NEET (UG) 2024

SAMPLE PAPER - 5

Time Allowed: 3 hours and 20 minutes **Maximum Marks: 720**

General Instructions:

- The test is of 3 hours and 20 minutes and it contains 200 questions. Internal choice is given within the sections.
- 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.

PHYSICS (Section-A)

1. The dimensional formula of magnetic flux is: **[4]**

   a) $[ML^2T^{-2}A^{-1}]$ b) $[ML^0T^{-2}A^{-2}]$

   c) $[ML^2T^{-1}A^3]$ d) $[M^0L^{-2}T^{-2}A^{-2}]$

2. Which of the following quantity is NOT dimensionless? **[4]**

   a) Angle b) Reynold's number

   c) Strain d) Radius of gyration

3. A stone falls freely under gravity. It covers distances h_1, h_2 and h_3 in the first 4 seconds, the next 4 seconds and the next 4 seconds respectively. The relation between h_1, h_2 and h_3 is ($g = 10\ m/s^2$) **[4]**

   a) $h_2 = 3h_1$ and $h_3 = 3h_2$ b) $h_2 = 3h_1$ and $h_3 = 5h_1$

   c) $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$ d) $h_1 = 2h_2 = 3h_3$

4. Two particles of equal masses are revolving in circular paths of radii r_1 and r_2 respectively with the same period. The ratio of their centripetal force is: **[4]**

a) $(\frac{r_1}{r_2})^2$

b) $\frac{r_1}{r_2}$

c) $\sqrt{\frac{r_1}{r_2}}$

d) $(\frac{r_2}{r_1})^2$

5. The range of a projectile is 100 m. Its kinetic energy will be maximum after covering a distance of: **[4]**

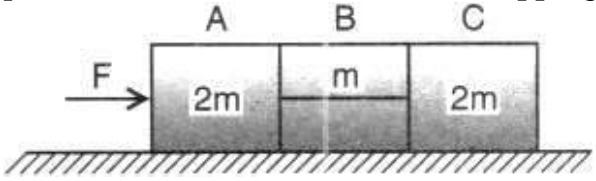
a) 75 m

b) 100 m

c) 50 m

d) 25 m

6. The system is pushed by a force F as shown in figure. All surfaces are smooth except between B and C. Friction coefficient between B and C is μ. Minimum value of F to prevent block B from downward slipping is: **[4]**



a) $\left(\frac{5}{2\mu}\right)mg$

b) $\left(\frac{3}{2\mu}\right)mg$

c) $\left(\frac{5}{2}\right)\mu mg$

d) $\left(\frac{3}{2}\right)\mu mg$

7. A ball moving with a velocity of 6 m/s strikes an identical stationary ball. After the collision, each ball moves at an angle of 30° with the original line of motion. What are the speeds of the balls after the collision? **[4]**

a) $\sqrt{3}$

b) $\sqrt{3}$ m/sec

$\frac{}{2}$ m/sec

c) 3 m/sec

d) $2\sqrt{3}$ m/sec

8. A horizontal force F pulls a 10 kg box at a constant speed along a horizontal floor. If the coefficient of friction between the box and the floor is 0.5, how much work is done by the force F in moving the box through a distance of 4 m? **[4]**

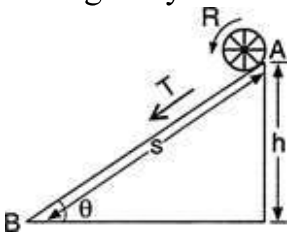
a) 196 J

b) 147 J

c) 49 J

d) 98 J

9. Suppose a body of mass M and radius R is allowed to roll on an inclined plane without slipping from its topmost point A. The velocity acquired by the body, time taken by the rolling body to reach the bottom of the inclined plane is: **[4]**



(Where $\beta = 1 + \frac{I}{MR^2}$, I is the moment of inertia of the body about its axis of rotation)

a) $\frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}$

b) $\sqrt{\beta\left(\frac{2h}{g}\right)}$

c) $\frac{1}{\sin\theta}\sqrt{\beta\left(\frac{2h}{g}\right)}$

d) $\sqrt{\frac{2h}{g}}$

10. A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the n^{th} power of R If the period of rotation of the particle **[4]**

is T, then:

a) $T \propto R^{(n+1)/2}$

b) $T \propto R^{3/2}$ for any n.

c) $T \propto R^{n/2}$

d) $T \propto R^{n/2+1}$

[4]

11. The value of acceleration due to gravity is g_1 at a height $h = \frac{R}{2}$ (R = radius of the earth) from the surface of the earth. It is again equal to g_1 and a depth d below the surface of the earth. The ratio $\left(\frac{d}{R}\right)$ equals:

a) $\frac{5}{9}$

b) $\frac{1}{3}$

c) $\frac{7}{9}$

d) $\frac{4}{9}$

12. An Indian rubber cord L metre long and area of cross-section A metre^2 is suspended vertically. Density of rubber is ρ kg/metre^3 and Young's modulus of rubber is Y newton/metre^2. If the cord extends by l metre under its own weight, then extension l is: **[4]**

a) $\frac{L^2\rho g}{4Y}$

b) $\frac{Y}{L^2\rho g}$

c) $\frac{L^2\rho g}{2Y}$

d) $\frac{L^2\rho g}{Y}$

13. If a thermometer reads freezing point of water as 20°C and boiling point as 150°C, how much thermometer read when the actual temperature is 60°C? **[4]**

a) $110^{o}C$

b) $98^{o}C$

c) $60^{o}C$

d) $40^{o}C$

14. Which of the following statements is true about the radiation emitted by human body? **[4]**

a) The radiation emitted lies in the ultraviolet region and hence is not visible

b) The radiation is emitted only during the day

c) The radiation emitted is in the infrared region

d) The radiation is emitted during the summers and absorbed during the winters

15. A reversible engine converts $\frac{1}{6}$ of heat into work. When the temperature of sink is reduced by $62^{o}C$, its efficiency is doubled; the temperature of source is: **[4]**

a) $100^{o}C$

b) $99^{o}C$

c) $200^{o}C$

d) $162^{o}C$

16. A cubic vessel (with faces horizontal + vertical) contains an ideal gas at normal temperature and pressure. The vessel is being carried by rocket which is moving at a speed of 500 ms^{-1} in the vertical direction. The pressure of the gas inside the vessel is observed by us on the ground: **[4]**

a) will increase by a factor equal to $\frac{v_{rms}^{2} + (500)^{2}}{v_{rms}^{2}}$ where v_{rms} was the original mean square velocity of the gas

b) will be different on the top wall and bottom wall of the vessel

c) remains the same because the motion of the vessel as a whole does not affect the relative motion of the gas molecules and the walls

d) remains the same because 500 ms^{-1} is very much smaller than v_{rms} of the gas

17. The equation of SHM is given as: **[4]**
$x = 3 \sin 20\pi t + 4 \cos 20\pi t$,

where x is in cms and t is in seconds. The amplitude is:

a) 4 cm

b) 5 cm

c) 7 cm

d) 3 cm

18. The equation of a travelling wave is, **[4]**
$y = 60 \cos (1800t - 6x)$.
Where y is in microns, t in seconds and x in metres. The ratio of maximum particle velocity to velocity of wave propagation is:

a) 3.6

b) 3.6×10^{-4}

c) 3.6×10^{-6}

d) 3.6×10^{-11}

19. When the pressure increased by 1 atmosphere and temperature increases by 1^{o} C, the velocity of sound: **[4]**

a) decreases by 61 ms^{-1}

b) decreases by 0.61 ms^{-1}

c) increases by 0.61 ms^{-1}

d) increases by 61 ms^{-1}

20. The bob of a simple pendulum is hanging vertically down from a fixed identical bob by means of a string of length l. If both bobs are charged with a charge each, time period of the pendulum is: (ignore the radii of the bobs) **[4]**

a) $2\pi\sqrt{\dfrac{l}{g-\left(\dfrac{q^2}{l^2 m}\right)}}$

b) $2\pi\sqrt{\dfrac{l}{g-\left(\dfrac{q^2}{l}\right)}}$

c) $2\pi\sqrt{\dfrac{l}{g}}$

d) $2\pi\sqrt{\dfrac{l}{g+\left(\dfrac{q^2}{l^2 m}\right)}}$

21. A square of side $\sqrt{2}$ m has charges of $+2 \times 10^{-9}$ C, 1×10^{-9} C, -2×10^{-9}C and -3×10^{-9}C respectively at its corners. Potential at the centre of the square is: **[4]**

a) -18 V

b) +8 V

c) -8V

d) +18 V

22. n identical cells are joined in series with two cells A and B with reversed polarities. EMF of each cell is E and internal resistance is r. Potential difference across cell A or B is (n > 4): **[4]**

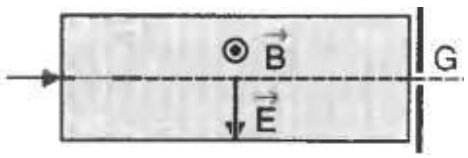
a) $2E\left(1-\dfrac{2}{n}\right)$

b) $\dfrac{4E}{n}$

c) $2E\left(1-\dfrac{1}{n}\right)$

d) $\dfrac{2E}{n}$

23. A stream of electrons and protons are directed towards a narrow slit in a screen (see figure). The intervening region has a uniform electric field $\vec{E}$ (vertically downwards) and a uniform magnetic field $\vec{B}$ (out of the plane of the figure) as shown. Then: **[4]**



a) electrons and protons with speed $\frac{|\vec{E}|}{|\vec{B}|}$ will pass through the slit

b) electrons will always be deflected downward irrespective of their speed

c) neither electrons nor protons will go through the slit irrespective of their speed

d) $\frac{|\vec{E}|}{|\vec{B}|}$ protons with speed will pass through the slit, electrons of the same speed will not

24. The direction of magnet in tan B position is along: **[4]**

a) east-west

b) north-south

c) north-west

d) south-west

25. If a diamagnetic substance is brought near the north or the south pole of a bar magnet, it is: **[4]**

a) repelled by the north-pole and attracted by the south-pole

b) repelled by both the poles

c) attracted by both the poles

d) attracted by the north-pole and repelled by the south-pole

26. A motor having an armature of resistant 2Ω is designed to operate at 220 V mains. At full speed, it develops a back emf of 210 V. When the motor is running at full speed, the current in the armature is: **[4]**

a) 10 A

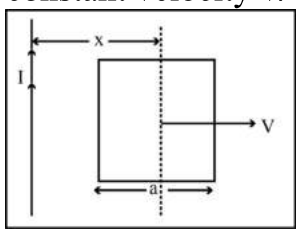
b) 5 A

c) 3 A

d) 7 A

27. A conducting square frame of side **a** and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a **[4]**

constant velocity v. The emf induced in the frame will be proportional to:



a) $\frac{1}{(2x-a)(2x+a)}$

b) $\frac{1}{(2x-a)^2}$

c) $\frac{1}{x^2}$

d) $\frac{1}{(2x+a)^2}$

28. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are **[4]**

a) 600 V, 15 A

b) 450 V, 15 A

c) 450 V, 13.5 A

d) 300 V, 15 A

29. The electric fields of two plane electromagnetic plane waves in vacuum are given by **[4]**
$\vec{E}_1 = E_0\hat{j}\cos(\omega t - kx)$ and and $\vec{E}_2 = E_0\hat{k}\cos(\omega t - ky$.

At t = 0, a particle of charge q is at origin with a velocity
$\vec{v} = 0.8c\hat{j}$ (c is the speed of light in vacuum). The instantaneous force experienced by

the particle is:

a) $E_0q\,(0.8\hat{i} - \hat{j} + 0.4\hat{k})$

b) $E_0q\,(0.4\hat{i} - 3\hat{j} + 0.8\hat{k})$

c) $E_0q\,(-0.8\hat{i} + \hat{j} + \hat{k})$

d) $E_0q\,(0.8\hat{i} + \hat{j} + 0.2\hat{k})$

30. The focal length of the objective and eye-piece of a telescope are respectively 200 cm and 5 cm. The maximum magnifying power of the telescope will be: **[4]**

a) -48 b) -40

c) -60 d) -100

31. The width of a single slit, if the first minimum is observed at an angle of 2° with a light **[4]**
o

of wavelength 6980 A, (in mm) is:

a) 2×10^{-5} b) 0.2

c) 0.02 d) 2

32. Which of the following device is the application of photoelectric effect? **[4]**

a) Transistor b) Light emitting diode

c) Diode d) Photocell

33. The maximum wavelength of a beam of light that can be used to produce a photoelectric effect on metal is 250 nm. The energy of the electrons (in joule) emitted from the surface of the metal when a beam of light of wavelength 200 nm is used: **[4]**

a) 19.86×10^{-20} b) 89.61×10^{-22}

c) 18.96×10^{-20} d) 69.81×10^{-22}

34. The ratio of minimum to maximum wavelength in Balmer series is: **[4]**

a) 5 : 9 b) 3 : 4

c) 1 : 4 d) 5 : 36

35. The half-life of a radioactive substance is 20 minutes. The time between 20% and 80% of decay will be: **[4]**

a) 40 min b) 30 min

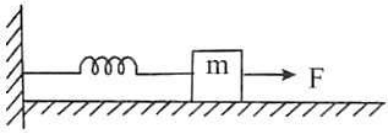
c) 25 min d) 20 min

PHYSICS (Section-B)

Attempt any 10 questions

36. A block of mass m, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant k. The other end of the spring is fixed, as shown in the figure. The block is initally at rest in its equilibrium position. If now the block is **[4]**

pulled with a constant force F, the maximum speed of the block is:



a) $\frac{F}{\sqrt{mk}}$

b) $\frac{F}{\pi\sqrt{mk}}$

c) $\frac{2F}{\sqrt{mk}}$

d) $\frac{\pi F}{\sqrt{mk}}$

37. A solid sphere is in rolling motion. In rolling motion, a body possesses translational kinetic energy (K_t) as well as rotational kinetic energy (K_r) simultaneously. The ratio $K_t : (K_t + K_r)$ for the sphere is **[4]**

a) 5 : 7

b) 7 : 10

c) 10 : 7

d) 2 : 5

38. Imagine earth is rotating at a very high speed such that weight of a body at the equator is zero. Then the number of hours in a day is: **[4]**

a) $\frac{2\pi}{3600}\sqrt{\frac{g}{R}}$

b) $\frac{2\pi}{3600}\sqrt{\frac{R}{g}}$

c) $\frac{3600}{2\pi}\sqrt{\frac{R}{g}}$

d) $\frac{3600}{2\pi}\sqrt{\frac{g}{R}}$

39. The radiant energy from the sun, incident normally at the surface of the earth, is 20 kcal/m^2-min. What would have been the radiant energy incident normally on the earth, if the sun had a temperature twice of the present one? **[4]**

a) 320 Kcal/m^2 -min

b) 40 Kcal/m^2 -min

c) 160 Kcal/m^2 -min

d) 80 Kcal/m^2 -min

40. A long glass tube is held vertically in water. A tuning fork is struck and held over the tube. Strong resonances are observed at two successive lengths 0.50 m and 0.84 m above the surface of water. If the velocity of sound is 340 m/s, then the frequency of the tuning fork is: **[4]**

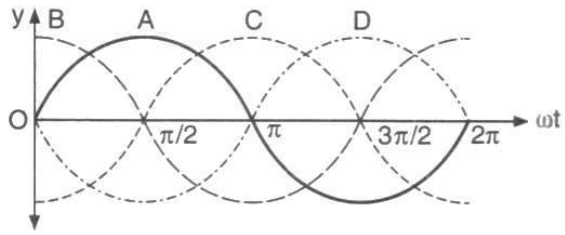
a) 256 Hz

b) 500 Hz

c) 384 Hz

d) 128 Hz

41. Figure given below shows four progressive waves A,B,C and D with their phases expressed with respect to the wave A. It can be calculated from the figure that: **[4]**



a) The wave C lags behind by a phase angle of π and the wave B is ahead by a phase angle of π

b) The wave C is ahead by a phase angle of π and the wave B lags behind by a phase angle of π

c) The wave C lags behind by a phase angle of $\pi/2$ and the wave B is ahead by a phase angle of $\pi/2$

d) The wave C is ahead by a phase angle of $\pi/2$ and the wave B lags behind by a phase angle of $\pi/2$

