CHEMISTRY

1. Considering the state of hybridization of carbon atoms, find out the molecule among the following which is linear?

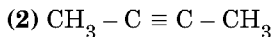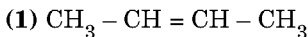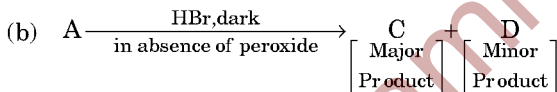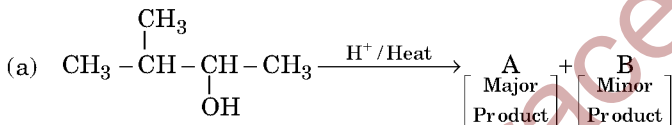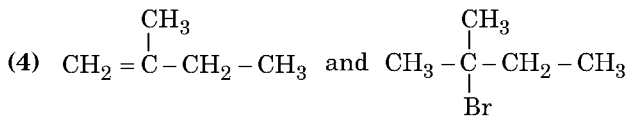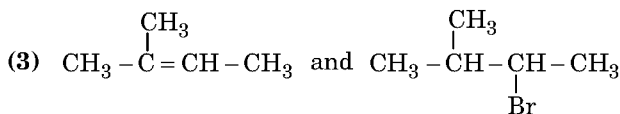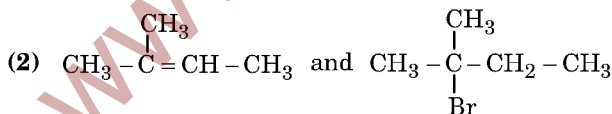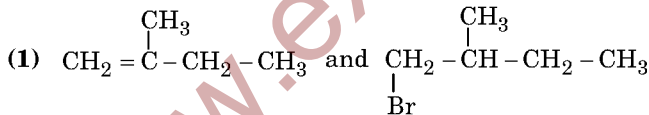**(1)** $CH_3 - CH = CH - CH_3$ **(2)** $CH_3 - C \equiv C - CH_3$

(3) $CH_2 = CH - CH_2 - C \equiv CH$ **(4)** $CH_3 - CH_2 - CH_2 - CH_3$
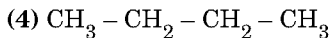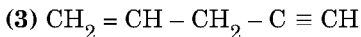
Sol.: $\overset{1}{C}H_3 - \overset{2}{C} \equiv \overset{3}{C} - \overset{4}{C}H_3$ is a linear molecule as C_2 and C_3 are sp hybridized.

∴ **Correct choice : (2)**

2. In the following reactions,

(a) $CH_3 - \underset{\underset{OH}{|}}{CH} - \overset{\overset{CH_3}{|}}{CH} - CH_3 \xrightarrow{H^+/Heat} \begin{bmatrix} A \\ Major \\ Product \end{bmatrix} + \begin{bmatrix} B \\ Minor \\ Product \end{bmatrix}$

(b) $A \xrightarrow[\text{in absence of peroxide}]{HBr,dark} \begin{bmatrix} C \\ Major \\ Product \end{bmatrix} + \begin{bmatrix} D \\ Minor \\ Product \end{bmatrix}$

the major products (A) and (C) are respectively:

(1) $CH_2 = \overset{\overset{CH_3}{|}}{C} - CH_2 - CH_3$ and $\underset{\underset{Br}{|}}{CH_2} - \overset{\overset{CH_3}{|}}{CH} - CH_2 - CH_3$

(2) $CH_3 - \overset{\overset{CH_3}{|}}{C} = CH - CH_3$ and $CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3$

(3) $CH_3 - \overset{\overset{CH_3}{|}}{C} = CH - CH_3$ and $CH_3 - \overset{\overset{CH_3}{|}}{CH} - \underset{\underset{Br}{|}}{CH} - CH_3$

(4) $CH_2 = \overset{\overset{CH_3}{|}}{C} - CH_2 - CH_3$ and $CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3$

