH dehydrogenase
- Complex II = Succinate dehydrogenase (also involved in the Krebs cycle)
- Complex III = Cytochrome bc_1 complex
- Complex IV = Cytochrome c oxidase
- Complex V = ATP synthase

Complex II is unique because it is part of both the Krebs cycle (converts succinate $\rightarrow$ fumarate) and the ETC. Although it does not pump protons, it transfers electrons from $FADH_2$ to coenzyme Q (ubiquinone).

92. Option (2) is correct.

Explanation: PCR is a molecular biology technique used to amplify specific DNA sequences. It involves three steps per cycle:

1. Denaturation (DNA strands separate)
2. Annealing (primers bind)
3. Extension (Taq polymerase extends DNA)

Each cycle doubles the DNA:

- 1st cycle: 2 copies
- 2nd cycle: 4 copies
- 3rd cycle: 8 copies
- and so on...

The number of DNA molecules after n cycles is ideally: 2^n

93. Option (1) is correct.

Explanation: IVF involves hormone injections, egg retrieval and potential complications like Ovarian Hyperstimulation Syndrome (OHSS), which can be fatal in rare cases. IVF labs are costly to set up and maintain. This makes IVF unaffordable for many. IVF can now use donor sperm or eggs, even for single parents or same-sex couples. As IVF becomes more common, adoption rates decline, since couples prefer biological offspring. IVF is widely available in India in both private and some government facilities. Embryo loss can occur in any reproduction method, including natural pregnancy. Hence, it's a limitation of reproduction in general, not IVF specifically.

94. Option (4) is correct.

Explanation: Frogs have a three-chambered heart (2 atria + 1 ventricle). The vena cava is the large vein that collects deoxygenated blood from the body and delivers it to the right atrium of the heart. Aorta carries oxygenated blood from the heart to the body. Pulmonary artery carries deoxygenated blood from the heart to the lungs/skin. Pulmonary vein carries oxygenated blood from lungs to the left atrium.

95. Option (1) is correct.

Explanation: Reductionist biology aims to understand living systems by studying their smallest components — molecules, atoms, and physical-chemical interactions. Examples include: Studying enzymes by their structure and function, Analysing gene expression at the molecular level and investigating cellular respiration by chemistry of mitochondria.

96. Option (1) is correct.

Explanation: The RNA world hypothesis suggests that early life forms used RNA as both the genetic material and as enzymes (ribozymes). RNA can store information and catalyse reactions. Over time, DNA likely evolved from RNA because it is more stable (due to deoxyribose sugar and double-stranded nature), allows for proofreading and repair and less prone to degradation.

97. Option (1) is correct.

Explanation: Commensalism is a type of interaction where one organism benefits while the other is neither harmed nor benefited. Epiphytes are plants that grow on other plants (like a mango tree) for physical support but do not derive nutrients from them. They absorb moisture and nutrients from the air, rain, and debris accumulating around them. The host (mango tree) is unaffected. Hence, it is an example of commensalism.

98. Option (1) is correct.

Explanation: Eukaryotic ribosomes are 80S type, made of two subunits: 60S and 40S. Prokaryotic ribosomes are 70S, composed of 50S and 30S subunits. These "S" values refer to the Svedberg units, indicating sedimentation rate during centrifugation, not additive numerically due to their shape and density. Each ribosome consists

of two subunits. Hence statements A, B, and C are correct.

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

Explanation: *Ex-situ* conservation means conservation of species outside their natural habitat, such as in controlled environments. Zoos and botanical gardens maintain animals and plants away from their native habitats for preservation and research. In contrast, national parks, sanctuaries and protected areas are examples of in situ conservation, where organisms are protected in their natural environments.

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

Explanation: Solar energy is indeed the primary source of energy for almost all ecosystems. It drives photosynthesis in autotrophs (like plants), which form the base of the food chain. The rate of production of organic matter during photosynthesis in an ecosystem is called gross primary productivity (GPP). GPP represents the total amount of organic matter produced by plants through photosynthesis over a specific time period.

101. **Option (4) is correct.**

Explanation: Emphysema is a chronic lung disease in which the alveolar walls get damaged, reducing the respiratory surface area for gas exchange. Therefore, it matches with "Damaged alveolar walls and decreased respiratory surface." Angina pectoris is a condition characterised by acute chest pain that occurs when there is insufficient oxygen supply to the heart muscles, usually due to reduced blood flow. This aligns with the description "acute chest pain when not enough oxygen is reaching the heart muscle." Glomerulonephritis is an inflammation of the glomeruli in the kidney, which are the filtration units. Hence, it matches with "inflammation of glomeruli of kidney." Tetany is a condition caused by a deficiency of calcium ions (Ca^{2+}) in body fluids, leading to rapid and involuntary muscle spasms, corresponding to "rapid spasms in muscle due to low Ca^{2+} in body fluid."