42. A long conducting wire having a current I flowing through it, is bent into a circular coil of N tums.Then it is bent into a circular coil of n turns. The magnetic field is calculated at the centre of coils in both the cases. The ratio of the magnetic field in first case to that of second case is: **[4]**

a) $n^2 : N^2$

b) $N^2 : n^2$

c) n : N

d) N : n

43. A bar magnet of magnetic moment M and moment of inertia I is freely suspended such that the magnetic axial line is in the direction of magnetic meridian. If the magnet is displaced by a very small angle θ, angular acceleration is: (magnetic induction of the earth's horizontal field is B_H) **[4]**

a) $\frac{MB_H\theta}{I}$

b) $\frac{I\theta}{MB_H}$

c) $\frac{IB_H\theta}{M}$

d) $\frac{M\theta}{IB_H}$

44. A conducting circular loop is placed in a uniform magnetic field of induction B tesla with its plane normal to the field. Now, the radius of the loop starts shrinking at the rate (dr/dt). Then, the induced emf at the instant when the radius is r, is: **[4]**

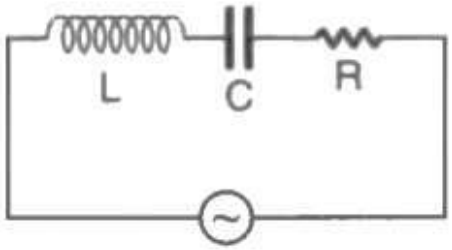
a) $\pi rB(\frac{dr}{dt})$

b) $\pi r^2(\frac{dr}{dt})$

c) $(\frac{\pi r^2}{2})B(\frac{dr}{dt})$

d) $2\pi rB(\frac{dr}{dt})$

45. A 100 V, AC source of frequency 500 Hz is connected to an L-C-R circuit with L = 8.1 mH, C = 12.5 μF, R = 10Ω, all connected in series as shown in the figure. What is the quality factor of the circuit? **[4]**



a) 20.54

b) 2.02

c) 2.5434

d) 200.54

46. When light is refracted into a medium: **[4]**

a) its wavelength increases but the frequency remain unchanged

b) its wavelength and frequency both increase

c) its wavelength decreases but the frequency remain unchanged

d) its wavelength and frequency both decrease

47. ACB is a right-angled triangle of refractive index 1.5. ∠A, ∠B and ∠C are 60^o, 30^o and 90^o. A thin layer of liquid is on the face AB for a ray of light which is incident normally on AC to be totally reflected at AB, the refractive index of the liquid on AB should be: **[4]**

a) 1.4

b) 1.3

c) 1.2

d) 1.5

48. A proton, a neutron, an electron and α-particle have the same energy. Then their de Broglie wavelengths compare as: **[4]**

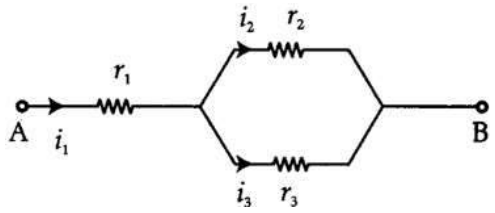
a) $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$

b) $\lambda_\alpha < \lambda_p = \lambda_n < \lambda_e$

c) $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$

d) $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$

49. Three resistors having resistances r_1, r_2 and r_3 are connected as shown in the given circuit. The ratio $\frac{i_3}{i_1}$ of currents in terms of resistances used in the circuit is: **[4]**



a) $\frac{r_2}{r_2+r_3}$

b) $\frac{r_1}{r_2+r_3}$

c) $\frac{r_1}{r_1+r_2}$

d) $\frac{r_2}{r_1+r_3}$

50. O_2 molecule consists of two oxygen atoms. In the molecule, nuclear force between the nuclei of the two atoms: **[4]**

a) is not important because nuclear forces are short-ranged

b) cancels the repulsive electrostatic force between the nuclei

c) is not important because oxygen nucleus have equal number of neutrons and protons

d) is as important as electrostatic force for binding the two atoms

CHEMISTRY (Section-A)

51. An element, X has the following isotopic composition: **[4]**
^{200}X : 90% ^{199}X : 8.0% ^{202}X : 2.0%
The average atomic mass of the naturally-occurring element X is closest to:

a) 200 amu

b) 201 amu

c) 199 amu

d) 202 amu

52. If m and e are the mass and charge of the revolving electron in the orbit of radius r for hydrogen atom, the total energy of the revolving electron will be: **[4]**

a) $-\frac{1}{2}\frac{e^2}{r}$

b) $\frac{me^2}{r}$

c) $\frac{1}{2}\frac{e^2}{r}$

d) $-\frac{e^2}{r}$

53. Which of the following is the most electropositive element? **[4]**

a) Phosphorus

b) Magnesium

c) Sulphur

d) Aluminum

54. Consider the following: **[4]**
H_5IO_6 SOF_4 $PSCl_3$ SeF_6

(I) , (II) , (III) , (IV)

Select the CORRECT combination of hybridisation states:

a) (I)-sp^3d, (II)-sp^3d, (III)-sp^3d^2, (IV)-sp^3d^3

b) (I)-sp^3d^2, (II)-sp^3d, (III)-sp^3d, (IV)-sp^3d^2

c) (I)-sp^3d^2, (II)-sp^3d, (III)-sp^3, (IV)-sp^3d^2

d) (I)-sp^3d^2, (II)-sp^3d, (III)-sp^3, (IV)-sp^3d^3

55. If the atomic number of an element X is 8, its electron-dot symbol is _____. **[4]**

a) $\cdot\cdot$ X $\cdot$

b) X

c) $_{X}:$

d) $\cdot$ $\cdot\ \cdot$ $\cdot X \cdot$ $\cdot$

56. Bond enthalpies of N ≡ N, H - H and Cl - Cl bonds are 946, 436 and 243 kJ mol^{-1} respectively. Arrange them in the increasing order of their reactivity. **[4]**

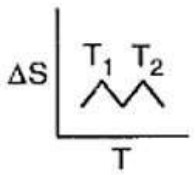
a) $H_2 < Cl_2 < N_2$

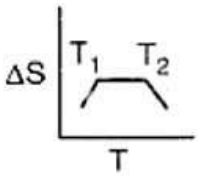
b) $H_2 < N_2 < Cl_2$

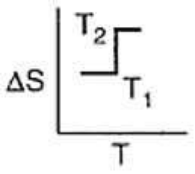
c) $Cl_2 < H_2 < N_2$

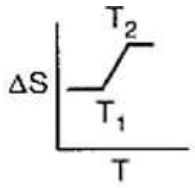
d) $N_2 < H_2 < Cl_2$

57. For a given substance T_1 and T_2 are freezing point and melting point of a substance. Which of the graph represents correctly, the variation of ΔS with temperature? **[4]**

a) 

b) 

c) 

d) 

58. Acetic acid and propionic acid have K_a values 1.75×10^{-5} and 1.3×10^{-5} respectively at a certain temperature. An equimolar solution of a mixture of the two **[4]**

acids is partially neutralised by NaOH. How is the ratio of the contents of acetate and propionate ions related to the K_a values?

a) The ratio is related to the molarity

b) $\left(\frac{\alpha}{1-\alpha}\right) = \frac{1.75}{1.3} \times \left(\frac{\beta}{1-\beta}\right)$ where α and β are ionised fraction of the acids

c) The ratio is unrelated to the pH of the solution

d) The ratio is unrelated to the K_a values

59. Excess of KI reacts with $CuSO_4$ solution and then $Na_2S_2O_3$ solution is added to it. Which of the statements is incorrect in this reaction? **[4]**

a) $Na_2S_2O_3$ is oxidised

b) Cu_2I_2 is formed

c) Evolved I_2 is reduced

d) CuI_2 is formed

60. Which of the following equation depicts reducing nature of H_2O_2? **[4]**

a) $2[Fe(CN)_6]^{4-} + 2H^+ + H_2O_2 \longrightarrow 2[Fe(CN)_6]^{3-} + 2H_2O$

b) $PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$

c) $Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + 2OH^-$

d) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

61. Electrode potentials for the general reaction, $M^{3+}_{(aq)} + 3e^- \rightarrow M_{(s)}$ are given below. **[4]**

M belongs to group 13. Identify the most electropositive metal.

Metal	M_1	M_2	M_3	M_4
Electrode Potential	-0.56	-1.66	+1.26	-0.34

a) M_1

b) M_3

c) M_4

d) M_2

62. Match the compounds given in Column I with the hybridisation and shape given in column II and mark the correct option. **[4]**

Column I	**Column II**

(A) XeF_6	(i) distorted octahedral
(B) XeO_3	(ii) square planar
(C) $XeOF_4$	(iii) pyramidal
(D) XeF_4	(iv) square pyramidal

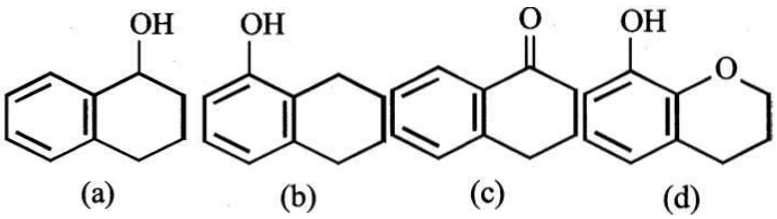
a) (A) - (iv), (B) - (iii), (C) - (i), (D) - (ii)

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

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

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

63. Arrange the Mowing compounds in increasing order of rate of aromatic electrophilic substitution reaction. **[4]**



a) d, b, c, a

b) d, b, a, c

c) c, a, b, d

d) b, c, a, d

64. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is _____. **[4]**

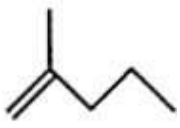
a) CH_4

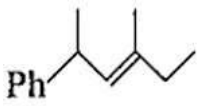
b) CH ≡ CH

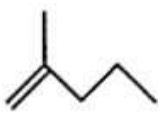
c) $CH_3 - CH_3$

d) $CH_2 = CH_2$

65. Which of the following alkene will give enantiomeric product on reaction with HBr? **[4]**

a) 

b) 

c) 

d) 

66. The freezing point of a solution containing 10 mL of non-volatile and non-electrolyte liquid **A** in 500 g of water is -0.413^oC. If K_f of water is 1.86 K kg mol^{-1} and the **[4]**

molecular weight of A = 60 g mol^{-1}, what is the density of the solution in g mL^{-1}? (Assume $\Delta_{mix}V = 0$)

a) 0.90 b) 0.993

c) 1.3 d) 1.13

67. Pure water can be obtained from sea water by: **[4]**

a) reverse osmosis b) centrifugation

c) sedimentation d) plasmolysis

68. A cell constant of 1 N electrolyte solution is 0.33 cm^{-1} and the equivalent conductance is 95.2 Ω^{-1} cm^2 eq^{-1}. If a potential difference between electrodes is 6 V, the current is _____. **[4]**

a) 1.42 A b) 1.73 A

c) 3.47 A d) 20.8 A

69. In a reaction, A + B $\longrightarrow$ Product, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentrations of both the reactants (A and B) are doubled, rate law for the reaction can be written as: **[4]**

a) Rate = k[A] [B] b) Rate = $k[A]^2$ [B]

c) Rate = $k[A]^2$ $[B]^2$ d) Rate = k[A] $[B]^2$

70. The reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ follows first order kinetics. The pressure of a vessel containing only N_2O_5 was found to increase from 50 mm Hg to 87.5 mm Hg in 30 min. The pressure exerted by the gases after 60 min. will be (assume temperature remains constant): **[4]**

a) 116.25 mm Hg b) 106.25 mm Hg

c) 125 mm Hg d) 150 mm Hg

71. In the following transition metals, the maximum number of oxidation states are exhibited by: **[4]**

a) chromium (Z = 24) b) manganese (Z = 25)

c) titanium (Z = 22) d) iron (Z = 26)

72. Pure N_2 is not produced when: **[4]**

a) $Ba(N_3)_2 \xrightarrow{\Delta}$

b) $NaN_3 \xrightarrow{\Delta}$

c) $Ba(N_5)_4 \xrightarrow{\Delta}$

d) Red hot $CuO + NH_3 \xrightarrow{\Delta}$

73. Magnetic moment 2.83 BM is given by which of the following ions? **[4]**
(At. no's. Ti = 22, Cr = 24, Mn = 25, Ni = 28)

a) Ni^{2+}

b) Mn^{2+}

c) Cr^{3+}

d) Ti^{3+}

74. Geometrical isomerism can be shown by: **[4]**

a) $[PtCl_4I_2]$

b) $[Ag(NH_3)(CN)]$

c) $Na_2[Cd(NO_2)_4]$

d) $[Pt(NH_3)_3Cl][Au(CN)_4]$

75. In which of the following metal carbonyls the C—O bond order is lowest? **[4]**

a) $[Cr(CO)_6]$

b) $[Ti(CO)_6]^{2-}$

c) $[V(CO)_6]^{-}$

d) $[Mn(CO)_6]^{+}$

76. In the following halogenated organic compounds the one with maximum number of chlorine atoms in its structure is: **[4]**

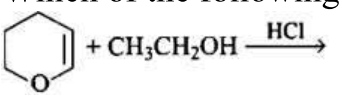
a) Chloral

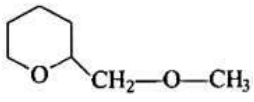
b) Freon-12

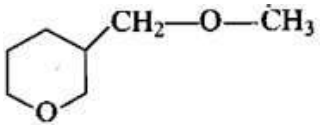
c) Chloropicrin

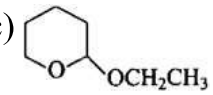
d) Gammaxene

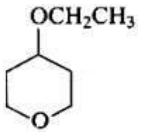
77. Which of the following is correct? **[4]**



a) 

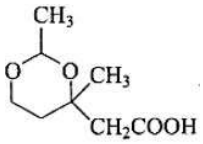
b) 

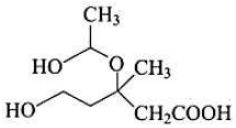
c) 

d) 

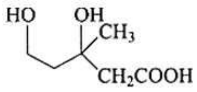
78. What would be the product of following reaction? **[4]**

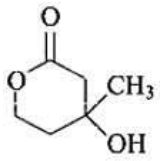
$$\xrightarrow[H_2O]{H^{\oplus}}$$



a) 

b) None of these

c) 

d) 

$$\xrightarrow[523K]{POCl_3}$$ **[4]**

79. A → B → Cyanoethane

C_5H_5N

Predict A.

a) N-Ethylformamide

b) Ethanoic acid

c) Ethanamide

d) Acetaldoxime

80. Which is not true for arginine? **[4]**

a) It is a crystalline solid.

b) It has a fairly high melting point.

c) It is associated with more than one pK_a values.

d) It has high solubility in benzene.