Sol.:

$$CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{CH}} - CH - CH_3 \xrightarrow[-H_2O]{H^+} CH_3 - \underset{\oplus}{\overset{\overset{CH_3}{|}}{CH}} - CH - CH_3 \xrightarrow{-\overset{\oplus}{H}}$$

$$\underset{\substack{(A) \\ \text{major product}}}{CH_3 - \overset{\overset{CH_3}{|}}{C} = CH - CH_3} \quad + \quad \underset{\substack{(B) \\ \text{minor product}}}{CH_3 - \overset{\overset{CH_3}{|}}{CH} - CH = CH_2}$$

$$CH_3 - \overset{\overset{CH_3}{|}}{C} = CH - CH_3 \xrightarrow[\substack{\text{absence of} \\ \text{peroxide}}]{\text{HBr, dark}} \underset{\substack{(C) \\ \text{major}}}{CH_3 - \overset{\overset{CH_3}{|}}{\underset{\underset{Br}{|}}{C}} - CH_2 - CH_3}$$
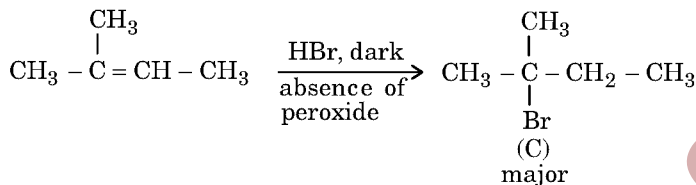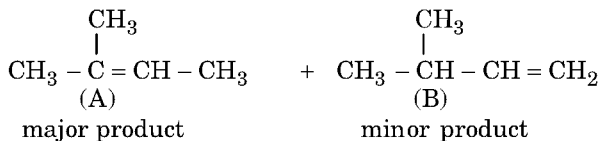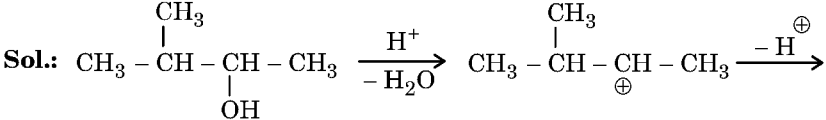
∴ **Correct choice : (2)**

3. Standard electrode potential of three metals X, Y and Z are – 1.2 V, + 0.5 V and – 3.0 V respectively. The reducing power of these metals will be:

(1) Y > Z > X   (2) Y > X > Z   (3) Z > X > Y   (4) X > Y > Z

Sol.: Reducing power of the metal is inversely proportional to the reduction potential of the metal.

Z > X > Y

∴ **Correct choice : (3)**

4. The total number of atomic orbitals in fourth energy level of an atom is:

(1) 8   (2) 16   (3) 32   (4) 4

Sol.: 4th energy level has one s, three p, five d and seven f orbitals.

Total = 1 + 3 + 5 + 7 = 16

∴ **Correct choice : (2)**

5. Which of the following has the minimum bond length?

(1) O_2^+ (2) O_2^- (3) O_2^{2-} (4) O_2

Sol.: Minimum length is related to maximum bond order

Species	Bond order
O_2^+	(2.5)
O_2^-	(1.5)
O_2^{2-}	(1.0)
O_2	(2.0)

∴ **Correct choice : (1)**

6. If x is amount of adsorbate and m is amount of adsorbent, which of the following relations is **not** related to adsorption process?

(1) $\dfrac{x}{m}$ = f(p) at constant T

(2) $\dfrac{x}{m}$ = f(T) at constant p

(3) p = f(T) at constant $\left(\dfrac{x}{m}\right)$

(4) $\dfrac{x}{m}$ = p × T

Sol.: $\dfrac{x}{m}$ = f(T) at constant p is wrongly related.