102. **Option (2) is correct.**

Explanation: The assertion states that wind- and water-pollinated flowers are not very colourful and do not produce nectar, which is true because these flowers do not need to attract pollinators like insects or animals. The reason given is also correct: wind- and water-pollinated flowers produce enormous quantities of pollen to increase the chances of successful pollination, compensating for the randomness of these methods. Producing large amounts of pollen is an adaptation to ensure pollination, but it does not explain why the flowers lack colour or nectar. Thus option (2) is the correct answer.

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

Explanation: Beer is an example of a non-distilled alcoholic beverage that is produced through the fermentation of sugars present in cereals like barley. Yeast plays a crucial role in converting these sugars into alcohol and carbon dioxide. Unlike distilled beverages, beer is not subjected to distillation to increase its alcohol content. Other options like whisky, brandy, and rum are all distilled beverages, where the fermented liquid undergoes an additional distillation process to concentrate the alcohol.

104. **Option (4) is correct.**

Explanation: Symbol ⊕ denotes actinomorphic symmetry, meaning the flower can be divided into two equal halves in only one plane. Additionally, the symbol G (G with an underline) represents a superior ovary. This indicates that the ovary is located above the other floral parts (like calyx, corolla, and androecium) on the receptacle.

105. **Option (4) is correct.**

Explanation: Streptokinase is an enzyme produced by the bacterium *Streptococcus*. Medically, it is used as a clot-dissolving agent (a thrombolytic) in the treatment of acute myocardial infarction (heart attack). It works by converting plasminogen to plasmin, an enzyme that dissolves blood clots. This function is critical in restoring blood flow in blocked vessels. It is not used in curd production, ethanol production, or treatment of liver disease.

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

Explanation: In the human genome, Chromosome 1 is the largest chromosome and carries the highest number of genes. It contains over 2,000 genes that code for various proteins involved in essential bodily functions. In contrast, chromosomes like X and Y are smaller and have fewer genes, with Y carrying the least due to its reduced genetic content. Chromosome 1 has most genes (2968), and the Y has the fewest (231).

107. **Option (4) is correct.**

Explanation: In male frogs, during the breeding season, a copulatory pad develops on the first digit (thumb) of the forelimbs. This structure helps the male to grip the female firmly during mating (amplexus). It is one of the secondary sexual characteristics observed in male frogs, enabling successful transfer of sperm externally during reproduction.

108. **Option (4) is correct.**

Explanation: Cytokinins are plant hormones that delay leaf senescence (aging) by promoting nutrient mobilisation and sustaining chlorophyll levels. This keeps the leaf green and photosynthetically active for a longer time. Other hormones like

ethylene and abscisic acid promote senescence, while gibberellins are more associated with growth processes like stem elongation.

109. **Option (2) is correct.**

Explanation: In the scenario, the animal has mesodermal tissue along the body wall but not surrounding the alimentary canal, indicating that the body cavity is not entirely lined by mesoderm. This is characteristic of a pseudocoelom, found in animals like roundworms. True coelomates (schizocoelomates or enterocoelomates) have the cavity completely lined by mesoderm, whereas acoelomates lack a body cavity altogether.

110. **Option (1) is correct.**

Explanation: Head contains the genetic material (IV), including the haploid nucleus. Middle piece contains mitochondria that provide energy (III) for movement. Acrosome is a cap-like structure that contains enzymes (I) necessary to penetrate the ovum. Tail is responsible for sperm motility (II) by enabling swimming through fluid.

111. **Option (1) is correct.**

Explanation: The correct sequence of stages in the life cycle of pteridophytes is as follows:

- B: Meiosis in spore mother cells leads to the formation of haploid spores.
- A: These spores germinate to form the prothallus (gametophyte).
- D: The prothallus develops archegonia and antheridia (sex organs).
- E: Antherozoids (male gametes) swim through water to reach the archegonia.
- C: Fertilisation occurs, forming a diploid zygote which will grow into the sporophyte.

112. **Option (1) is correct.**

Explanation:

A. Nodal tissue: Includes the SA node and AV node, responsible for generating and conducting impulses to regulate heartbeat.

B. A special neural centre in the medulla oblongata: The medulla controls autonomic regulation of the heart rate through sympathetic and parasympathetic nerves.