81. Which of the vitamins given below is water-soluble? **[4]**

a) Vitamin E

b) Vitamin C

c) Vitamin K

d) Vitamin D

82. Find out strongest acid among the following: **[4]**

a) $H_2N-\overset{\overset{\oplus}{||}}{C}-NH_2$

b) 

c) $CH_3-\overset{\oplus}{N}H_3$

d) $C_6H_5-\overset{\oplus}{N}H_3$

83. How many faraday are needed to reduce a mole of $MnO4^{-}$ to Mn^{2+}? **[4]**

a) 4 b) 3

c) 2 d) 5

84. When a solid vapourize directly without melting, the process is called **[4]**

a) Sublimation b) Saponification

c) Evaporation d) Sedimentation

85. Aqueous solution of salt **A** gives white ppt (B) on treatment with dil.HCI. Compound (B) dissolves in hot water and the solution gives yellow ppt. (C) on treatment with K_2CrO_4 solution. Salt (A) gives brown fumes on heating with H_2SO_4. **[4]**
Identify (A), (B), and (C) respectively.

a) $Pb(NO_3)_2$, $PbCl_2$, PbO b) $PbSO_4$, $PbCl_2$, $PbCrO_4$

c) $Pb(NO_3)_2$, $PbCl_2$, $PbCrO_4$ d) $PbCl_2$, Pb_5, $PbCrO_4$

CHEMISTRY (Section-B)

Attempt any 10 questions

86. Out of all halides of caesium (Cs^{+}): **[4]**

a) CsF has maximum lattice energy b) CsF has minimum covalent character

c) all are correct

d) CsI has maximum covalent character

87. Which of the following is not correct about the reaction in $VO + Fe_2O_3 \rightarrow FeO + V_2O_5$ **[4]**

a) V changes from + 2 to + 5 state

b) V is reduced to + 5 state

c) Fe is reduced to + 2 state

d) Stoichiometric balanced form coefficient of VO and Fe_2O_3 are 2 and 3 respectively.

88. The most stable dihalide is _____. **[4]**

a) $GeCl_2$

b) $PbCl_2$

c) $SnCl_2$

d) $SiCl_2$

89. The electronegativities of the following elements, H, O, F, S and Cl increase in the order: **[4]**

a) H < O < F < S < Cl

b) S < H < Cl < O < F

c) H < S < Cl < O < F

d) H < S < O < Cl < F

90. An ion with 3 units of negative charge has 54 electrons. If the mass number is 122, then the number of neutrons is _____. **[4]**

a) 39.2% more than the number of electrons.

b) 39.2% more than the number of protons.

c) 31.4% more than the number of protons.

d) 31.4% less than the number of electrons.

91. Which one of the following elements is unable to form MF_6^{3-} ion? **[4]**

a) AI

b) In

c) B

d) Ga

92. Which of the following elementary reaction is not a biomolecular reaction? **[4]**

a) $PCl_3 + Cl_2 \rightarrow PCl_5$

b) $H_2 + I_2 \rightarrow 2HI$

c) $2HCl \rightarrow H_2 + Cl_2$

d) $N_2O_5 \rightarrow N_2O_4 + \frac{1}{2}O_2$

93. A button cell used in watches functions as following, **[4]**

$Zn(s) + Ag_2O(s) + H_2O(l) \rightleftharpoons 2Ag(s) + 2Zn^{2+}(aq) + 2OH^-(aq)$

If half cell potentials are,

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$; $E^o = -0.76$ V

$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq) + 2OH^-(aq)$; $E^o = 0.34$ V

The cell potential will be:

a) 0.84 V

b) 1.34 V

c) 1.10 V

d) 0.42 V

94. Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have the highest $E^0_{M^{3+}/M^{2+}}$ value? **[4]**

a) Fe (Z = 26)

b) Mn (Z = 25)

c) Cr (Z = 24)

d) Co (Z = 27)

95. The activation energy of a reaction is zero. The rate constant of reaction: **[4]**

a) increases with increase of temperature

b) independent of temperature

c) decreases with decrease of temperature

d) decreases with increase of temperature

96. Inert gases have positive electron gain enthalpy. Its correct order is **[4]**

a) Xe < Kr < Ne < He

b) He < Xe < Kr < Ne

c) He < Ne < Kr < Xe

d) He < Kr < Xe < Ne

97. Chlorine water on standing loses its colour and forms: **[4]**

a) HCl and HOCl

b) HCl and $HClO_2$

c) HOCl and $HOCl_2$

d) HCl only

98. Highest oxidation state of Mn is exhibited in Mn_2O_7. The correct statements about Mn_2O_7 are. **[4]**

A. Mn is tetrahedrally surrounded by oxygen atoms.
B. Mn is octahedrally surrounded by oxygen atoms.
C. Contains Mn-O-Mn bridge.
D. Contains Mn-Mn bond.

a) B and C only
b) A and C only
c) A and D only
d) B and D only

99. The coordination number and oxidation state of Cr in $K_3Cr(C_2O_4)_3$ are respectively: **[4]**

a) 3 and +3
b) 3 and 0
c) 6 and + 3
d) 4 and + 2

$LiAlH_4$ $Fe/conc.HCl$ **[4]**

100. $P_1 \leftarrow C_6H_5NO_2 \rightarrow P_2$

dry ether

Predict P_1 and P_2.

a) $P_1 = C_6H_5 - CH_2 - NH_2$
$P_2 = C_6H_5N_2{}^+Cl^-$

b) $P_1 = C_6H_5 - NO$
$P_2 = C_6H_5 - N = N - C_6H_5$

c) $P_1 = C_6H_5 - N = N - C_6H_5$
$P_2 = C_6H_5 - NH_2$

d) $C_6H_5 - CH = N - OH$
$P_2 = C_6H_5 - NH_2$

BOTANY (Section-A)

101. Which of the following ranks contain organisms least similar to one another? **[4]**

a) Genus
b) Class
c) Species
d) Family

102. Which of the following organism do not reproduce? **[4]**

a) Infertile human
b) Worker bees
c) All of these
d) Mules

103. What is true for cyanobacteria? **[4]**

a) oxygenic with nitrogenase

b) non-oxygenic without nitrogenase

c) oxygen without nitrogenase

d) non-oxygenic with nitrogenase

104. Rickettsia is: **[4]**

a) Virus

b) Micro-organism

c) Bacteria

d) PPLO

105. Match the items given in column I with those given in column II and choose the correct option given below. **[4]**

Column I	Column II
(A) Tapetum	(i) Oxalis and Commelina
(B) Chasmogamous flowers	(ii) Allogamy
(C) Hydrophily	(iii) Nourishes the developing pollen grains.
(D) Xenogamy	(iv) Zostera

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

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

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

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

106. Sporophyte of bryophyte are: **[4]**

a) Attached to the photosynthetic gametophyte

b) Both (Attached to the photosynthetic gametophyte) and (Derives nourishment from gametophyte) are correct

c) Free-living

d) Derives nourishment from gametophyte

107. The basis of karyotaxonomy is : **[4]**

a) Chromosome banding

b) Sedimentation rate of ribosomes

c) Chromosome number

d) Number of nucleoli

108. Male gametophyte with least number of cells is present in: **[4]**

a) Pteris

b) Pinus

c) Funaria

d) Lilium

109. Malacophily is the name given to pollination by: **[4]**

a) Animal
b) Bat
c) Snail
d) Birds

110. Which of the following statements is incorrect about sclereids (stone cells)? **[4]**

a) Different shape
b) Commonly found in the fruits like, wallnuts, seed coats of legumes and leaves of tea
c) Highly thickened and lignified cell wall and lumen is narrow
d) They are types of parenchyma

111. Division of meristem into apical, intercalary and lateral are based on **[4]**

a) function
b) development
c) origin
d) position

112. Casparian strips occur in: **[4]**

a) Endodermis
b) Epidermis
c) Cortex
d) Pericycle

113. Genotype of hybrid is determined by: **[4]**

a) Crossing one F, progeny with another F progeny
b) Crossing one F, progeny with recessive parent
c) Crossing one F_2 progency with female parent
d) Crossing one F_2 progeny with male parent

114. The genes, which are confined to differential region of Y-chromosome only, are called **[4]**

a) Sex-linked
b) Mutant
c) Holandric
d) Autosomal

115. What would be the base sequence of RNA transcript obtained from the given DNA segment? **[4]**
5' - GCATTCGGCTAGTAAC - 3'Coding strand of DNA
3' - CGTAAGCCGATCATTG - 5'- Non-coding strand of DNA

a) 5' - GCAUUCGGCUAGUAAC - 3'
b) 5' - GCATTCGGCTAGTAAC - 3'

c) 5' - CGUAAGCCGAUCAUUG - 3'

d) 3' - CGTAAGCC6ATCATTG - 5'

116. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids? **[4]**

a) 64

b) 20

c) 60

d) 61

117. Two cells are connected by the help of: **[4]**

a) Plasmodesmata

b) Cell wall

c) Plasma membrane

d) Plasma cell

118. In germinating seeds fatty acids are degraded exclusively in the: **[4]**

a) Mitochondria

b) Peroxisome

c) Proplastids

d) Glyoxysomes

119. Which of the following disease is now considered nearly eradicated from India? **[4]**

a) Plague

b) Chicken pox

c) Smallpox

d) Kala azar

120. A person suffering from leukaemia has **[4]**

a) tumours in adipose tissue.

b) increased number of plasma cells.

c) increased number of WBCs.

d) increased number of melanocytes.

121. The mandatory combination responsible for assembly of microtubules are **[4]**

a) Cl^- and Ca^{2+}

b) Na^+ and K^+

c) Mg^{2+} and Ca^{2+}

d) Na^+ and Ca^{2+}

122. Savannahs are: **[4]**

a) Desert

b) Dense forest with close canopy

c) Grassland with scattered trees

d) Tropical rain forest

123. In an ecosystem: **[4]**

a) Primary consumers are least depend on primary producers.

b) Primary consumers are larger than primary producers.

c) Primary producers are more than primary consumers.

d) Secondary consumers are larger than primary.

124. Saccharomyces cervisiae is: **[4]**

a) Eukaryote

b) Prokaryote

c) cryptophyte

d) Algae

125. Which of the following is the most serious threat to biodiversity? **[4]**

a) Competition from exotic species

b) Over exploitation

c) Commercial harvesting

d) Habitat loss

126. Species diversity increase as one proceeds from **[4]**

a) high altitude to low altitude and low latitude to high latitude.

b) high altitude to low altitude and high latitude to low latitude.

c) low altitude to high altitude and high latitude to low latitude.

d) low altitude to high altitude and low latitude to high latitude.

127. How many Biodiversity hot spots in the world have been proposed for intensive conservation efforts? **[4]**

a) 40

b) 15

c) 34

d) 27

128. Beaded structure on chromosomes in leptotene are: **[4]**

a) Centromere

b) Centrosome

c) Chromomeres

d) Genes

129. Identify the stage when homologous chromosomes separate but sister chromatids remain associated. **[4]**

a) Metaphase - I

b) Anaphase - I

c) Anaphase - II

d) Metaphase - II

130. The molecule that acts as the source of CO_2 for Calvin cycle in C4 plants is **[4]**

a) OAA

b) Malic acid

c) RuBP

d) Phosphoglyceric acid

131. Which of the following is the first substance that a green plant synthesises during photosynthesis? **[4]**

a) A simple sugar

b) Starch

c) Protein

d) Fat

132. Impure air is purified in the presence of light and green plants was first said by: **[4]**

a) Jan Ingen-Housz

b) Priestley

c) Van Helmont

d) De Saussur

133. Carbon dioxide is necessary for photosynthesis. The chemical used to remove this gas most effectively from entering a control apparatus is **[4]**

a) Sodium carbonate

b) Calcium oxide

c) Distilled water

d) Potassium hydroxide solution

134. Among the following, identify the substrate required for the only oxidative reaction that occurs in the process of glycolysis. **[4]**

a) 3 - phosphoglyceric acid

b) Glyceraldehyde - 3 - phosphate

c) Fructose - 6 - phosphate

d) Glucose - 6 - phosphate

135. Read the following statements and choose the correct set from the options given below. **[4]**

i. Kinetin is a degradative substance from DNA.

ii. ABA is present in all plants including lower plants,

iii. Low ratio of cytokinin to auxin favours root formation only.

iv. ABA is synthesised catabolically through glycolytic pathway.

a) (i) and (iii)

b) (iii) and (iv)

c) (ii) and (iii)

d) (i) and (ii)

BOTANY (Section-B)

Attempt any 10 questions

136. Which of the following is correct for Mangifera indica Linn? **[4]**

a) This species was first described by Linnaeus

b) None of these

c) Name of mango was changed by Linnaeus

d) This species was not first described by Linnaeus

137. Deuteromycetes is known as fungi imperfecti because **[4]**

a) They are not autotrophic

b) Only asexual phases are known

c) Mycelium is aseptate

d) They undergo meroblastic and holoblastic cleavage in their cell cycle

138. The stems are branched in: **[4]**

a) Pinus

b) Cycas

c) Cedrus

d) Both Cedrus and Pinus

139. In which type of flowers, stigma is rough and sticky? **[4]**

a) Wind pollinated

b) All of these

c) Insect pollinated

d) Water pollinated

140. In some plants, thalamus contributes to fruit formation. Such fruits are termed as **[4]**

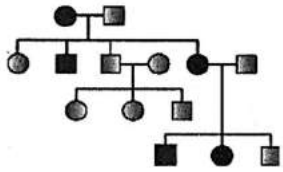
a) aggregate fruits

b) false fruits

c) parthenocarpic fruit

d) true fruits

141. The given pedigree chart shows the inheritance of which of the following mendelian disorder? **[4]**



A. Sex linked dominant trait

B. Autosomal dominant trait

C. Sex linked recessive trait

D. Autosomal recessive trait

a) (D)

b) (C)

c) (A)

d) (B)

142. That, DNA is present in the chromosome, was demonstrated by staining them with: **[4]**

a) Feulgen
b) Haematoxylin
c) Carmine
d) Fuchsin

143. Choose the wrong statement for mitochondria. **[4]**

i. Each mitochondrion is a double membrane-bound structure.
ii. The inner compartment is called the matrix.
iii. The outer membrane forms the continuous limiting boundary of the organelle.
iv. The inner membrane forms a number of infoldings called the cristae.
v. They produce cellular energy in the form of ATP, hence they are called 'power houses' of the cell.
vi. The matrix also possesses many circular DNA molecule, a few RNA molecules, ribosomes (70S) and the components required for the synthesis of carbohydrates.

a) Only (iii)
b) (iv) and (vi)
c) Only (vi)
d) (ii) and (iii)

144. Which of the following is a rod-shaped virus? **[4]**

a) CMV
b) TMV
c) Bacteriophage
d) All of these

145. Pyruvic acid is produced at the end of: **[4]**

a) Calvin cycle
b) Photo-respiration
c) Krebs' cycle
d) Glycolysis

146. The nutritive medium for growing bacteria and many fungi in the laboratory is called **[4]**

a) fermentation media
b) growth media
c) culture media
d) baking media

147. Mr. X is eating curd/yoghurt. For this food intake in a food chain he should be considered as occupying **[4]**

a) First trophic level
b) Fourth trophic level
c) Third trophic level
d) Second trophic level

148. Choose the correct option from given statement: **[4]**

a) All of these

b) One single maize root apical meristem can give rise to more than 17,500 new cells per hour, this growth is expressed as an increase in cell number.

c) The growth of a pollen tube is measured in terms of its length, an increase in surface area denotes the growth in a dorsiventral leaf.

d) Whereas cells in watermelon may increase in size by upto 3,50,000 times, this growth expresses an increase in the size of the cell.