It must be as $\left(\dfrac{x}{m}\right) = f\left(\dfrac{1}{T}\right)$

∴ **Correct choice : (2)**

7. A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5}, what is the pH of this solution? (log 2.7 = 0.43)

(1) 9.08   (2) 9.43   (3) 11.72   (4) 8.73

Sol.: $pOH = pK_b + \log \dfrac{[salt]}{[base]}$

$= -\log\left(1.8 \times 10^{-5}\right) + \log\left(\dfrac{0.2}{0.3}\right)$

$= 4.57$

Hence pH = 14 − 4.57 = 9.43

∴ **Correct choice : (2)**

8. The electrode potentials for $Cu_{(aq)}^{2+} + e^- \longrightarrow Cu_{(aq)}^+$ and $Cu_{(aq)}^+ + e^- \longrightarrow Cu_{(s)}$ are + 0.15 V and + 0.50 V respectively. The value of $E_{Cu^{2+}/Cu}^o$ will be:

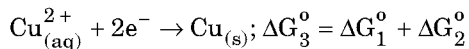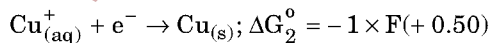(1) 0.500 V   (2) 0.325 V   (3) 0.650 V   (4) 0.150 V

Sol.: $Cu_{(aq)}^{2+} + e^- \rightarrow Cu_{(aq)}^+;\ \Delta G_1^o = -1 \times F \times (+\,0.15)$

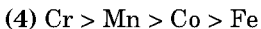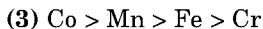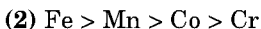$\dfrac{Cu_{(aq)}^+ + e^- \rightarrow Cu_{(s)};\ \Delta G_2^o = -1 \times F(+\,0.50)}{Cu_{(aq)}^{2+} + 2e^- \rightarrow Cu_{(s)};\ \Delta G_3^o = \Delta G_1^o + \Delta G_2^o}$

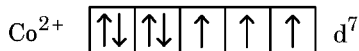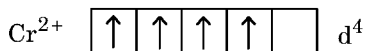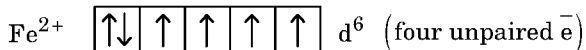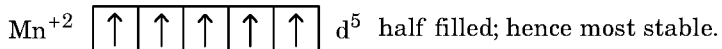$\Delta G_3^o = -nFE^o = -2FE^o$

Hence $E^o = 0.325$ V

∴ **Correct choice : (2)**

9. For the four successive transition elements (Cr, Mn, Fe and Co), the stability of + 2 oxidation state will be there in which of the following order?

(1) $Mn > Fe > Cr > Co$ 　　　　　　**(2)** $Fe > Mn > Co > Cr$

(3) $Co > Mn > Fe > Cr$ 　　　　　　**(4)** $Cr > Mn > Co > Fe$
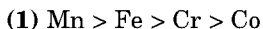
(At. nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

Sol.: Stability of +2 state of the following is $Mn > Fe > Cr > Co$

Mn^{+2} ↑ ↑ ↑ ↑ ↑ d^5 half filled; hence most stable.

Fe^{2+} ↑↓ ↑ ↑ ↑ ↑ d^6 (four unpaired $\bar{e}$)

Cr^{2+} ↑ ↑ ↑ ↑ d^4

Co^{2+} ↑↓ ↑↓ ↑ ↑ ↑ d^7

∴ **Correct choice : (1)**

10. Which one of the following statements for the order of a reaction is **incorrect**?

(1) Order can be determined only experimentally.

(2) Order is not influenced by stoichiometric coefficient of the reactants.

(3) Order of reaction is sum of power to the concentration terms of reactants to express the rate of reaction

(4) Order of reaction is always whole number.

Sol.: Order of reaction may be whole number, zero or fractional.

∴ **Correct choice : (4)**

11. Which one of the following is most reactive towards electrophilic reagent?

(1) (benzene ring) CH_3 / OCH_3 　　　　**(2)** (benzene ring) CH_3 / OH

(3) (benzene ring) CH_3 / $NHCOCH_3$ 　　**(4)** (benzene ring) CH_3 / CH_2OH
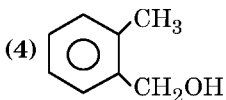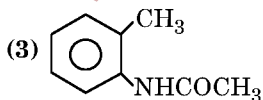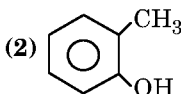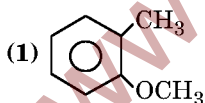
Sol.: For Electrophilic attack, benzene ring must be activated. $- CH_3$ group, $- OCH_3$ group as well as $- OH$ group activate the benzene ring. But $- OCH_3$ group activates more than $- OH$ group.