C. Adrenal medullary hormones (like adrenaline): This inner part of the adrenal gland releases epinephrine and norepinephrine, which are catecholamines that act on beta-receptors in the heart.

113. **Option (2) is correct.**

Explanation: *Azotobacter*, *Anabaena*, *Nostoc*, *Oscillatoria*: All are capable of nitrogen fixation. *Azotobacter* is a free-living nitrogen-fixing bacterium. *Anabaena* and *Nostoc* are cyanobacteria with heterocysts for nitrogen fixation. *Oscillatoria* is a filamentous cyanobacterium; some species

can fix nitrogen. *Volvox* is a colonial green alga and does not fix nitrogen.

114. **Option (4) is correct.**

Explanation: The statement that transfer RNAs and ribosomal RNAs do not interact with mRNA is incorrect because tRNA directly interacts with mRNA during translation by matching anticodons with mRNA codons. rRNA is also part of the ribosome that binds mRNA.

RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence is correct, RNAi is a biological process in eukaryotes where small RNAs (siRNA, miRNA) silence specific mRNA molecules, thereby regulating gene expression and defending against viral genomes.

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

Explanation: The plasmid shown contains:

amp^R gene: for ampicillin resistance

tet^R gene: for tetracycline resistance

LacZ gene (β-galactosidase) interrupted at the EcoRI site

When a foreign DNA is inserted at the EcoRI site within the LacZ gene, the enzyme β-galactosidase is not produced due to insertional inactivation. The presence of a chromogenic substrate gives blue-coloured colonies if the plasmid in the bacteria does not have an insert. Presence of insert results into insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour, these are identified as recombinant colonies. Ampicillin and tetracycline resistance genes present in the given DNA will remain intact. Thus, the given DNA will show resistance for amp^R and tet^R. Thus, Option (3) is the correct answer.

116. **Option (1) is correct.**

Explanation: Eli Lilly used genetically engineered bacteria (specifically *Escherichia coli*) to produce recombinant human insulin, which was one of the first successful products of recombinant DNA technology. Genes for insulin's A and B chains were inserted into plasmids and expressed in separate bacterial cultures. These were later purified and combined chemically.

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

Explanation: In the given reaction, a group (G) is transferred from one molecule (S–G) to another substrate ($S^\#$), forming a new compound ($S^\#$–G). This is characteristic of the transferase class of enzymes, which catalyse the transfer of functional groups (like methyl, glycosyl or phosphate) from one molecule to another.

118. **Option (1) is correct.**

Explanation: The hypodermis is composed of collenchymatous or sclerenchymatous tissue, which provides mechanical strength, rather than

parenchymatous tissue. Vascular bundles are scattered. Vascular bundles are conjoint and closed. Phloem parenchyma is absent.

119. **Option (3) is correct.**
Explanation: The correct sequence is:
B. Attachment of gametophyte to substratum
E. Release of antherozoids into water
A. Fusion of antherozoid with egg (fertilisation)
D. Formation of sporophyte
C. Reduction division (meiosis) to produce haploid spores
This represents the alternation of generations in bryophytes, where the gametophyte is dominant, and the sporophyte is dependent.

120. **Option (4) is correct.**
Explanation: CT scans and MRI scans are valuable tools for detecting cancers of internal organs. CT scans are particularly effective for visualising the chest, lungs, and abdomen, while MRI excels at providing detailed images of soft tissues and organs like the brain and spinal cord. Chemotherapeutic drugs target cancerous cells. α-interferons enhance immune response against tumours. In leukaemia, blood cell counts increase abnormally due to uncontrolled proliferation of WBCs.

121. **Option (4) is correct.**
Explanation: The centromere is the part of a chromosome that links sister chromatids and plays a crucial role in cell division. Cilia are hair-like structures that help in cell movement. Cristae are the folds in the inner membrane of mitochondria, increasing the surface area for ATP production. The cell membrane is composed of a phospholipid bilayer, providing structural integrity and selective permeability.

122. **Option (2) is correct.**
Explanation: Chlorophyll a is the primary pigment and appears blue-green. Chlorophyll b is an accessory pigment that appears yellow-green. Xanthophylls are yellow pigments contributing to yellow coloration. Carotenoids include pigments like beta-carotene, ranging from yellow to orange in colour.

123. **Option (4) is correct.**
Explanation: In human beings, after one month of pregnancy, the embryo's heart is formed.
By the end of the second month of pregnancy, the foetus develops limbs and digits.
By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed.
The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month.