149. Cut or excised leaves remain green for long if induced to root or dipped in **[4]**

a) auxins

b) gibberellins

c) cytokinins

d) ethylene

150. In one of the following plant types both PEP carboxylase and RuBP carboxylase are present in the cell chloroplast: **[4]**

a) CAM

b) C_4

c) CAM and C_4

d) C_3

ZOOLOGY (Section-A)

151. Polyesters mammal is: **[4]**

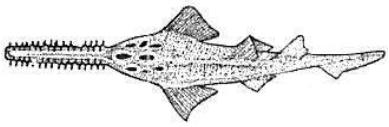
a) Man

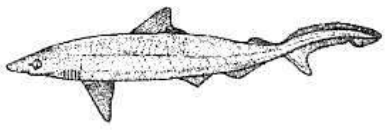
b) Cat

c) Rabbit

d) Dog

152. Which of the following option is correct for given diagram regarding their class and character? **[4]**

I. Pristis 

II. Scoliodon 

a) I- Saw fish - Osteichthyes, II- Dog fish - Chondrichthyes

b) I- Saw fish - Chondrichthyes, II- Dog fish - Chondrichthyes

c) I- Sting ray- Chondrichthyes, II- Dog fish - Chondrichthyes

d) I- Great white shark - Osteichthyes, II- Saw fish - Osteichthyes

153. In contrast to Annelids the Platyhelminthes show: **[4]**

a) Absence of body cavity
b) Radial symmetry
c) Presence of pseudocoel
d) Bilateral symmetry

154. Which one of the following contains the largest quantity of extracellular material? **[4]**

a) Areolar tissue
b) Myelinated nerve fibers
c) Striated muscle
d) Stratified epithelium

155. Which of the following is considered as a unit of the neural system? **[4]**

a) Axon
b) Neurons
c) Dendron
d) Neuroglia

156. Match the columns and find correct combination: **[4]**

(A) Earthworm	(i) Pulmonary
(B) Human	(ii) Gills
(C) Prawn	(iii) Tracheal
(D) Insects	(iv) Cutaneous

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

157. Match the column I (organs) with column II (functions) and choose the correct option. **[4]**

Column I (Organs)	**Column II (Functions)**
A Nose	(i) stops food from going down into lungs.
B Epiglottis	(ii) produces sound.
C Pharynx	(iii) traps bacteria as well as dust.
D Larynx	(iv) allows air to pass from nose to oesophagus.

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

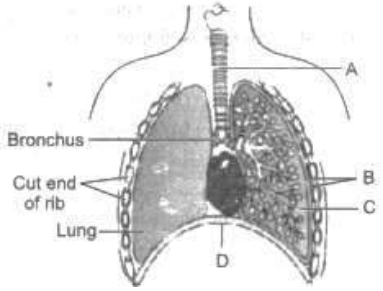
158. Bulk of oxygen diffuses from the plasma into the red blood corpuscles where it joins loosely with Fe^{2+} ions of hemoglobin (Hb) to form bright red oxyhemoglobin (HbO_2). The process is called **[4]**

a) dehydrogenation
b) oxidation
c) oxygenation
d) hydration

159. The partial pressures (in mm Hg) of oxygen (O_2) and carbon dioxide (CO_2) at alveoli (the site of diffusion) are **[4]**

a) $pO_2 = 159$ and $pCO_2 = 0.3$
b) $pO_2 = 104$ and $pCO_2 = 40$
c) $pO_2 = 40$ and $pCO_2 = 45$
d) $pO_2 = 95$ and $pCO_2 = 40$

160. The figure shows a diagrammatic view of the human respiratory system with labels A, B, C, and D. Select the option which gives correct identification and main function and/or characteristic. **[4]**



a) B-pleural membrane - surround ribs on both sides to provide cushion against rubbing
b) D-Lower end of lungs - diaphragm pulls it down during inspiration
c) A-trachea - long tube supported by complete cartilaginous rings for conducting inspired air
d) C-Alveoli - thin walled vascular bag like structures for exchange of gases

161. During cleavage, what is true about embryo? **[4]**

a) Size does not increase
b) The division is like meiosis
c) These is less consumption of oxygen
d) Nucleocytoplasmic ratio remains unchanged

162. Which of the following statements is false for uterus? **[4]**

a. It opens into oviducts through cervix whose cavity is called cervical canal.
b. Its wall has three layers, outer perimetriwn, middle myometriwn, and inner endometriwn.

c. It is also called womb and its shape is like an inverted pear.

d. It is supported by ligaments attached to the pelvic wall.

a) Statement (b) is false.

b) Statement (c) is false.

c) Statement (d) is false.

d) Statement (a) is false.

163. Chorionic gonadotropin is secreted by: **[4]**

a) Thymus

b) Pituitary

c) Ovary

d) Placenta

164. Artificial insemination means: **[4]**

a) Introduction of sperms of a healthy donor directly into the ovary

b) Transfer of sperms of a healthy donor to a test tube containing ova

c) Artificial introduction of sperms of a healthy donor into the vagina

d) Transfer of sperms of husband to a test tube containing ova.

165. Select the incorrect statements regarding in vitro fertilisation. **[4]**

i. In this method, ova from the donor female and sperms from the donor male are induced to form zygote in the uterus.

ii. Embryo with 2 blastomeres is transferred into the uterus.

iii. Embryo with more than 8 blastomeres is transferred into the uterus.

iv. The baby thus produced is called test tube baby.

a) (ii) and (iii)

b) (i) and (ii)

c) (iii) and (iv)

d) (i) and (iv)

166. Light coloured Peppered Moth/Biston betularia gets changed to its darker carbonaria variety due to: **[4]**

a) Deletion of gene segment due to industrial pollution

b) Mutation of single Mendelian gene for survival in smoke-laden Industrial environment

c) Industrial carbon deposited on wings

d) Translocation of block of genes in response to heavy carbons

167. The cranial capacity of modern man is: **[4]**

a) 350-400 cc

b) 500-1000 cc

c) 1350-1700 cc

d) 1350-1500 cc

168. Human urine as compared to human blood is normally: **[4]**

a) Hypotonic

b) Isotonic

c) All of these

d) Hypertonic

169. The increase in osmolarity from outer to inner medullary interstitium is maintained due to **[4]**

i. close proximity between Henle's loop and vasa recta.

ii. counter current mechanism.

iii. selective secretion of HCO_3^- and hydrogen ions in PCT.

iv. higher blood pressure in glomerular capillaries.

a) Only (ii)

b) (i) and (ii)

c) (i), (ii) and (iii)

d) (iii) and (iv)

170. Match the abnormal conditions given in Column A with their explanations given in Column B and Choose the correct option: **[4]**

Column A	Column B
(A) Glycosurea	(i) Accumulation of uric acid in joints
(B) Renal calculi	(ii) Inflammation in glomeruli
(C) Glomerular nephritis	(iii) Mass of crystallised salts within the kidney
(D) Gout	(iv) Presence of glucose in urine

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

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

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

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

171. A synovial joint is found between: **[4]**

a) Two skull bones

b) Two vertebrae

c) Tail vertebrae

d) Humerus and ulna

172. Forearm is rotated to turn palm downward or backwards by muscle: **[4]**

a) Abductor

b) Extensor

c) Adductor

d) Pronator

173. An acromion process is characteristically found in the **[4]**

a) pelvic girdle of mammals.
b) skull of frog
c) pectoral girdle of mammals.
d) sperm of mammals

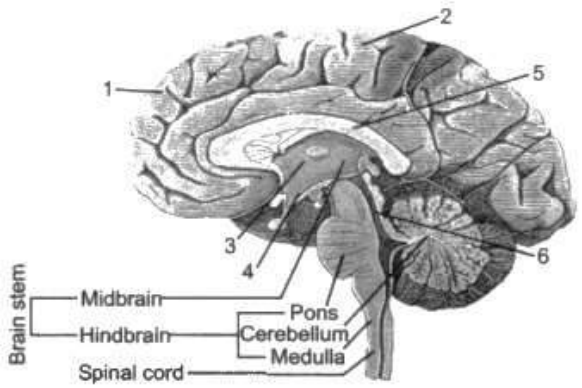
174. The transmission of nerve impulse is a: **[4]**

a) Physical process
b) Chemical-electrical process
c) physical-electrical process
d) Chemical process

175. During stress condition which of the following nerves start working? **[4]**

a) Parasympathetic nerves
b) Autonomic nerves
c) Cranial nerves
d) Sympathetic nerves

176. Identify 2, 3, 5, and 6 respectively in the given structure of the human brain: **[4]**



a) Cerebral hemisphere, Thalamus, corpus callosum and Cerebellum aqueduct
b) Cerebral hemisphere, mid brain, Corpus callosum and Cerebellum aqueduct
c) Cerebrum, Thalamus, corpus callosum and Cerebral aqueduct
d) Cerebral hemisphere, Hypothalamus, Corpus callosum and Cerebellum aqueduct

177. Which is gastrointestinal hormone? **[4]**

a) Cholecystokinin
b) GIP
c) Secretin
d) All of these

178. A man has an less I.Q., this is due to deficiency of which hormone? **[4]**

a) All of these
b) Adrenaline

c) Aldosterone

d) Thyroxine

179. Which of the following set of animals has an incomplete double circulation system? **[4]**

a) Toad and lizard

b) Frog and crocodile

c) Lizard and pigeon

d) Shark and whale

180. Blood coagulation is assisted by : **[4]**

a) Leucocytes

b) Erythrocytes

c) Phagocytes

d) Thrombocytes

181. Rank the following blood vessels in order of their average pressure, from highest to lowest: artery, vein, arteriole, venule, aorta, capillary. **[4]**

a) Capillary > arteriole > venule > artery > vein > aorta

b) Aorta > arteriole > venule > artery > vein > capillary

c) Capillary > vein > venule > arteriole > artery > aorta

d) Aorta > artery > arteriole > capillary > venule > vein

182. The term **molecular scissors** refers to **[4]**

a) Taq polymerase

b) Restriction enzymes

c) recombinant DNA.

d) palindromic nucleotide sequences

183. Which one of the following is used as vector for cloning genes into higher organisms? **[4]**

a) Salmonella typhimurium

b) Baculovirus

c) Retrovirus

d) Rhizopus nigricans

184. Transgenic animal has: **[4]**

a) Foreign DNA in all its cells

b) Foreign DNA in some of the cells

c) Foreign RNA in all its cells

d) Both Foreign RNA in all its cells and Foreign DNA in some of the cells

185. Which step was proved to be the main challenge in the production of human insulin by recombinant DNA technology? **[4]**

a) Addition of C - peptide to proinsulin

b) Splitting A and B - peptide chain

c) Removal of C - peptide from active insulin

d) Getting insulin assembled into mature form

ZOOLOGY (Section-B)

Attempt any 10 questions

186. 12 pairs of cranial nerves are found in: **[4]**

a) Mammals

b) Birds

c) All of these

d) Reptiles

187. The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in: **[4]**

a) Eustachian tube and Salivary duct

b) Bile duct and Bronchioles

c) Bronchioles and Fallopian tubes

d) Fallopian tubes and Pancreatic duct

188. This type of lymphocyte functions in the immune response by acting directly against virus-infected cells and tumour cells. **[4]**

a) B-cells

b) Monocytes

c) T-cells

d) Neutrophils

189. Dissociation of CO_2 from carbamino-haemoglobin takes place when: **[4]**

a) pCO_2 is equal to pO_2 in tissue, i.e. high

b) Po_2 is low and Pco_2 is high in alveoli

c) pCO_2 is equal to pO_2 in lungs, i.e. low

d) pCO_2 is less in alveoli and pO_2 is less

190. What happens during fertilisation in humans after many sperms reach close to the ovum? **[4]**

a) Only two sperms nearest the ovum penetrate zona pellucida

b) Cells of corona radiata trap all the sperms except one

c) All sperms except the one nearest to the ovum lose their tails

d) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida

191. From the sexually transmitted diseases mentioned below, identify the one which does not specifically affect the sex organs: **[4]**

a) Syphilis
b) Genital warts
c) AIDS
d) Gonorrhea

192. Which of these is a false statement? **[4]**

A. The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
B. The first autotrophic organisms were the chemoautotrophs that never released oxygen.
C. Prokaryotes were started photosynthesis.
D. The primitive atmosphere was more suitable for cynobacteria.

a) (A) and (B)
b) Only (D)
c) (C) and (D)
d) (B) and (D)

193. All of the following are present in sweat except: **[4]**

a) Calcium
b) Urea
c) Lactic acid
d) Uric acid

194. Who propounded the Sliding filament theory for muscles contraction? **[4]**

a) H.E. Huxley and A.F. Huxley
b) A.F. Huxley
c) J. Huxley
d) H.E. Huxley

195. The nerves leading to the central nervous system are called: **[4]**

a) Afferent
b) Efferent
c) Motor
d) thoracic nerves

196. The steroid responsible for the balance of water and electrolytes in our body is: **[4]**

a) Testosterone
b) Insulin
c) Aldosterone
d) Melatonin

197. A child with a weak immune system could have problem in which of the following gland? **[4]**

a) Thymus
b) Parathyroid gland

c) Thyroid gland

d) Pituitary gland

198. Minerals ions presents in blood plasma : **[4]**

a) HCO_3

b) Ca^{++}

c) All of these

d) Na^{+}

199. The most important feature in a plasmid to be used as a vector in gene cloning experiment is : **[4]**

a) Origin of replication (ori)

b) Presence of sites for restriction endonuclease

c) Its size

d) Presence of a selectable marker

200. Match the column A with column B : **[4]**

Column A	Column B
(A) Antigen-antibody interaction	(i) ADA deficiency patient
(B) PCR	(ii) Detaching mutated gene
(C) Recombinant DNA technology	(iii) ELISA
(D) Gene therapy	(iv) Detect HIV in suspected AIDS patients

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

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

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

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

Solution

SAMPLE PAPER - 5

PHYSICS (Section-A)

1. **(a)** $[ML^2T^{-2}A^{-1}]$

   Explanation: $[\phi] = [BA] = \left[\frac{F}{qv}A\right]$

   $= \left[\frac{MLT^{-2}L^2}{ATLT^{-1}}\right] = \left[ML^2T^{-2}A^{-1}\right]$

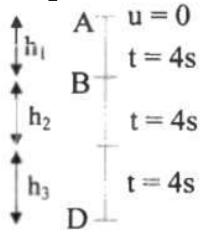
2. **(d)** Radius of gyration

   Explanation: The radius of gyration is not dimensionless.

3. **(b)** $h_2 = 3h_1$ and $h_3 = 5h_1$

   Explanation:

   At point A, u = 0

   $\therefore\ h_1 = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 16$

   $\therefore\ h_1 = 80$ m

   Now, $v = u + gt = 0 + 10(4)$

   $\therefore\ v = 40$ m/s

   At point B, final velocity from A to B = initial velocity at B

   $\therefore\ h_2 = ut + \frac{1}{2}gt^2 = 40 \times 4 + \frac{1}{2} \times 10 \times 16$

   $= 240$ m

   $v = u + gt = 40 + 10(4)$

   $\therefore\ v = 80$ m/s

   Similarly, At point C,

   $h_3 = 400$ m

   $\therefore\ h_1 : h_2 : h_3 = 80 : 240 : 400 = 1 : 3 : 5$

   i.e., $h_2 = 3h_1$ and $h_3 = 5h_1$

4. **(a)** $(\frac{r_1}{r_2})^2$

Explanation: As $T_1 = T_2$

Hence, $\frac{2\pi r}{v_1} = \frac{2\pi r_2}{v_2}$ or $\frac{v_1}{v_2} = \frac{r_1}{r_2}$

$$\frac{F_1}{F_2} = \frac{mv_1^2}{r_1} \times \frac{r_2}{mv_2^2} = \left(\frac{v_1}{v_2}\right)^2 \times \frac{r_2}{\eta} = \left(\frac{r_1}{r_2}\right)^2 \times \frac{r_2}{r_1} = \frac{\eta}{r_2}.$$

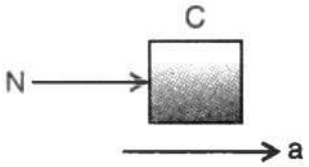
5.

(b) 100 m

Explanation: The velocity is maximum, i.e., equal to initial velocity, when it strikes the ground again, i.e., after covering a distance of 100 m (= Range).

6. **(a)** $\left(\frac{5}{2\mu}\right)mg$

Explanation:



Horizontal acceleration of the system is,

$$a = \frac{F}{2m+m+2m} = \frac{F}{5m}$$

Let N be the normal reaction between B and C.