∴ **Correct choice : (1)**

12. In a set of reactions m-bromobenzoic acid gave a product D. Identify the product D.

$$A \xrightarrow{SOCl_2} B \xrightarrow{NH_3} C \xrightarrow[Br_2]{NaOH} D$$

(1) (SO_2NH_2, Br)

(2) (COOH, NH_2)

(3) (NH_2, Br)

(4) ($CONH_2$, Br)

Sol.:

COOH (A) $\xrightarrow{SOCl_2}$ COCl (B) $\xrightarrow{NH_3}$ $CONH_2$ (C) $\xrightarrow[Br_2]{NaOH}$ NH_2, Br (D) (meta isomer)
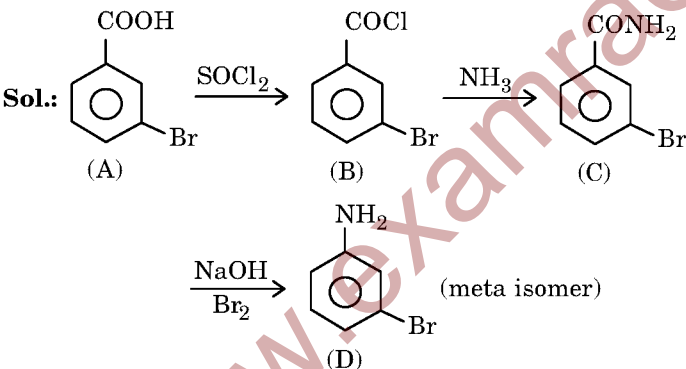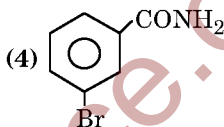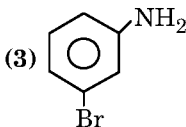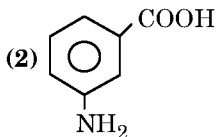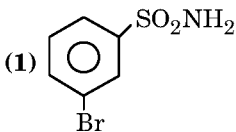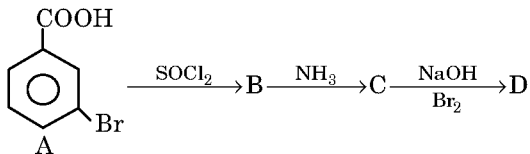
∴ **Correct choice : (3)**

13. Which of the two ions from the list given below that have the geometry that is explained by the same hybridization of orbitals, $NO_2^-, NO_3^-, NH_2^-, NH_4^+, SCN^-$?

(1) NO_2^- and NO_3^-

(2) NH_4^+ and NO_3^-

(3) SCN^- and NH_2^-

(4) NO_2^- and NH_2^-
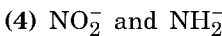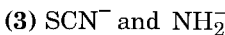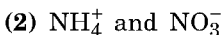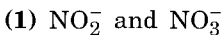
Sol.:	Species		Hybridization of the central atom

NO_2^- $\qquad \dfrac{5+1}{2} = 3 \qquad\qquad sp^2$

NO_3^- $\qquad \dfrac{5+1}{2} = 3 \qquad\qquad sp^2$

NH_4^+ $\qquad \dfrac{5+4-1}{2} = 4 \qquad\quad sp^3$

NH_2^- $\qquad \dfrac{5+2+1}{2} = 4 \qquad\quad sp^3$

SCN^- $\qquad \ddot{:}\!S = C = \ddot{N}\!\ddot{:}^{\,-} \qquad\quad sp$
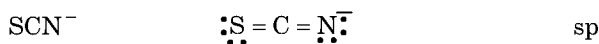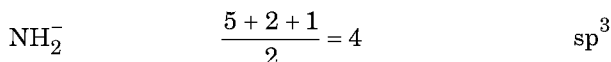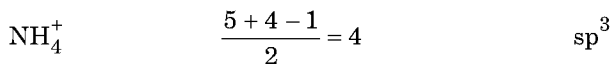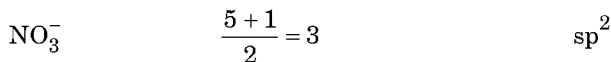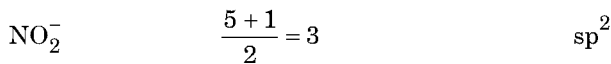
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ ∴ **Correct choice : (1)**