124. **Option (4) is correct.**
Explanation: The aleurone layer is a protein-rich layer in cereal grains like wheat and maize. It lies between the endosperm and the embryo and plays a critical role during germination by secreting enzymes (like amylase) to break down stored starch. Whereas the coleoptile and coleorhiza are protective sheaths covering the shoots and roots respectively.

125. **Option (2) is correct.**
Explanation: In the proximal convoluted tubule (PCT), the following processes occur:
• Reabsorption of Na^+, Cl^-, HCO_3^-, and H_2O.
• Secretion of H^+ and NH_3 (ammonia).
In the distal convoluted tubule (DCT):
• Reabsorption of Na^+, Cl^-, HCO_3^-, and H_2O.
• Secretion of H^+ and K^+ (important for acid-base balance).
Option (2) accurately represents these movements of ions and water in both tubules. It shows reabsorption of useful ions and water and secretion of H^+ and NH_3 in the proximal and of K^+ and H^+ in the distal, matching physiological processes.

126. **Option (4) is correct.**
Explanation: In the diagram of a stirred-tank bioreactor, the foam breaker is the component at the top (C). It is a mechanical or chemical device used to break or reduce foam generated during fermentation or mixing. Foam formation is common in aerobic fermentation due to agitation and gas bubbling, and it can interfere with sensors and reduce efficiency. Foam breakers ensure that the system operates smoothly without overflow or contamination.

127. **Option (3) is correct.**
Explanation: A typical, unfertilised angiosperm embryo sac is 8-nucleate and 7-celled. It consists of 3 antipodal cells, 2 synergids, 1 egg cell, and a central cell with 2 polar nuclei. The egg apparatus includes only: 1 egg cell and 2 synergids. It does not contain the polar nuclei. The polar nuclei lie in the central cell, which is separate from the egg apparatus.

128. **Option (1) is correct.**
Explanation: Mesosomes are infoldings of the plasma membrane in prokaryotic cells (especially bacteria). They are associated with several functions like cell wall formation, DNA replication and respiration. These structures increase surface area for enzymatic activity. They are absent in eukaryotic cells.

129. **Option (2) is correct.**
Explanation: In eukaryotic cells, post-transcriptional modifications occur after transcription but before mRNA is translated. These include:
Capping: A 5' cap, typically a modified guanine nucleotide, is added to the 5' end of the mRNA. This cap protects the mRNA from degradation, aids in its export from the nucleus, and is recognised by translation machinery.

Splicing: Non-coding sequences (introns) are removed from the pre-mRNA, and coding sequences (exons) are joined together. This process, known as RNA splicing, is crucial for creating mature mRNA molecules.

Polyadenylation: A poly(A) tail, a long chain of adenine nucleotides, is added to the 3' end of the mRNA. This tail contributes to mRNA stability and helps with its transport out of the nucleus.

RNA Modification: Various chemical modifications can occur within the RNA sequence, including methylation, pseudouridylation, and other changes that can alter RNA structure and function.

130. **Option (2) is correct.**
Explanation: Polygenic traits are controlled by multiple genes, each having a small additive effect. These traits (like skin color, height) do not follow Mendel's simple dominant-recessive patterns. Instead, they show continuous variation and are non-Mendelian in inheritance.

131. **Option (4) is correct.**
Explanation: Catalase is an enzyme that breaks down hydrogen peroxide into water and oxygen, which is a crucial function in protecting cells from oxidative damage. It contains 'Haem' (an iron–porphyrin complex) as a prosthetic group, which is essential for its activity.

Other enzymes:

• RuBisCO: No haem, it binds CO_2 in the Calvin cycle.

• Carbonic anhydrase: Contains zinc, not haem.

• Succinate dehydrogenase: Uses FAD and iron-sulfur clusters, not haem.

132. **Option (2) is correct.**
Explanation: Arrange from simple to complex:
1. A – Multicellular heterotrophs with chitin cell walls → Fungi
2. E – Eukaryotes with cellular body organisation → Protista
3. C – Prokaryotes with cell walls made of polysaccharides → Monera
4. D – Eukaryotic autotrophs with tissue/organ level → Plantae
5. B – Heterotrophs with tissue/organ/organ system level → Animalia
Thus, the correct increasing order is: C (Monera), E (Protista), A (Fungi), D (Plantae), B (Animalia)

133. **Option (2) is correct.**
Explanation: Ramdeo Misra is widely regarded as the Father of Ecology in India. He made pioneering contributions to plant ecology and ecosystem studies in the Indian context, promoting ecological research and education across the country.