Free body diagram of C gives

$$N = 2ma = \frac{2}{5}F$$

Now, B will not slide downward if

$\mu N \geq m_B g$

or $\mu\left(\frac{2}{5}F\right) \geq mg$

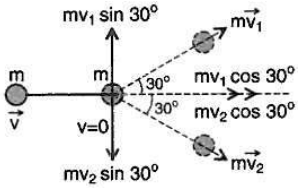
or $F \geq \frac{5}{2\mu}mg$

So, $F_{\min} = \left(\frac{5}{44}\right)mg$

7.

(d) $2\sqrt{3}$ m/sec

Explanation:



Applying the law of conservation of momentum in perpendicular to the initial line of motion,

$0 = mv_1 \sin 30° - mv_2 \sin 30°$

$\therefore\ v_1 = v_2$ ...(i)

Now, along the line of motion,

$m \times v + m \times 0 = mv_1 \cos 30° + mv_2 \cos 30°$ ...(ii)

Putting eqn. (i) in eqn. (ii), $mv = 2mv_1 \cos 30°$

or $m \times 6 = 2 \times m \times v_1 \times \frac{\sqrt{3}}{2}$

or $v_1 = \frac{6}{\sqrt{3}} = 2\sqrt{3}$ m/sec

8. **(a)** 196 J

Explanation: Since the box is moving at a constant speed, the force F is just enough to overcome the force of kinetic friction, i.e., $F = f = \mu mg$.

Therefore, work done is

$W = Fs = \mu mgs = 0.5 \times 10 \times 9.8 \times 4 = 196$ J

9. **(c)** $\frac{1}{\sin\theta}\sqrt{\beta\left(\frac{2h}{g}\right)}$

Explanation: As here acceleration is constant and body starts from rest, so from 2nd equation of translatory motion,

$s = \frac{h}{\sin\theta} = 0 \times t + \frac{1}{2}\frac{g\sin\theta}{\beta}t^2$

$\therefore\quad t = \frac{1}{\sin\theta}\sqrt{\beta\left(\frac{2h}{g}\right)}$

10. **(a)** $T \propto R^{(n+1)/2}$

Explanation: $m\omega^2 R = \text{Force} \propto \frac{1}{R^n}\left(\text{Force} = \frac{mv^2}{R}\right)$

$\Rightarrow \omega^2 \propto \frac{1}{R^{n+1}} \Rightarrow \omega \propto \frac{1}{R^{\frac{n+1}{2}}}$

Time period T = $\frac{2\pi}{\omega}$

Time period, T $\propto$ R$^{\frac{n+1}{2}}$

11. **(a)** $\frac{5}{9}$

Explanation: According to question, $g_h = g_d = g_1$

$g_h = \frac{GM}{\left(R+\frac{R}{2}\right)^2}$ and $g_d = \frac{GM(R-d)}{R^3}$

$\frac{GM}{\left(\frac{3R}{2}\right)^2} = \frac{GM(R-d)}{R^3} \Rightarrow \frac{4}{9} = \frac{(R-d)}{R}$

$\Rightarrow$ 4R = 9R - 9d $\Rightarrow$ 5R = 9d

$\therefore \frac{d}{R} = \frac{5}{9}$

12.

(c) $\frac{L^2\rho g}{2Y}$

Explanation: Weight of the cord, W = Fρg = ALρg

$Stress = \frac{W}{A} = L\rho g$

For the purpose of extension, the weight acts at the centre of gravity of the bar. Hence the upper half length, i.e., $(\frac{L}{2})$ will be stretched.

$\therefore$ Strain $= \frac{l}{(L/2)} = \frac{2l}{L}$

$\therefore Y = \frac{\text{stress}}{\text{strain}} = \frac{L\rho g}{2l/L} = \frac{L^2\rho g}{2l}$

or $l = \frac{L^2\rho g}{2Y}$

13.

(b) 98^{o}C

Explanation: Using, $\frac{100-60}{60-0} = \frac{150-x}{x-20}$

or 40 (x - 20) = 60 (150 - x)

$\therefore$ x = 98^{o}C

14.

(c) The radiation emitted is in the infrared region

Explanation: We know that the human body at all times and at all temperatures, except absolute temperature, emits radiations. We also know that radiations emitted by the human body are in the infrared region.

15.

(b) 99^{o}C

Explanation: 99^{o}C

16.

(b) will be different on the top wall and bottom wall of the vessel

Explanation: As P = $\frac{nRT}{V}$, it remains unaffected by n, R, T and V.

17.

(b) 5 cm

Explanation: Both the SHM have same frequency, with an amplitude of 3 and 4, with a phase difference of 90^{o}

The maximum value of the equation,

x = 3sin(20πt) + 4cos(20πt) is

$\sqrt{3^2 + 4^2}$ = 5 cm

18.

(b) 3.6 $\times$ 10^{-4}

Explanation: Maximum particle velocity = ωA

Wave velocity = $\frac{\omega}{K}$

Required ratio = $\frac{\omega A}{\omega / K}$

= AK

= 60 $\times$ 10^{-6} $\times$ 6

= 3.6 $\times$ 10^{-4}

19.

(c) increases by 0.61 ms^{-1}

Explanation: The increase of pressure does not change the velocity of sound. When the temperature increases by 1^{o}C, the velocity of sound increases roughly by 0.6 m/s. (V_1 = V_0 + 0.6t)

20.

(c) $2\pi\sqrt{\frac{l}{g}}$

Explanation: $2\pi\sqrt{\frac{l}{g}}$

21. **(a)** -18 V
Explanation: -18 V

22. **(a)** $2E\left(1-\frac{2}{n}\right)$

Explanation: Current in the circuit will be,

$I = \frac{(n-4)E}{nr}$

Hence, potential difference across A and B is,

$V = E + Ir = E + \frac{(n-4)E}{nr} \cdot r = 2E\left(1-\frac{2}{n}\right)$

23.

(d) protons with speed $\frac{|\vec{E}|}{|\vec{B}|}$ will pass through the slit, electrons of the same speed will not

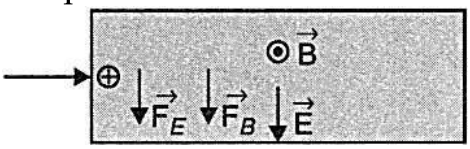
Explanation:

A charge q moving with velocity $\vec{v}$ in presence of both electric field $\vec{E}$ and magnetic field $\vec{B}$ experiences a Lorentz force and is given by

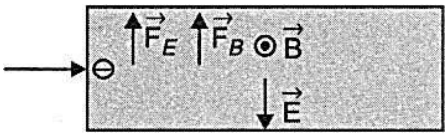
$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B}) = \vec{F}_E + \vec{F}_B$

If the total force $\vec{F}$ on the charge is zero, the charge will move in the fields undeflected.

For proton



For electron



24. **(a)** east-west
Explanation: In tan B position, the magnet will be parallel to the arms of the magnetometer and will be in an east-west direction

25.

(b) repelled by both the poles
Explanation: A diamagnet is always repelled by a magnetic field. Therefore, it is repelled by both the north-pole as well as south-pole.

26.

(b) 5 A

Explanation: $I = \frac{e_1 - e_2}{R} = \frac{220 - 210}{R} = \frac{10}{2} = 5A$

27. **(a)** $\frac{1}{(2x - a)(2x + a)}$

Explanation: Induced emf = $B_1vl - B_2vl$

$$= \frac{\mu_0 I}{2\pi\left(x - \frac{a}{2}\right)} lv - \frac{\mu_0 I}{2\pi\left(x + \frac{a}{2}\right)} lv$$

$$= \frac{\mu_0 Ilv}{\pi(2x - a)} - \frac{\mu_0 Ilv}{\pi(2x + a)}$$

$$= \frac{\mu_0 Ilv(2a)}{(2x - a)(2x + a)}$$

Hence, induced emf = $\frac{1}{(2x - a)(2x + a)}$

28.

(b) 450 V, 15 A

Explanation: Power output = $\frac{90}{100} \times$ 3 kW = 2.7 kW

$I_S = 6A$

$V_S = \frac{2.7\text{ kW}}{6\text{ A}} = \frac{2700\text{ W}}{6\text{ A}} = 450\text{ W}$

$I_P = \frac{3\text{ kW}}{200\text{ V}} = \frac{3000\text{ W}}{200\text{ V}} = 15\text{ A}$

29.

(d) $E_0q\,(0.8\hat{i} + \hat{j} + 0.2\hat{k})$

Explanation: Given: $\vec{E}_1 = E_0\hat{j}\cos(\omega t - kx)$

i.e., Travelling in + ve x-direction $\vec{E} \times \vec{B}$ should be in x-direction

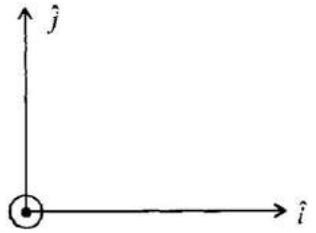
$\therefore$ $\vec{B}$is in $\vec{K}$

$\therefore \quad = \frac{E_0}{C}\cos(\omega t - kx)\hat{k} \left(\because B_0 = \frac{E_0}{C} \right)$

$\vec{E}_2 = E_0\hat{k}\cos(\omega t - ky)$

$\vec{B}_2 = \frac{E_0}{C}\hat{i}\cos(\omega t - ky)$

$\therefore$ Travelling in + ve y-axis $\vec{E} \times \vec{B}$ should be in y-axis



$\therefore$ Net force $\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})\hat{k}$

$q\left(\vec{E}_1 + \vec{E}_2\right) + q\left(0.8c\hat{j} \times \left(\vec{B}_1 + \vec{B}_2\right)\right.$

If t = 0 and x = y = 0

$\vec{E}_1 = E_0\hat{j}, \vec{E}_2 = \boldsymbol{E_0\hat{k}}, \boldsymbol{\vec{B}_1 = \frac{E_0}{c}\hat{k}}$ **and** $\boldsymbol{\vec{B}_2 = \frac{E_0}{c}\hat{i}}$

$\therefore \vec{F}_{\text{net}} = qE_0(\hat{j} + \hat{k}) + q \times 0.8c \times \frac{E_0}{c}\hat{j} \times (\hat{k} + \hat{i})$

$= qE_0(\hat{j} + \hat{k}) + 0.8qE_0(\hat{i} - \hat{k}) = qE_0(0.8\hat{i} + \hat{j} + 0.2\hat{k})$

30. **(a)** -48

Explanation: Magnifying power, $M = \frac{f_o}{f_e}\left(1 + \frac{f_e}{d}\right)$

Least distance of distinct vision, d = 25 cm

$M = -\frac{200}{5}\left(1 + \frac{5}{25}\right) = -40\left(1 + \frac{1}{5}\right)$

$= -40\left(\frac{6}{5}\right) = -48$ cm

31.

(c) 0.02

Explanation: For the first minimum, $a\sin\theta = \lambda$

where, a = width of slit

$\therefore \quad a = \frac{\lambda}{\sin\theta} = \frac{6980 \times 10^{-10}}{\sin 2^\circ} = 2 \times 10^{-5}$ m = 0.02 mm

32.

(d) Photocell

Explanation: Photocell

33. **(a)** 19.86×10^{-20}

Explanation: $\lambda_0 = 250$ nm $= 250 \times 10^{-9}$ m

$\lambda = 200$ nm $= 200 \times 10^{-9}$ m

$E = \frac{1}{2} mv^2 = hv - hv_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$

$= hc \left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$

$= 6.62 \times 10^{-34} \times 3 \times 10^8 \times \left[\frac{1}{200} - \frac{1}{250}\right] \times \frac{1}{10^{-9}}$

$\therefore$ $E = 19.86 \times 10^{-20}$ J

34. **(a)** 5 : 9

Explanation: Shortest wavelength

$n_1 = 2$

$n_2 = \infty$

$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - 0\right)$

$\lambda_1 = \frac{4}{R}$

Largest wavelength

$n_1 = 2$

$n_2 = 3$

$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$\lambda_2 = \frac{5}{36R}$

Ratio $= \frac{5}{9}$

35. **(a)** 40 min

Explanation: According to radioactive decay

$N = N_0 e^{-\lambda t}$ where,

N_0 = Number of redioactive nuclei present in the sample at t = 0

N = Number of radioactive nuclei left undecayed after time t

λ = decay constant

For 20% decay

$\frac{80N_0}{100} = N_0 e^{-\lambda t_1}$ ...(i)

For 80% decay

$\frac{20N_0}{100} = N_0 e^{-\lambda t_2}$ ...(ii)

Dividing equation (i) by (ii), we get

$4 = e^{-\lambda\left(t_1 - t_2\right)}$

$\Rightarrow 4 = e^{\lambda\left(t_2 - t_1\right)}$

Taking natural logarithms of both sides, we get

$\text{In } 4 = \lambda(t_2 - t_1)$

$2 \text{ In } 2 = \frac{\ln 2}{T\frac{1}{2}}\left(t_2 - t_1\right)$

$t_2 - t_1 = 2 \times T\frac{1}{2} = 2 \times 20 \text{ min} = 40 \text{ min}$

PHYSICS (Section-B)

36. **(a)** $\frac{F}{\sqrt{mk}}$

Explanation: Maximum speed is at mean position or equilibrium. At equilibrium Position,

$F = kx \Rightarrow x = \frac{F}{k}$

From work-energy theorem,

$W_F + W_{sp} = \Delta KE$

$F(x) - \frac{1}{2}kx^2 = \frac{1}{2}mv^2 - 0$

$F\left(\frac{F}{k}\right) - \frac{1}{2}k\left(\frac{F}{k}\right)^2 = \frac{1}{2}mv^2 \Rightarrow \frac{1}{2}\frac{F^2}{K} = \frac{1}{2}mv^2$

or, $v_{max} = \frac{F}{\sqrt{mk}}$

37. **(a)** 5 : 7

Explanation: $\frac{(\text{K.E.})_{\text{linear}}}{(\text{K.E.})_{\text{rolling}}} = \frac{1}{1 + \frac{K^2}{R^2}}$

$$= \frac{1}{1+\frac{2}{5}} \ldots \left[\left(\frac{K^2}{R^2}\right)_{solid} = \frac{2}{5}\right]$$

$$= \frac{5}{7}$$

38.

(b) $\frac{2\pi}{3600}\sqrt{\frac{R}{g}}$

Explanation: Given that weight of a body at the equator is zero. It implies that acceleration due to gravity at the equator is zero.

$\therefore \quad g' = g - \omega^2 R = 0$ or $\omega = \sqrt{\frac{g}{R}}$

Number of hours in a day

$$= \frac{2\pi}{\omega \times 60 \times 60}$$

$$= \frac{2\pi}{\sqrt{g/R} \times 3600}$$

$$= \frac{2\pi}{3600}\sqrt{\frac{R}{g}}$$

39. **(a)** 320 Kcal/m^2 -min

Explanation: $E = \sigma T^4 = 20$

$T' = 2T$

$E' = \sigma (2T)^4 = 16\ \sigma T^4$

$= 16 \times 20 = 320$ Kcal/m^2 -min

40.

(b) 500 Hz

Explanation: $\lambda = 2\ (x_2 - x_1) = 2\ (0.84 - 0.50) = 0.68$

$n = \frac{v}{\lambda} = \frac{340}{0.68} = 500$ Hz

41.

(c) The wave C lags behind by a phase angle of $\pi/2$ and the wave B is ahead by a phase angle of $\pi/2$

Explanation: It is clear from figure that the wave A attains its mean position T/4 times earlier than C, i.e., C lags behind A by phase angle $\pi/2$. Further, B attains the mean position T/4 times earlier than A, i.e., B is ahead by a phase angle of $\pi/2$.

42.