14. Which of the following is least likely to behave as Lewis base?

(1) H_2O $\qquad\qquad$ **(2)** NH_3 $\qquad\qquad$ **(3)** BF_3 $\qquad\qquad$ **(4)** OH^-
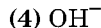
Sol.: BF_3 is an electron deficient species and it is a Lewis acid.

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ ∴ **Correct choice : (3)**

15. Which **one** of the following statements is **not** true regarding (+) Lactose?

(1) On hydrolysis (+) Lactose gives equal amount of D(+) glucose and D(+) galactose

(2) (+) Lactose is a β-glycoside formed by the union of a molecule of D(+) glucose and a molecule of D(+)galactose

(3) (+) Lactose is a reducing sugar and does not exhibit mutarotation

(4) (+) Lactose, $C_{12}H_{22}O_{11}$ contains 8-OH groups

Sol.: Reducing sugar will show mutarotation.

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ ∴ **Correct choice : (3)**

16. The freezing point depression constant for water is $- 1.86°C\ m^{-1}$. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O, the freezing point is changed by $- 3.82°C$. Calculate the van't Hoff factor for Na_2SO_4.

(1) 2.05 $\qquad\qquad$ **(2)** 2.63 $\qquad\qquad$ **(3)** 3.11 $\qquad\qquad$ **(4)** 0.381

Sol.: $\Delta T_f = i \, K_f \dfrac{1000 \, W_2}{M_2 W_1}$

$i = \dfrac{\Delta T_f \, M_2 W_1}{K_f \, 1000 \, W_2} = \dfrac{3.82 \times 142 \times 45}{1.86 \times 1000 \times 5}$

$= 2.6247 \approx 2.63$

$\therefore$ **Correct choice : (2)**

17. Of the following complex ions, which is diamagnetic in nature?

(1) $[NiCl_4]^{2-}$ **(2)** $[Ni(CN)_4]^{2-}$ **(3)** $[CuCl_4]^{2-}$ **(4)** $[CoF_6]^{3-}$

Sol.: Ni^{2+} in

$[Ni(CN)_4]^{2-}$
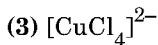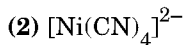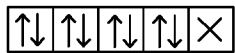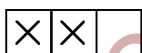
dsp^2

No unpaired electrons and hence diamagnetic.

$\therefore$ **Correct choice : (2)**

18. The correct IUPAC name of the compound

is:

(1) 4-Ethyl-3-propyl hex-1-ene   **(2)** 3-Ethyl-4-ethenyl heptane

(3) 3-Ethyl-4-propyl hex-5-ene   **(4)** 3-(1-ethyl propyl) hex-1-ene

Sol.:

4-Ethyl-3-propyl hex-1-ene
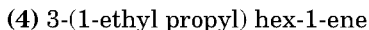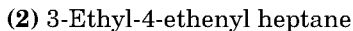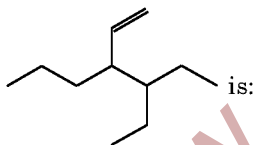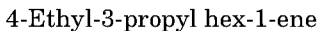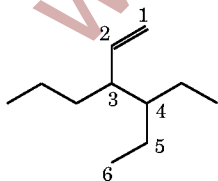
$\therefore$ **Correct choice : (1)**

19. By what factor does the average velocity of a gaseous molecule increase when the temperature (in Kelvin) is doubled?

(1) 2.0   **(2)** 2.8   **(3)** 4.0   **(4)** 1.4

Sol.: Average velocity = $\sqrt{\dfrac{8RT}{\pi M}}$

When temperature is doubled, new velocity is $\sqrt{2}$ times the original velocity i.e., 1.4 times.