134. **Option (3) is correct.**
Explanation: A. Alfred Hershey and Martha Chase → IV. DNA as genetic material confirmation

They confirmed that DNA, not protein, is the genetic material using bacteriophage T2 in the famous blender experiment.
B. Euchromatin → III. Loosely packed and light-stained
Euchromatin is less condensed, transcriptionally active DNA, and appears light under a microscope.
C. Frederick Griffith → I. *Streptococcus pneumoniae*
Griffith discovered the transformation principle using *S. pneumoniae* and mice.
D. Heterochromatin → II. Densely packed and dark-stained
Heterochromatin is highly condensed, transcriptionally inactive, and appears dark-stained.

135. **Option (2) is correct.**
Explanation: Neoplasia refers to the abnormal and uncontrolled proliferation of cells, resulting in the formation of a mass that may become cancerous. Rapid growth is a hallmark of neoplastic cells. Invasion and tissue damage is characteristic of malignancy. Cells confined to their original location describe benign tumours, not neoplastic malignancy.

136. **Option (1) is correct.**
Explanation: DNA fragments separated via gel electrophoresis can be extracted and used to construct recombinant DNA. In agarose gel electrophoresis, DNA being negatively charged, moves toward the positive end of the electrode (anode). Smaller fragments migrate faster (farther from wells), while larger fragments stay near wells.

137. **Option (3) is correct.**
Explanation: Adenosine is a nucleoside. It consists of a nitrogenous base (adenine) and a pentose. Adenylic acid (AMP) is a nucleotide made of adenine, sugar, and phosphate. Adenine is one of the purine nitrogenous bases. Alanine is a standard amino acid used in protein synthesis.

138. **Option (1) is correct.**
Explanation: Meiosis starts earlier in females than in males. In females, it begins during fetal development, around the 12th week of gestation, and pauses in prophase I until puberty. In males, the time gap between meiosis I and II is indeed shorter (continuous and quick) but prolonged in females, where meiosis II completes only after fertilisation. The first polar body is formed after meiosis I, which marks the formation of the secondary oocyte, not the primary oocyte (the primary oocyte already exists from fetal life). LH surge leads to ovulation, not menstruation. Menstruation is due to drop in progesterone and oestrogen if fertilisation does not occur.

139. **Option (4) is correct.**
Explanation: All living members of the class Cyclostomata are ectoparasites on some fishes. They have an elongated body bearing 6–15 pairs of gill slits for respiration. Cyclostomes have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins.

140. Option (1) is correct.

Explanation: The main function of the Golgi apparatus is to package and sort materials (proteins and lipids) from the ER and send them to their correct destinations. Vesicles from the ER fuse with the cis face of the Golgi apparatus, where the contents undergo modifications such as glycosylation and tagging, before being transported out from the trans face.

141. Option (1) is correct.

Explanation: In monocots (e.g., maize), the scutellum is a specialised cotyledon, functioning in nutrient absorption and is considered rudimentary in structure. Non-albuminous seeds do not retain endosperm. Groundnut (peanut) is an example. In monocot embryos, the epiblast is a rudimentary or underdeveloped cotyledon, essentially a vestigial or incomplete cotyledon. Perisperm refers to the persistent nucellus tissue found in some seeds, particularly those of black pepper, coffee, castor, and cardamom. This residual nucellus acts as a nutritive tissue, providing nourishment to the developing embryo.

142. Option (1) is correct.

Explanation: All vertebrates are chordates because they have a notochord at some stage. However, not all chordates are vertebrates (e.g., tunicates and cephalochordates). In vertebrates, the notochord is present during the embryonic stage, but in adults, it is replaced by the vertebral column made of cartilage or bone.

143. Option (3) is correct.

Explanation: Antibodies are Y-shaped proteins made up of two light chains and two heavy chains, connected by disulfide bonds. The antigen-binding site is located at the variable region of the antibody, specifically at the N-terminal ends. The constant region (C-region) lies toward the C-terminal and determines the class/function of the antibody.

144. Option (1) is correct.

Explanation: RNA interference (RNAi) is a gene-silencing process triggered by double-stranded RNA (dsRNA), which is complementary to a specific mRNA. The dsRNA is processed into siRNA or miRNA, which guide the RNA-induced silencing complex (RISC) to degrade or block the target mRNA.

145. Option (3) is correct.

Explanation: This is a classic Mendelian dihybrid cross involving independent assortment of two genes (R and Y) where yellow colour is dominant over green and round seed shape over wrinkled seed shape..