(b) $N^2 : n^2$

Explanation: We have,

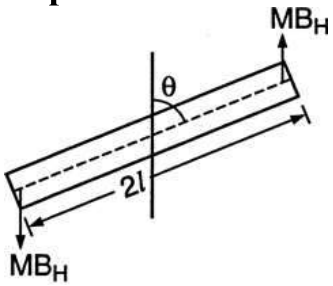
$B_1 = \frac{N\mu_0 I}{2r_1}$ and $B_2 = \frac{n\mu_0 I}{2r_2}$

Now, $N \times 2\pi r_1 = n \times 2\pi r_2 \Rightarrow Nr_1 = nr_2 \Rightarrow \frac{r_2}{r_1} = \frac{N}{n}$

So, $\frac{B_1}{B_2} = \frac{Nr_2}{r_1 n} = \frac{N}{n}\left(\frac{r_2}{r_1}\right) = \frac{N^2}{n^2}$

43. **(a)** $\frac{MB_H\theta}{I}$

Explanation:



$\tau = -2mB_H I\sin\theta$

$= -MB_H \sin\theta$

If θ is small, $\sin\theta \approx \theta$

$I\alpha = -MB_H\theta$

$|\alpha| = \frac{MB_H\theta}{I}$

44.

(d) $2\pi rB(\frac{dr}{dt})$

Explanation: If the radius is r at a time t, then the instantaneous magnetic flux ϕ is given by:

$\phi = \pi r^2 B$

Now, induced emf e is given by:

$e = -\frac{d\phi}{dt} = -\frac{d}{dt}\left(\pi r^2 B\right)$

$= -\pi B\left(2r\frac{dr}{dt}\right) = -2\pi Br\left(\frac{dr}{dt}\right)$

Induced emf $2\pi rB(\frac{dr}{dt})$ numerically as $(\frac{dr}{dt})$ is negative.

45.

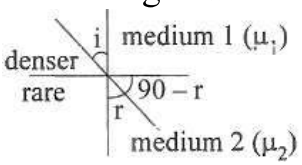
(c) 2.5434

Explanation: 2.5434

46. **(a)** its wavelength increases but the frequency remain unchanged

Explanation:

According to Snell's law



$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2} = \frac{\mu_2}{\mu_1}$$

From figure we see that,

r > i

$\Rightarrow v_2 > v_1$

from Snell's Law,

So, $v_2 = n\lambda_2 > v_1 = n\lambda_1$

$\Rightarrow \lambda_2 > \lambda_1$ (Frequency of wave does not change on reflection)

47.

(b) 1.3

Explanation: Given, μ = refractive index of the liquid.

From the figure, it is itself clear that, angle of incidence, $i = 60^o$

Now, for internal reflection, angle of refraction $r = 90^o$

Now, $\frac{\sin i}{\sin r} = \frac{\mu}{\mu_1}$

$\Rightarrow \sin 60° = \frac{\mu}{1.5}$

$\Rightarrow \mu = \frac{\sqrt{3}}{2} \times 1.5$

$\Rightarrow \mu = 1.3$

48.

(b) $\lambda_\alpha < \lambda_p = \lambda_n < \lambda_e$

Explanation: Kinetic energy of particle,

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

or $mv = \sqrt{2mK}$

de Broglie wavelength, $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mK}}$

For the given value of K, $\lambda \propto \frac{1}{\sqrt{m}}$

$\therefore \quad \lambda_p : \lambda_n : \lambda_e : \lambda_\alpha = \frac{1}{\sqrt{m_p}} : \frac{1}{\sqrt{m_n}} : \frac{1}{\sqrt{m_e}} : \frac{1}{\sqrt{m_\alpha}}$

Since $m_p = m_n$, hence $\lambda_p = \lambda_n$

As $m_\alpha > m_p$, therefore $\lambda_\alpha < \lambda_p$

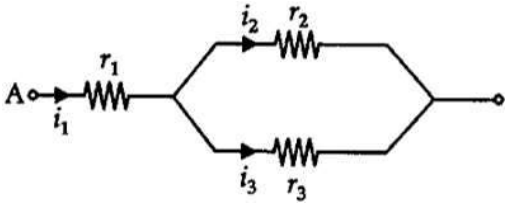
As $m_e < m_n$, therefore $\lambda_e > \lambda_n$

Hence, $\lambda_\alpha < \lambda_p = \lambda_n < \lambda_e$

49. **(a)** $\frac{r_2}{r_2 + r_3}$

Explanation: Given,

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



$i_1 = i_2 + i_3$ ...(i)

$V_2 = V_3$ ($\because$ Parallel connection)

$\Rightarrow \quad i_2 r_2 = i_3 r_3$

$\Rightarrow \quad i_2 = i_3 \times \frac{r_3}{r_2}$ ...(ii)

Now, from equation (i) and (ii)

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

$\Rightarrow \quad i_1 = \frac{i_3 r_3 + i_3 r_2}{r_2}$

$$\Rightarrow i_1 = i_3 \frac{\left(r_3 + r_2\right)}{r_2}$$

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

50. **(a)** is not important because nuclear forces are short-ranged

Explanation: Key concept: Forces that keep the nucleons bound in the nucleus are called nuclear forces.

i. Nuclear forces are short-range forces. These do not exist at large distances greater than $10 \sim 15$ m.
ii. Nuclear forces are the strongest forces in nature.
iii. These are attractive force and causes the stability of the nucleus.
iv. These forces are charge-independent.
v. Nuclear forces arc non-central force.

The nuclear binding force has to dominate over the Coulomb repulsive force between protons inside the nucleus. The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few femtometres.

In O_2 molecule which consists of two oxygen atoms molecules, nuclear force between the nuclei of the two atoms is not important because nuclear forces are short-ranged and act inside the nucleus only.

CHEMISTRY (Section-A)

51. **(a)** 200 amu

Explanation: Average atomic mass $= \frac{(90 \times 200) + (8 \times 199) + (2 \times 202)}{100}$

$= 199.96 \approx 200$ amu

52. **(a)** $-\frac{1}{2}\frac{e^2}{r}$

Explanation: Total energy of a revolving electron is the sum of its kinetic and potential energy.

Total energy = K.E. + P. E.

$$= \frac{e^2}{2r} + \left(-\frac{e^2}{r}\right) = -\frac{e^2}{2r}$$

53.

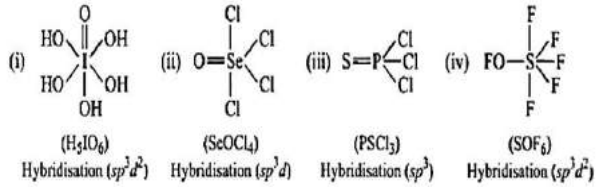
(b) Magnesium

Explanation: Sulphur and phosphorus are non-metals, they have very low electropositivity. As aluminium has one extra-nuclear charge than Mg, it has lesser electropositive character than Mg (due to greater pull exerted by nucleus on the electron).

54.

(c) (I)-sp^3d^2, (II)-sp^3d, (III)-sp^3, (IV)-sp^3d^2

Explanation:



55.

(d) $\cdot\dot{x}\cdot$

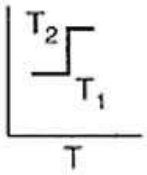
Explanation: Electronic configuration of 'X' = $1s^2\ 2s^2\ 2p^4$ 5. 'X' has six valence electrons.

56.

(b) $H_2 < N_2 < Cl_2$

Explanation: $H_2 < N_2 < Cl_2$

57.

(c) 

Explanation: T_1 and T_2 are same for a substance

58.

(b) $\left(\frac{\alpha}{1-\alpha}\right) = \frac{1.75}{1.3} \times \left(\frac{\beta}{1-\beta}\right)$ where α and β are ionised fraction of the acids

Explanation: In a given mixture, the ionisation of two acids can be written as: Let α, β be degree of ionisation at same concentration.

$CH_3COOH 1-\alpha \rightleftharpoons CH_3C\alpha OO^- + H^+ \alpha+\beta$

$C_2H_5COOH 1-\beta \rightleftharpoons C_2H_5C\beta OO^- + H^+ \alpha+\beta$

$$\therefore K_{A.A.} = \frac{[\alpha]\,[\alpha+\beta]\cdot c}{[1-\alpha]}$$

$$K_{P.A.} = \frac{[\beta]\,[\alpha+\beta]\cdot c}{[1-\beta]}$$

$$\therefore \frac{K_{A.A}}{K_{P.A.}} = \frac{\alpha}{1-\alpha} \times \frac{(1-\beta)}{\beta}$$

or $\frac{\alpha}{1-\alpha} = \frac{1.75}{1.3} \times \left[\frac{\beta}{1-\beta}\right]$

59.

(d) CuI_2 is formed

Explanation: Copper sulphate reacts with potassium iodide to form cuprous iodide and iodine.

$2CuSO_4 + 4KI \longrightarrow Cu_2I_2 \downarrow + I_2 + 2K_2SO_4$

Thus, CuI_2 is not formed in this reaction.

The liberated iodine is titrated with sodium thiosulphate to form sodium tetrathionate.

$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$

Iodine is reduced and sodium thiosulphate is oxidized.

60.

(d) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

Explanation: In (A), Fe^{+2} is oxidized to Fe^{+3} which shows the oxidizing nature of H_2O_2.

In (B), I_2 is reduced to I^- which shows the reducing nature of H_2O_2.

In (C), Mn^{+2} is oxidized to Mn^{+4} which shows the oxidizing nature of H_2O_2.

In (D), S^{2-} is oxidized to S^{+6} which shows the oxidizing nature of H_2O_2.

61.

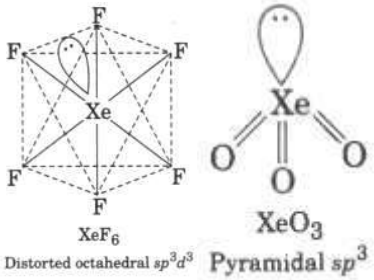
(d) M_2

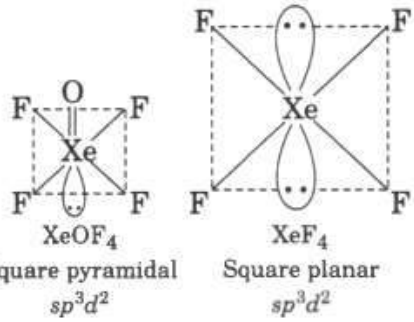
Explanation: Negative electrode potential indicates that the reaction as written is less favorable, thus, M_2 has a greater tendency to undergo oxidation, i.e., to donate electrons and thus M_2 is the most electropositive metal.

62.

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

Explanation:

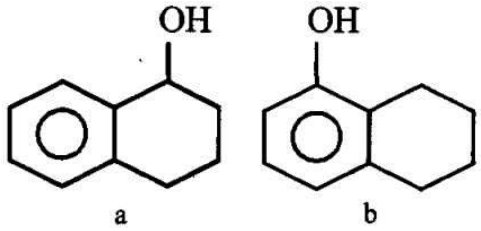




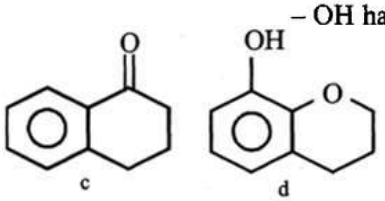
63.

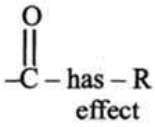
(c) c, a, b, d

Explanation: Benzene becomes more reactive towards EAS when any substituent raises the electron density.



– OH has + R





–OH and – O both show +R effect

∴ Correct order

$c < a < b < d$

64. **(a)** CH_4

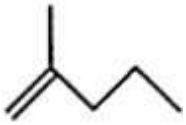
Explanation: $CH_4 + Br_2 \xrightarrow{h\nu} CH_3Br$

Methane ′*A*′ (*Substitution*) *Methyl bromide*

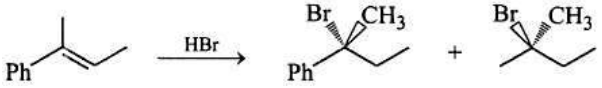
$CH_3Br + 2Na + CH_3Br \xrightarrow{\text{dry ether}} CH_3 - CH_3 + 2NaBr$

Methyl bromide *Methyl bromide* (Wurtz reaction) *Ethane* (Gaseous *hydrocarbon*)

65. **(a)**



Explanation:



66.

(b) 0.993

Explanation: $\Delta T = 0.413^oC$, $V_B = 10$ mL, $M_A = 500$ g $= 0.5$ kg, $K_f = 1.86$ K kg mol^{-1}, $M_B = 60$ g mol^{-1}

$\Delta T = K_f \cdot m$

∴ $m = \frac{\Delta T}{K_f} = \frac{0.413}{1.86} = 0.222$ m

Molality (m) $= \frac{W_B}{M_B} \times \frac{1}{M_A(\text{inkg})}$

$$0.222 = \frac{W_B}{60} \times \frac{1}{0.5}$$

$\therefore$ $W_B = 0.222 \times 60 \times 0.5 = 6.66$ g

$$\text{Molarity (M)} = \frac{W_B}{M_B} \times \frac{1}{\text{Volume of solution (in L)}}$$

Total volume of the solution = Volume of solvent + Volume of non-volatile solute
= 500 + 10 = 510
mL = 0.51 L

$\therefore$ $\text{Molarity (M)} = \frac{6.66}{60} \times \frac{1}{0.51} = 0.218$ M

Relation between molality (m) and mole fraction of solute (x_B), m = $\frac{x_B \times 1000}{x_A \times M_A} = \frac{x_B \times 1000}{(1 - x_B) \times M_A}$ **where, x_A = mole fraction of solvent, MA = Molar mass of solvent in g mol^{-1}**

$$\frac{d}{M} = \frac{1}{m} + \frac{M_B}{1000}$$

$\therefore$ $d = \frac{M}{m} + \frac{M \times M_B}{1000}$

$= \frac{0.218}{0.222} + \frac{0.218 \times 60}{1000}$

= 0.982 + 0.013

= 0.995 $\approx$ 0.993 g mL^{-1}

67. **(a)** reverse osmosis

Explanation: The osmotic pressure of sea water is 25 atm at 15^o C. When pressure greater than 26 atm is applied on sea water separated by a rigid semipermeable membrane. Pure water is obtained. This is also called desalination of sea water.

68.

(b) 1.73 A

Explanation: Specific conductance

$= \frac{equivalent\ conductance}{1000} \times$ Concentration

$= \frac{95.2 \Omega^{-1}\ cm^2 eq^{-1}}{1000\ cm^3\ L^{-1}} \times 1$ eq L^{-1}

= 0.0952 Ω^{-1} cm^{-1}

$\text{Conductance} = \frac{specific\ conductance}{cell\ constant}$

$$= \frac{0.0952\Omega^{-1}\,\text{cm}^{-1}}{0.33\,\text{cm}^{-1}} = 0.288\,\Omega^{-1}$$

$$\text{Resistance} = \frac{1}{conductance} = \frac{1}{0.288\Omega^{-1}}$$

$= 3.47\ \Omega$

Now,

$V = IR$

$\therefore\ I = \frac{V}{R} = \frac{6V}{3.47\Omega} = 1.73\ A$

69.

(b) $\text{Rate} = k[A]^2[B]$

Explanation: Let, $r = K[A]^m[B]^n$

$r_1 = K[A]^m[2B]^n$

$r_2 = K[2A]^m[2B]^n$

Also, $\frac{r_1}{r} = 2$ and $\frac{r_2}{r} = 8$ (given)

Therefore m = 2 and n = 1

$\therefore\ r = K[A]^2[B]^1$

70.