Cross: RRYY × rryy → F$_1$: RrYy (round yellow)

F$_2$ phenotypic ratio from RrYy × RrYy =

9 Round Yellow

3 Round Green

3 Wrinkled Yellow

1 Wrinkled Green

Hence, 9 : 3 : 3 : 1 is the correct ratio.

146. Option (1) is correct.

Explanation: Histones are basic proteins that help DNA wrap into nucleosomes. They are positively charged due to high content of basic amino acids, especially lysine and arginine, which helps them bind tightly to the negatively charged DNA (due to phosphate groups).

147. Option (2) is correct.

Explanation: Menarche is the term used for the first menstrual bleeding in females, marking the onset of reproductive capability. Menopause is permanent cessation of menstruation. Diapause is a period of suspended development (seen in insects/animals). Ovulation is release of the ovum from the ovary (not related to first menstruation directly).

148. Option (4) is correct.

Explanation: ANF is secreted by the heart when blood pressure increases. It helps reduce water and sodium reabsorption, thus lowering blood pressure. The kidneys produce erythropoietin, a hormone that stimulates red blood cell production in response to low oxygen. Secretin is produced in the small intestine and stimulates the pancreas to release bicarbonate to neutralise stomach acid. Aldosterone is a mineral corticoid hormone secreted by the adrenal cortex that regulates sodium and potassium balance.

149. Option (3) is correct.

Explanation: An enzyme may have two parts:

Apoenzyme: The protein part of the enzyme.

Cofactor: A non-protein component (could be metal ion or organic molecule).

When apoenzyme + cofactor combine, they form the holoenzyme, the active form.

150. Option (4) is correct.

Explanation: Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (gm^{-2}) or energy (kcal m^{-2}). The rate of biomass production is called productivity. It is expressed in terms of gm^{-2} yr^{-1} or (kcal m^{-2}) yr^{-1}.

151. Option (1) is correct.

Explanation: Sweet potato (root modification) and potato (stem modification) have a similar function (storage) but different origins. This is an example of analogous organs—similar function, different origin. Convergent evolution occurs when unrelated species evolve similar traits due to similar environmental pressures.

152. Option (2) is correct.

Explanation: From the pedigree:

Step 1: Determine Mode of Inheritance

From the pedigree:
- Affected individuals are present in both sexes.
- Disease skips generations.
- Affected offspring (black squares and circles) appear from carrier parents.
  This suggests it is an X-linked recessive disorder.
- Genotype key:
- XX or XY: Normal (non-carrier, non-affected)
- X^aX: Carrier female (one mutant allele, no disease)
- X^aX^a and X^aY affected female and male

Step 2: Look at F_2 Generation Couple

We are examining the F_2 couple who produce the F_2 children. From the pedigree:
- Mother (F_2): A carrier female → Genotype = X^aX
- Father (F_2): An affected male → Genotype = X^aY

Their cross is:

X^aX (carrier) $\times$ X^aY (affected)

Step 3: Use a Punnett Square

Cross: $X^aX \times X^aY$

	X^a	Y
X^a	X^aX^a	X^aY
X	X^aX	XY

Results:
- X^aX : 25% (carrier female, not affected).
- X^aX^a : 25% (affected female).
- XY : 25% (unaffected male).
- X^aY : 25% (affected male).

Step 4: What the Question Asks

We want the probability of a child who is:
- Unaffected and
- Carrier

25% males are unaffected and 25% females are carrier but not diseased. So, the probability for the birth of a child having no disease and being a carrier is 50% or 1/2.

153. Option (1) is correct.

Explanation: The tapetum is the innermost layer of the anther wall in flowering plants and plays a crucial role in the nourishment and development of microspores (pollen grains). Tapetal cells are often binucleate or multinucleate and have dense cytoplasm to support the developing pollen. The reason correctly explains the assertion: more nuclei mean enhanced metabolic support and secretion of materials like enzymes and nutrients for microspore development.

154. Option (3) is correct.

Explanation: In angiosperms, the megaspore mother cell undergoes one meiotic division to produce four haploid megaspores, out of which one survives. This functional megaspore undergoes three rounds of mitosis, producing eight nuclei which organise into the embryo sac (mature female gametophyte). Therefore, the total is 1 meiosis + 3 mitosis.

155. Option (3) is correct.

Explanation: A zygomorphic flower shows bilateral symmetry, meaning it can be divided into two equal halves in only one plane. Pea (*Pisum sativum*) exhibits zygomorphy. In contrast, Datura, Petunia and Chilli are actinomorphic (radially symmetrical).

156. Option (4) is correct.

Explanation: Secondary lymphoid organs are sites within the lymphatic system where mature lymphocytes (B and T cells) encounter antigens, are activated and initiate adaptive immune responses. These organs include lymph nodes, the spleen, tonsils, adenoids and various mucosa-associated lymphoid tissues (MALT).

157. Option (4) is correct.

Explanation: A fig is generally considered a vegetarian fruit. Figs rely on wasps for pollination, the making them a plant-based food. The fig–wasp mutualism is a well-known example where the wasp lays eggs in the fig and in turn pollinates the fig flowers. It's a classic mutualistic relationship.

158. Option (1) is correct.

Explanation: During mitosis, spindle fibres (microtubules) originate from the centrosomes and attach to the centromeres of chromosomes. Their primary function is to align the chromosomes at the metaphase plate and then separate sister chromatids during anaphase, pulling them to opposite poles of the cell. This ensures equal distribution of genetic material into the daughter cells.

159. Option (2) is correct.

Explanation: Gymnosperms are seed-producing plants but unlike angiosperms, their seeds are not enclosed within fruits; instead, they are naked and exposed on cones or scale-like structures.

160. Option (2) is correct.

Explanation: The adrenal medulla secretes epinephrine (adrenaline) and norepinephrine (noradrenaline). Adrenaline causes pupillary dilation, not constriction. These hormones increase blood glucose levels (hyperglycemia) by stimulating glycogenolysis. Piloerection (hair standing on end) is a sympathetic response. Adrenaline increases heart rate and contraction strength.

161. Option (2) is correct.

Explanation: Insulin is a protein hormone, and if taken orally, it would be broken down by proteolytic enzymes in the stomach and intestines, just like dietary proteins. As a result, it would become inactive before reaching the bloodstream, rendering it ineffective. That's why insulin is usually administered via injection.

162. **Option (2) is correct.**
Explanation: A. Pteridophyte → IV. *Salvinia* (Correct: *Salvinia* is a water fern, a pteridophyte)
B. Bryophyte → III. *Polytrichum* (Correct: *Polytrichum* is a moss, a bryophyte)
C. Angiosperm → I. *Salvia* (Correct: *Salvia* is a flowering plant, i.e., angiosperm)
D. Gymnosperm → II. *Ginkgo* (Correct: *Ginkgo biloba* is a gymnosperm)

163. **Option (1) is correct.**
Explanation: George Gamow was the first to propose that a set of three nucleotide bases (triplet code) could code for one amino acid. He theorised that combinations of four bases in triplets ($4^3 = 64$ possible codons) were sufficient to code for the 20 amino acids, laying the groundwork for deciphering the genetic code.

164. **Option (2) is correct.**
Explanation: The Evil Quartet refers to the four major causes of biodiversity loss: habitat loss, over-exploitation, alien species invasions, and co-extinctions. Ex situ conservation involves preserving components of biological diversity outside their natural habitats, like gene banks and cryopreservation. *Lantana camara* is an invasive alien species in India that threatens native flora. The Dodo is the classic example of extinction due to human activity and invasive species on islands.

165. **Option (2) is correct.**
Explanation: Though ADH (vasopressin) is released from the posterior pituitary, it is synthesised in the hypothalamus (in the supraoptic and paraventricular nuclei). It is then transported down nerve axons to the posterior pituitary for release into the bloodstream. Luteinising hormone (LH), FSH, and ACTH are synthesised and released by the anterior pituitary.

166. **Option (2) is correct.**
Explanation: The most distinctive feature of echinoderms is the presence of water vascular system which helps in locomotion, capture and transport of food and respiration.
The excretory system is absent in echinoderms.

167. **Option (2) is correct.**
Explanation: Innate immunity is the first line of defence present at the time of birth. It includes physical barriers (skin), chemical barriers (stomach acid) and cellular defences (macrophages). It is non-specific, acting the same way against all pathogens. In contrast, acquired immunity is developed after birth through exposure and is specific to particular pathogens.

168. **Option (2) is correct.**
Explanation: Gemmae are small, multicellular, asexual reproductive bodies found in structures called gemma cups in some bryophytes (e.g., liverworts like *Marchantia*). They detach from the parent and develop into new individuals, enabling asexual reproduction. They do not participate in sexual reproduction, nutrient absorption, or gaseous exchange.

169. **Option (4) is correct.**
Explanation: The renal portal system in frogs (and other lower vertebrates) is a secondary venous system that collects blood from the hind limbs and posterior body parts, channeling it first to the kidneys before it enters the general circulation. Specifically, the renal portal vein links the hind limbs and tail (via femoral and sciatic veins) to the kidneys. Although the liver is part of the hepatic portal system, the renal portal system specifically connects to the kidneys, not the liver.