(b) 106.25 mm Hg

Explanation: Rate law for first order reaction = $[N_2O_5]$

$$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$$

t = 0 min (Pressure in mm Hg)	50	0	0
t = 30 min (Pressure in mm Hg)	50 – 2p	4p	p

Total pressure = 50 - 2p + 4p + p = 50 + 3p = 87.5 mm Hg

$\therefore\ p = 12.5$ mm Hg

$\therefore\ P_0 = 50$

$p\ (t = 30\ \text{min}) = 50 - 2 \times 12.5 = 25$ for N_2O_5 reactant

$$\therefore\ K = \frac{2.303}{30\,\text{min}} \times \log\left(\frac{50}{25}\right) = \frac{2.303}{60\,\text{min}} \times \log\left(\frac{50}{x}\right)$$

On solving x = 12.5 mm Hg = $50 - 2p_{60}$

$\therefore\ P_{60} = 18075$ mm Hg

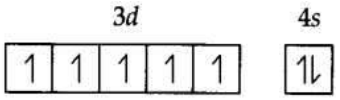
$\therefore$ Total pressure = 50 + 3p = 106.25 mm Hg

71.

(b) manganese (Z = 25)

Explanation: Due to five unpaired electrons present in manganese it shows maximum number of oxidation states.

Mn (25) = $[Ar]_{18}\ 3d^5\ 4s^2$



72.

(d) Red hot $CuO + NH_3 \xrightarrow{\Delta}$

Explanation: $Ba(N_3)_{2(s)} \xrightarrow{\Delta} Ba_{(s)} + 3N_{2(g)}$ (Pure)

$NaN_{3(s)} \xrightarrow{\Delta} Na_{(s)} + \frac{3}{2} N_{2(g)}$ (Pure)

73. **(a)** Ni^{2+}

Explanation: Magnetic moment is given by

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

[where n = no. of unpaired electrons]

When n = 2, then μ = 2.83 B.M.

For Ti^{3+} $(3d^1)$, n = 1; Cr^{3+} $(3d^3)$, n = 3

Ni^{2+} $(3d^8)$, n - 2 ; Mn^{2+} $(3d^5)$, n = 5

Hence, Ni^{2+} has two unpaired electrons, with magnetic moment 2.83 B.M.

74. **(a)** $[PtCl_4I_2]$

Explanation: $[PtCl_4I_2]$

75.

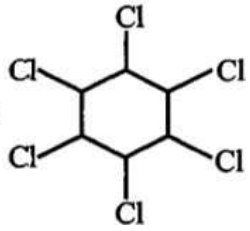
(b) $[Ti(CO)_6]^{2-}$

Explanation: $[Ti(CO)_6]^{2-}$

76.

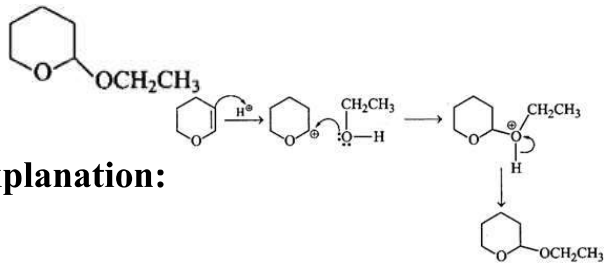
(d) Gammaxene

Explanation: Gammaxene



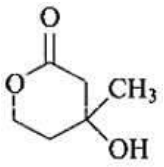
77.

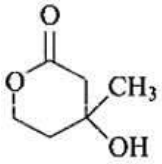
(c)



Explanation:

78.

(d) 

Explanation: 

79. **(a)** N-Ethylformamide

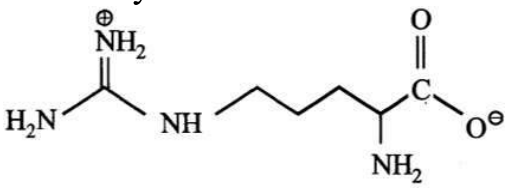
Explanation: $CH_3 - CH_2 - NH - \overset{\overset{O}{\|}}{C} - H$N-Ethylformamide($A$)

$\xrightarrow{POCl_3}$ $CH_3 - CH_2 - N \equiv C$Ethyl isocyanide(B)

$\xrightarrow[523K]{C_5H_5N}$ $CH_3 - CH_2 - C \equiv N$Cyanoethane($Ethylcyanide$)

80.

(d) It has high solubility in benzene.

Explanation: 

Arginine exist is zwitterion, so solid in nature and soluble in polar solvent.

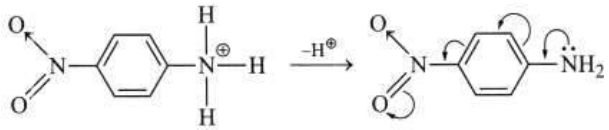
81.

(b) Vitamin C

Explanation: Vitamin B and C are water soluble while vitamin A,D,E and K are fat soluble or water insoluble.

82.

(b) 

Explanation: 

83.

(d) 5

Explanation: $Mn^{7+} + 5e \longrightarrow Mn^{2+}$

Thus 5 mole electron = 5 faraday.

84. **(a)** Sublimation

Explanation: Sublimation

85.

(c) $Pb(NO_3)_2$, $PbCl_2$, $PbCrO_4$

Explanation: $Pb^{2+} + 2HCl \longrightarrow \underset{\text{White ppt}}{PbCl_2} \downarrow + 2H^+$

(B)

$PbCl_2 + K_2CrO_4 \longrightarrow \underset{\text{Yellow ppt.}}{PbCrO_4} \downarrow + 2KCl$

(C)

$PbCl_2 + K_2CrO_4 \longrightarrow \underset{\text{Yellow ppt.}}{PbCrO_4} \downarrow + 2KCl$

(C)

$NO_3^- + H_2SO_4 \longrightarrow HSO_4^- + HNO_3 \longrightarrow \underset{(\text{Brown fumes})}{NO_2 \text{ gas}}$

CHEMISTRY (Section-B)

86.

(c) all are correct

Explanation: all are correct

87.

(b) V is reduced to + 5 state

Explanation: V is reduced to + 5 state

88.

(b) $PbCl_2$

Explanation: Pb is most stable in its +2 form.

89.

(c) H < S < Cl < O < F

Explanation: Paulings electronegativity of some elements.

H						
2.1						
Li	Be	B	C	N	O	F
1.0	1.5	2.0	2.5	3.0	3.5	4.0
Na	Mg	Al	Si	P	S	Cl
0.9	1.2	1.5	1.8	2.1	2.5	3.0

90.

(b) 39.2% more than the number of protons.

Explanation: number of electrons (e) = 54

number of protons (p) = 54 - 3 = 51

number of neutrons (n) = 122 - 51 = 71

Now, $n = p + \frac{x}{100}p$

$$71 = 51 + \frac{x}{100} \times 51$$

x = 39.2%

91.

(c) B

Explanation: The element M in the complex ion MF_6^{3-} has a coordination number of six. Since B has only s- and p-orbitals and no d-orbitals, therefore, at the maximum it can show a coordination number of 4. Thus, B cannot form complex of the type MF_6^{3-}.

92.

(d) $N_2O_5 \longrightarrow N_2O_4 + \frac{1}{2}O_2$

Explanation: $N_2O_5 \longrightarrow N_2O_4 + \frac{1}{2}O_2$

93.

(c) 1.10 V

Explanation: $E_{cell} = E_{OP_{Zn/Zn^{+2}}} + E_{RP_{Ag^+Ag}}$

$$= E^o_{OP_{Zn}} + E^o_{RP_{Ag}} + \frac{0.059}{2}\log\frac{\left[Ag^+\right]^2}{\left[Zn^{+2}\right]}$$

$$= 0.76 + 0.34 + \frac{0.059}{2}\log\frac{0}{\left[Zn^{2+}\right]}$$

$E^\circ_{cell} = 1.10$ V

This is E°_{cell} and not E_{cell} since $[Zn^{2+}]$ is not given.

94.

(d) Co (Z = 27)

Explanation: Reduction potential of all species:

$E^o_{Mn^{3+}/Mn^{2+}} = 1.57$ V

$E^o_{Fe^{3+}/Fe^{2+}} = 0.77$ V

$E^o_{Co^{3+}/Co^{2+}} = 1.97$ V

$E^o_{Cr^{3+}/Cr^{2+}} = -0.41$ V

from their standard reduction potential it can be seen that Co has highest tendency to reduce into +2 oxidation state.

95.

(b) independent of temperature

Explanation: independent of temperature

96.

(b) He < Xe < Kr < Ne

Explanation:

Element	Δ_{eg} H[KJ/mol]
He	+48
Ne	+116
Kr	+96
Xe	+77

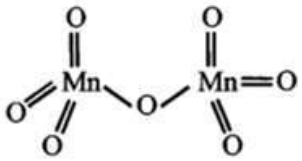
97. **(a)** HCl and HOCl

Explanation: HCl and HOCl

98.

(b) A and C only

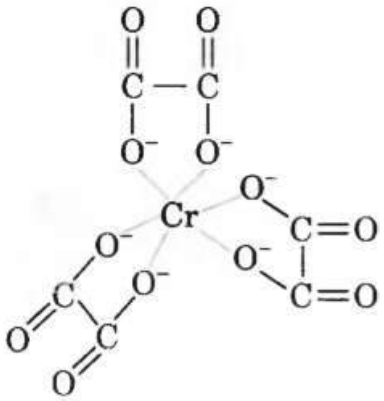
Explanation:



99.

(c) 6 and + 3

Explanation:



$K_3[Cr(C_2O_4)_3]$

As the number of atoms of the ligands that are directly bound to the central metal is known as coordination number. It is six here (see in figure).

Oxidation state :

Let oxidation state of Cr be x.

$\Rightarrow$ 3(+1) + x + 3 (-2) = 0

$\Rightarrow$ 3 + x - 6 = 0 $\Rightarrow$ x = 3

100.

(c) $P_1 = C_6H_5 - N = N - C_6H_5$

$P_2 = C_6H_5 - NH_2$

Explanation: $C_6H_5-N=N-C_6H_5$Diazobenzene(P_1) $\xleftarrow[\text{dry ether}]{LiAlH_4}$

$C_6H_5-NO_2$Nitrobenzene $\xrightarrow{Fe/conc.HCl}$ $C_6H_5-NH_2$Aniline(P_2)

BOTANY (Section-A)

101.

(b) Class

Explanation: Class contain organisms least similar to one another. The class represents organisms of related orders. However, species constitutes group of closely related individuals which can interbreed together. Hence, species contains organisms most similar to one another.

102.

(c) All of these

Explanation: Some organism do not reproduce throughout their life like mules, sterile worker bees, infertile human couples, etc., although they have characteristics of living organisms.

103. **(a)** oxygenic with nitrogenase

Explanation: Cyanobacteria are gram negative prokaryotes which are popularly known as blue-green algae.

Although cyanobacteria are true prokaryotes, but their photosynthetic system closely resembles with that of eukaryotes because they have chlorophyll a and photosystem II and they carry out oxygenic photosynthesis.

Like the red algae, cyanobacteria use phycobiliproteins as accessory pigments. Photosynthetic pigments and electron transport chain components are in thylakoid membranes lined with particles called phycobilisomes, which contain phycobilin pigments, particularly phycocyanin and transfer energy to photosystem II.

They contain nitrogenase enzyme for nitrogen fixation. This enzyme becomes inactive in the presence of oxygen but the thick walled heterocysts provide suitable anaerobic enviornment for nitrogenase activity even in aerobic conditions.

104.

(c) Bacteria

Explanation: Rickettsia is a genus of non-motile, Gram-negative, non-spore forming, highly pleomorphic bacteria that may occur in the forms of cocci, bacilli, or threads. The term "rickettsia" has nothing to do with rickets which is a deficiency disease resulting from lack of vitamin D the bacterial genus Rickettsia was named after Howard Taylor Ricketts in honour of his pioneering work on tick-borne spotted fever.

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

Explanation: Tapetum nourishes the developing pollen grains, Oxalis, and Commelina produce chasmogamous flowers with exposed anthers and stigma, hydrophily occurs in Vallisneria and Hydrilla and Zostera and xenogamy is an allogamy in which pollen grains are transferred from the anther to the stigma of a different plant.

106.

(b) Both (Attached to the photosynthetic gametophyte) and (Derives nourishment from

gametophyte) are correct

Explanation: The plant body of bryophytes is more differentiated than that of algae. It is thallus-like and prostrate or erect and attached to the substratum by unicellular or multicellular rhizoids. They lack true roots, stem, or leaves. They may possess root-like, leaf-like, or stem-like structures. The main plant body of the bryophyte is haploid. It produces gametes, hence it is called a gametophyte. An antherozoid (male gamete) fuses with the egg (female gamete) to produce the zygote. Zygotes do not undergo a reduction division immediately. They produce a multicellular body called a sporophyte. The sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it. Some cells of the sporophyte undergo reduction division (meiosis) to produce haploid spores.

107.

(c) Chromosome number

Explanation: Karyotaxonomy (karyon means nucleus) of organisms is based on the chromosome number in the nucleus.

108. **(a)** Pteris

Explanation: Pteris

109.

(c) Snail

Explanation: Snail

110.

(d) They are types of parenchyma

Explanation: They are types of parenchyma

Sclereids is a type of sclerenchyma with a highly reduced lumen and a very thick and strongly lignified secondary wall. These cells are dead and empty at maturity sclereids may occur singly or in groups. They vary in shape.

111.

(d) position

Explanation: Apical, intercalary and lateral meristems are differentiated based on position. Apical meristem is situated at the shoot apex and the root apex. Intercalary meristem is present at the base of internodes, e.g. in grasses or at the base of leaves e.g. in Pinus or at the base of nodes, e.g., mint. Lateral meristems are present along the lateral sides of stem and roots.

112. **(a)** Endodermis

Explanation: The innermost layer of the cortex is the endodermis. It is structurally and physiologically different from the cells on either side of it. The radial and transverse walls of the endodermal cells contain a band of lignin and suberin known as Casparian strip.

113.

(b) Crossing one F, progeny with recessive parent

Explanation: In order to find genotype, test cross is followed i.e., crossing the F_1 progeny with recessive parent.

114.

(c) Holandric

Explanation: All genes carried on Y-chromosome are known as holandric genes.

115. **(a)** 5' - GCAUUCGGCUAGUAAC - 3'
Explanation: mRNA strand is complementary to template strand of DNA, while coding strand has same sequence as RNA (except thymine at the place of uracil). Hence, the sequence of bases in RNA will be 5' - GCAUUCGGCUAGUAAC - 3'.

116. **(d)** 61
Explanation: 61

117. **(a)** Plasmodesmata
Explanation: Two cells are connected by the help of Plasmodesmata.They are cytoplasmic bridges between adjacent plant cell.

118. **(d)** Glyoxysomes
Explanation: In germinating seeds fatty acids are degraded exclusively in the Glyoxysomes. The latter is metabolised in glyoxylate cycle to produce carbohydrates.

119. **(c)** Smallpox
Explanation: In Ascariasis internal bleeding, muscular pain, fever, anaemia, and blockage of the intestinal passage. The eggs of the parasite are excreted along with the faeces of infected persons which contaminate soil, water, plants, etc. A healthy person acquires this infection through contaminated water, vegetables, fruits, etc.

120. **(c)** increased number of WBCs.
Explanation: A person suffering from leukaemia has abnormal increase in the number of WBCs due to their increased formation in the bone marrow.

121. **(d)** Na^{+} and Ca^{2+}
Explanation: Microtubules are unbranched hollow submicroscopic tubules of protein tubulin. They develop on specific nucleating regions and can undergo quick growth or dissolution at their ends by assembly or disassembly of monomers.Ca^{2+}, Mg^{2+}, GTP and calcium binding protein calmodium play important role in assembly of microtubules.

122. **(c)** Grassland with scattered trees
Explanation: Grassland with scattered trees

123. **(c)** Primary producers are more than primary consumers.
Explanation: Primary producers are more than primary consumers.

124. **(a)** Eukaryote
Explanation: Eukaryote

125. **(d)** Habitat loss
Explanation: Habitat loss is the most serious threat to biodiversity leading to extinction of animals and plants species. Since human population is growing so rapidly and consuming so many natural resources, habitat loss is occurring at a rapid pace.

126.

(b) high altitude to low altitude and high latitude to low latitude.