170. **Option (3) is correct.**
Explanation: Statement I is correct because energy flow in ecosystems follows a unidirectional path: from the sun to producers (plants) and then to consumers and decomposers, with energy being lost as heat at each step. Statement II is incorrect because ecosystems obey the second law of thermodynamics, which states that energy transformations are inefficient and tend toward increased entropy. Energy is lost as heat at each trophic level, illustrating the second law in ecological processes.

171. **Option (4) is correct.**
Explanation: RuBisCO (Ribulose-1,5-bisphosphate carboxylase/oxygenase) is a key enzyme in the Calvin cycle of photosynthesis. It catalysesv the carboxylation of RuBP (ribulose-1,5-bisphosphate) by adding CO_2, leading to the production of two molecules of 3-phosphoglycerate. RuBisCO is active in the light, not in the dark. RuBisCO actually has higher affinity for CO_2 than O_2, but under certain conditions (like high O_2 concentration), it also catalyses oxygenation (photorespiration). It is not involved in photolysis of water; that's part of the light-dependent reactions and done by photosystem II.

172. **Option (1) is correct.**
Explanation: In gene cloning, the essential enzymes are:
• Restriction enzymes: Cut DNA at specific sites.
• DNA ligase: Joins DNA fragments.
• DNA polymerase: Amplifies DNA sequences.
DNA mutase and DNA recombinase are not essential for the core steps of cloning:
DNA mutase is involved in mutation processes, not standard cloning.
DNA recombinase facilitates recombination but is not a must-have for standard gene cloning protocols.
Hence, option C (DNA mutase) and option D (DNA recombinase) are not essential.

173. Option (1) is correct.

Explanation: Parthenocarpy (development of fruit without fertilisation) can indeed be induced by auxins. Plant growth regulators (PGRs) do promote/inhibit growth. Dedifferentiation is a pre-requisite for re-differentiation, although they are related processes. Abscisic acid (ABA) is actually a growth inhibitor, not a promoter. Apical dominance (suppression of lateral bud growth) is caused by auxins from the apical bud.

174. Option (3) is correct.

Explanation: In prokaryotes, transcription is terminated through two mechanisms: rho-dependent and rho-independent termination. The ρ (rho) factor is a protein involved in rho-dependent termination. It binds to the RNA and facilitates the dissociation of the RNA polymerase from the DNA. Other options (α, σ, γ) are either part of polymerase or not involved in termination.

175. Option (3) is correct.

Explanation: Frogs exhibit dual mode of respiration: In water, they respire mainly through their skin (cutaneous respiration). On land, they use skin, buccal cavity and lungs for respiration. The respiration by lungs is called pulmonary respiration.

176. Option (2) is correct.

Explanation: Twins of different sexes (a boy and a girl) must be fraternal (dizygotic) twins, because monozygotic (identical) twins always share the same genetic material and hence the same sex. Fraternal twins arise from two different eggs fertilised by two different sperms, which allows for gender variation.

177. Option (2) is correct.

Explanation: A. *Aspergillus niger* – Not a household product. Used in citric acid production (used in foods).

B. *Lactobacillus* – used in curd/yogurt preparation.

C. *Trichoderma polysporum* – NOT used in household products; it's a fungicide/biocontrol agent.

D. *Saccharomyces cerevisiae* – baker's yeast, used in making bread and alcohol.

E. *Propionibacterium shermanii* – used in cheese production, contributes to the holes in Swiss cheese.

178. Option (1) is correct.

Explanation: Progesterone is secreted mainly by the corpus luteum of the ovary. Relaxin, a hormone involved in childbirth and pelvic relaxation, is secreted by the ovary. MSH is secreted by the pars intermedia of the pituitary gland. Catecholamine like adrenaline and noradrenaline is secreted by the adrenal medulla.

179. Option (4) is correct.

Explanation: Blue colonies do not contain the recombinant DNA. The presence of blue colour means no insertion in the lacZ gene, so it is non-recombinant. Colonies without blue colour (i.e., white colonies) indicate that the lacZ gene has been disrupted by insertion of recombinant DNA, making them recombinant.

180. Option (2) is correct.

Explanation: The Verhulst-Pearl logistic growth equation models population growth with a carrying capacity (K), limiting exponential growth:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

where:

N = population size

r = intrinsic rate of increase

K = carrying capacity

This equation shows that when N is much smaller than K, the population grows rapidly. As N approaches K, growth slows down.

■■■