Explanation: The variety in the number and richness of the species of a region is called species diversity. Species diversity increases from high altitude to low altitude and from high latitude to low latitude.

127.

(c) 34

Explanation: 34

128.

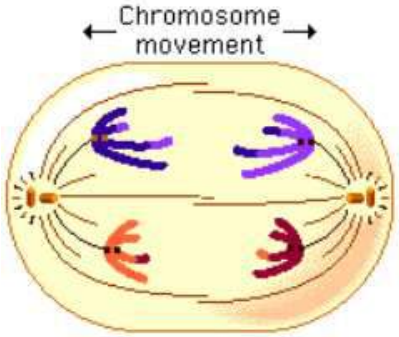
(c) Chromomeres

Explanation: A chromomere is one of the serially aligned beads or granules of a eukaryotic chromosome, resulting from local coiling of a continuous DNA thread. It is visible on a chromosome during the prophase of meiosis and mitosis.

129.

(b) Anaphase - I

Explanation: Anaphase- I: two homologous chromosomes of each bivalent (tetrad) separate and start moving toward opposite poles of the cell as a result of the action of the spindle, while sister chromatids remain associated at centromeres. During Anaphase- I, sister chromatids remain associated with centromeres.



130.

(b) Malic acid

Explanation: In C4 cycle, PEP carboxylase fixes CO_2 with PEP in the mesophyll cells and forms a 4-carbon compound, oxaloacetic acid (OAA). Then, another 4-carbon compound, malic acid or aspartic acid, is formed from OAA. These compounds are transported to the bundle sheath cells where, C4 acid is broken down to form C3 acid and CO_2. The bundle sheath cells are rich in RuBisCObut lack PEPcase. So, CO_2 released in the bundle sheath cells enters the C3 or the Calvin pathway, a pathway common to all plants. C3 acid, so formed, is again transported to the mesophyll cells and regenerated back into PEP.

131. **(a)** A simple sugar

Explanation: A simple sugar, glucose, is formed as the first substance by green plants during photosynthesis. Starch is synthesised later from glucose.

132.

(b) Priestley

Explanation: Priestley

133.

(d) Potassium hydroxide solution

Explanation: KOH is helpful because in this case KOH and CO_2 gas act as acid-base neutralization reactions. In this case, KOH is a strong base (alkali) and carbon dioxide is an acidic oxide. So, base and acid react to give salt and water. Hence, $2KOH + CO_2 \rightarrow K_2CO_3 + H_2O$

134.

(b) Glyceraldehyde - 3 - phosphate

Explanation: Glyceraldehyde - 3 - phosphate is required for the only oxidative reaction that occurs in the process of glycolysis.

135.

(c) (ii) and (iii)

Explanation: ABA is produced in many parts of green plants. Its presence is suspicious in lower plants (bryophytes and pteridophytes). ABA is formed by melvonic acid pathway, not by glycolysis.

BOTANY (Section-B)

136. **(a)** This species was first described by Linnaeus

Explanation: Mangifera indica Linn indicates that this species was first described by Linnaeus as in binomial nomenclature, the name of author appears after the species name. This method of mentioning the author's name is called a citation.

137.

(b) Only asexual phases are known

Explanation: The fungi imperfecti or imperfect fungi, also known as Deuteromycota, are fungi which do not fit into the commonly established taxonomic classifications of fungi that are based on biological species concepts or morphological characteristics of sexual structures because their sexual form of reproduction has never been observed. Only their asexual form of reproduction is known, meaning that these fungi produce their spores asexually, in the process called sporogenesis.

138.

(d) Both Cedrus and Pinus

Explanation: Both Cedrus and pinus are typical gymnosperms, which have a branched stem.

139. **(a)** Wind pollinated

Explanation: Wind pollinated

140.

(b) false fruits

Explanation: In false fruits, there is involvement of other parts along with ovary in formation of fruit.

141.

(d) (B)

Explanation: (B)

142.

(d) Fuchsin

Explanation: Fuchsin

143.
(c) Only (vi)
Explanation: Only (vi) is an incorrect statement.
Matrix does not include enzymes for carbohydrate synthesis.
144.
(b) TMV
Explanation: TMV
145.
(d) Glycolysis
Explanation: Glycolysis breaks one molecule of glucose into two molecules of pyruvic acid in the cytoplasm, in absence of oxygen. Thus pyruvic acid is the end product of glycolysis.
146.
(c) culture media
Explanation: The nutritive medium for growing bacteria and many fungi in the laboratory is called culture media.
147.
(c) Third trophic level
Explanation: Plants occupy first trophic level in a food chain and all the organisms grazing on plants occupy second trophic level. Also the products(curd) of grazing animals occupy the same trophic level as grazing animals. Thus a person eating curd will occupy third trophic level.
148. **(a)** All of these
Explanation: All of these
149.
(c) cytokinins
Explanation: Cytokinins are plant growth hormones which are basic in nature, cytokinins induce formation of new leaves, chloroplasts in leaves, which in turn keeps the leaves green for a longer duration of time. Cytokinins applied to marketed vegetables can keep them fresh for several days. Shelf life of cut shoots and flowers is prolonged by employing the hormones.
150.
(c) CAM and C_4
Explanation: CAM and C_4

ZOOLOGY (Section-A)

151.
(b) Cat
Explanation: Cat
152.
(b) I- Saw fish - Chondrichthyes, II- Dog fish - Chondrichthyes
Explanation: The image I, Pristis (Saw fish) and image II, Scoliodon (Dog fish) are both Chondrichthyes.
153. **(a)** Absence of body cavity
Explanation: Platyhelminthes are acoelomate animals whereas Annelids are coelomate

animals.

154. **(a)** Areolar tissue

Explanation: In areolar tissue, there is more intercellular space, so largest quantity of extracellular material is present in this tissue. It contains all cell types and fibres of connective tissue. There is a thin layer of extracellular fluid in stratified epithelium whereas striated muscle is attached with tendons and there is very less amount of extracellular fluid in myelinated nerve fibre.

155.

(b) Neurons

Explanation: The basic unit of the nervous or neural system is a nerve cell or neuron. The human brain contains about 100 billion neurons. The neuroglial cell constitutes the neural system that protects and supports neurons. Neuroglia makes up more than one half the volume of neural tissue in our body.

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

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

157.

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

Explanation: The correct option is A - (iii), B - (i), C - (iv), D - (ii)

The small hair presents in the nasal cavity (nose) help to filter particles of dust and other foreign matter.

Epiglottis, a leaf shaped cartilage, acts as a switch between the larynx and the oesophagus to permit air to enter the airway to the lungs and food to pass into the gastrointestinal tract. It also protects the body from choking on food that would normally obstruct the airway.

Pharynx is a cone-shaped passageway leading from the oral and nasal cavities in the head to the oesophagus and larynx. The pharynx chamber serves both respiratory and digestive functions.

Larynx (voice box) holds the vocal cords. It is responsible for producing voice, helping us swallow and breathe. Air passes in and out of the larynx each time the body inhales or exhales.

158.

(c) oxygenation

Explanation: Bulk of oxygen diffuses from the plasma into the red blood corpuscles where it joins loosely with Fe^{2+} ions of hemoglobin (Hb) to form bright red oxyhemoglobin (HbO_2). The process is called oxygenation.

159.

(b) $pO_2 = 104$ and $pCO_2 = 40$

Explanation: The pressure exerted by an individual gas in a mixture of gases is called the partial pressure of that gas. Itis represented with the letter 'p', The partial pressure of oxygen and carbon dioxide at the alveoli are $pO_2 = 104$ and $pCO_2 = 40$, respectively.

160.

(d) C-Alveoli - thin walled vascular bag like structures for exchange of gases

Explanation: In the given figure A, B, C and D are respectively trachea, pleural membranes, alveoli and diaphragm.

Trachea is supported by incomplete cartilaginous rings which prevent its collapse during inspiration and abdominal cavities. It is the principal muscle of respiration.

161. **(a)** Size does not increase
Explanation: The cleavage division is short and does not involve growth so that the resulting blastomeres become smaller in size as their number increases. Thus, the size of the cells (blastomeres) does not increase during cleavage.

162. **(d)** Statement (a) is false.
Explanation: The cervix is the part of uterus opens into vagina. The cavity of the cervix is called cervical canal.

163. **(d)** Placenta
Explanation: Placenta

164. **(c)** Artificial introduction of sperms of a healthy donor into the vagina
Explanation: In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (lUI- intra-uterine insemination)of the female.

165. **(b)** (i) and (ii)
Explanation: In test tube baby, the ovum is fertilised with the sperm outside the body of a woman under the same environmental conditions as that in the body. The zygote formed is grown inside a culture and when embryo is formed, it is then implanted into the fallopian tube or uterus where it develops into foetus.

166. **(b)** Mutation of single Mendelian gene for survival in smoke-laden Industrial environment
Explanation: A black form of the peppered moth rapidly took over in industrial parts of the UK during the 1800s, as soot blackened the tree trunks and walls of its habitat. The difference between the forms was due to variants of a single gene.

167. **(d)** 1350-1500 cc
Explanation: 1350-1500 cc

168. **(d)** Hypertonic
Explanation: Hypertonic is the solution that contains more solute as compared to the solvent. Humans can survive with limited fluid intake because the kidneys can produce highly concentrated urine more than 4 times as concentrated as blood. The osmolarity of human blood is about 300 milliosmols per liter (mOsm /L). The kidneys can produce urine with an osmolarity of about 1200 mOsm/L. As the initial filtrate passes through various regions of the renal tubule, salt (NaCl) is reabsorbed into the interstitial fluid, and a salt concentration gradient is established. The gradient is used to produce concentrated urine and makes it more hypertonic.

169. **(b)** (i) and (ii)

Explanation: The increase in osmolarity from outer to inner medullary interstitium, i.e., from 300 m $OsmolL^{-1}$ in the cortex to about 1200 m $OsmolL^{-1}$ in the inner medulla is maintained due to close proximity between henle's loop and vasa recta as well as counter-current mechanism.

Other statements can be corrected as- PCT helps in selective secretion of H^+, ammonia and K^+ ions and absorption of HCO_3^- from the filtrate. Blood pressure in glomerular capillaries is responsible for glomerular filtration and not for counter current mechanism.

170.

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

171.

(d) Humerus and ulna
Explanation: Humerus and ulna

172.

(d) Pronator
Explanation: Muscle is a bundle of fibrous tissue in a body that has the ability to contract, producing movement in or maintaining the position of parts of the body. The total number of muscles in the human body comes in the range of 640-850. The forearm is rotated to turn the palm downward or backward by muscle pronator. So, the correct answer is 'Pronator'.

173.

(c) pectoral girdle of mammals.
Explanation: An acromion process is characteristically found in the pectoral girdle of mammals. The acromion is a bony process on the scapula (shoulder blade). Together with the coracoid process it extends laterally over the shoulder joint. It articulates with the clavicle (collar bone) to form the acromioclavicular joint.

174.

(b) Chemical-electrical process
Explanation: Chemical-electrical process

175.

(d) Sympathetic nerves
Explanation: During stress condition, stimulation of the sympathetic nerves to adrenal medulla causes large quantities of adrenaline to be released into the blood circulation and then this hormone is carried to the specific tissues of the body where it produces its effects, e.g., increase in heartbeat.

176. **(a)** Cerebral hemisphere, Thalamus, corpus callosum and Cerebellum aqueduct
Explanation: Cerebral hemisphere, Thalamus, corpus callosum and Cerebellum aqueduct

177.

(d) All of these
Explanation: All of these

178.

(d) Thyroxine
Explanation: Thyroxine

179. **(a)** Toad and lizard
Explanation: The amphibians and reptiles have incomplete double circulation. The left atrium receives oxygenated blood from the respiratory organs - gills/lungs/skin and the right atrium gets the deoxygenated blood from other body parts which get mixed up in the single ventricle and hence pump out mixed blood.

180. **(d)** Thrombocytes
Explanation: Thrombocytes

181. **(d)** Aorta > artery > arteriole > capillary > venule > vein
Explanation: Blood pressure is highest at the origin of the aorta. As blood flows from the heart, the blood flow into progressively smaller vessels, however, the vessels also split into numerous branches. Because of the branching, resistance drops considerably. The low-pressure environment is favourable for gas exchange in the capillaries. Blood pressure decreases continuously along the path from aorta to vena cava.
Aorta > artery > arteriole > capillary > venule > vein

182. **(b)** Restriction enzymes
Explanation: Restriction enzymes are called molecular scissors as they are used to cut the DNA segments at specific points. There are two kinds of restriction enzymes exonucleases and endonucleases enzymes.

183. **(c)** Retrovirus
Explanation: Retrovirus has the ability to transform normal cells into cancerous cells. Hence, it can be used as a vector for cloning desirable genes into animal cells.

184. **(a)** Foreign DNA in all its cells
Explanation: Foreign DNA in all its cells

185. **(d)** Getting insulin assembled into mature form
Explanation: The main challenge for the production of insulin using rDNA technique was getting insulin assembled into a mature form.

ZOOLOGY (Section-B)

186. **(c)** All of these
Explanation: All of these

187. **(c)** Bronchioles and Fallopian tubes
Explanation: Bronchioles and Fallopian tubes are lined with ciliated epithelium to move particles or mucus in a specific direction.

188. **(c)** T-cells
Explanation: T cells or T lymphocyte is a type of lymphocyte (a subtype of white blood cell) that plays a central role in cell-mediated immunity. T cells can be distinguished from

other lymphocytes, such as B cells and natural killer cells, by the presence of a T-cell receptor on the cell surface.

189.

(b) Po_2 is low and Pco_2 is high in alveoli

Explanation: Dissociation of CO_2 from carbamino-haemoglo-bin takes place when pCO_2 is low and pO_2 is hig in alveoli.

190.

(d) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida

Explanation: Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida

191.

(c) AIDS

Explanation: Syphilis is a bacterial infection usually spread by sexual contact. The disease starts as a painless sore — typically on your genitals, rectum, or mouth. Gonorrhea is an infection caused by a sexually transmitted bacterium that infects both males and females. Gonorrhea most often affects the urethra, rectum, or throat. Genital warts are soft growths that appear on the genitals. They can cause pain, discomfort, and itching. Genital warts a sexually transmitted infection (STI) caused by certain low-risk strains of the human papillomavirus (HPV).

AIDS does not affect genital parts directly. It affects our immune system.

192.

(b) Only (D)

Explanation: Oparin of Russia and Haldane of England proposed that the first form of life could have come from pre-existing non-living organic molecules (e.g., RNA, protein, etc.) and that formation of life was preceded by chemical evolution, i.e., formation of diverse organic molecules from inorganic constituents. The conditions on earth were - high temperature, volcanic storms, reducing atmosphere containing CH_4, NH_3, etc.

193. **(a)** Calcium

Explanation: Calcium

194.

(b) A.F. Huxley

Explanation: Sliding filament theory explains the mechanism of muscle contraction. It states that the contraction of a muscle fibre takes place by the sliding of the thin filaments(actin) over the thick filaments (myosin). It was proposed by A.F. Huxley.

195.

(b) Efferent

Explanation: Efferent

196.

(c) Aldosterone

Explanation: Aldosterone

197. **(a)** Thymus

Explanation: A child with a weak immune system could have problem in his thymus

gland. Thymus gland is a lymphoid organ situated in the neck of vertebrates which produces T-lymphocytes for the immune system. The human thymus becomes much smaller at the approach of puberty.

198. **(c)** All of these
Explanation: All of these

199. **(a)** Origin of replication (ori)
Explanation: Origin of replication (ori), a selectable marker, sites for restriction endonuclease, and its size, all are important features required to facilitate cloning into vector.

200. **(c)** (A) - (iii), (B) - (iv), (C) - (ii), (D) - (i)
Explanation: (A) - (iii), (B) - (iv), (C) - (ii), (D) - (i)