∴ **Correct choice : (4)**

20. Which one of the following statement is **not** true?

(1) pH of drinking water should be between 5.5 – 9.5

(2) Concentration of DO below 6 ppm is good for the growth of fish

(3) Clean water would have a BOD value of less than 5 ppm

(4) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutant

∴ **Correct choice : (2)**

21. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared?

(1) Linear chain silicate   **(2)** Sheet silicate

(3) Pyrosilicate   **(4)** Three dimensional

Sol.:

$$O^- - \overset{\displaystyle O^-}{\underset{\displaystyle O^-}{\overset{|}{\underset{|}{S}}}} - O - \overset{\displaystyle O^-}{\underset{\displaystyle O^-}{\overset{|}{\underset{|}{S}}}} - O^- \quad \text{pyrosilicate.}$$
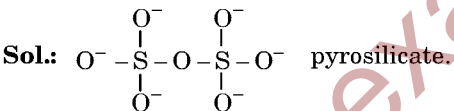
∴ **Correct choice : (3)**

22. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49 u. Molecular mass of B will be:

(1) 50.00 u   **(2)** 12.25 u   **(3)** 6.50 u   **(4)** 25.00 u

Sol.: Volume of diffusion of gases is the same

$$\frac{t_A}{t_B} = \sqrt{\frac{M_A}{M_B}}$$

$$\frac{20}{10} = \sqrt{\frac{49}{M_B}} \quad \text{or} \quad \frac{400}{100} = \frac{49}{M_B} \quad \text{or}$$

$$M_B = 12.25 \text{ u}$$

∴ **Correct choice : (2)**

23. In Dumas' method of estimation of nitrogen 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be:

(Aqueous tension at 300 K = 15 mm)

(1) 15.45   **(2)** 16.45   **(3)** 17.45   **(4)** 14.45

Sol.: $\dfrac{P_1 V_1}{T_1} = \dfrac{P_0 V_0}{T_0}$

$\dfrac{(715-15)55}{300} = \dfrac{760\, V_0}{273}$

$V_0 = \dfrac{700 \times 55 \times 273}{300 \times 760}$

Mass of Nitrogen = $\dfrac{700 \times 55 \times 273}{300 \times 760} \times \dfrac{28}{22,400}$ = 0.05762 g

Percentage of Nitrogen = $\dfrac{0.05762}{0.35} \times 100 = 16.45\%$

∴ **Correct choice : (2)**

24. Which **one** of the following is employed as Antihistamine?
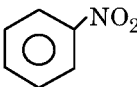
(1) Chloramphenicol   **(2)** Diphenyl hydramine

(3) Norothindrone   **(4)** Omeprazole

Sol.: Antihistamine is Diphenyl hydramine

∴ **Correct choice : (2)**

25. What is the product obtained in the following reaction:

(1)   **(2)**

(3)   **(4)**

Sol.:
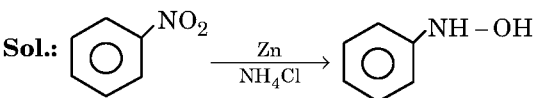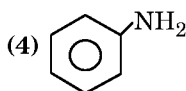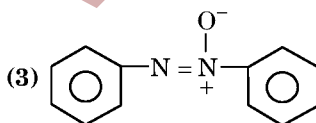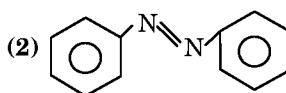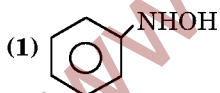
∴ **Correct choice : (1)**

26. Standard electrode potential for Sn^{4+}/Sn^{2+} couple is $+ 0.15$ V and that for the Cr^{3+}/Cr couple is $- 0.74$ V. These two couple in their standard state are connected to make cell. The cell potential will be:

(1) $+ 1.19$ V   (2) $+ 0.89$ V   (3) $+ 0.18$ V   (4) $+ 1.83$ V

Sol.: $Cr \left| Cr^{3+}_{aq} \right| \left| Sn^{2+}, Sn^{4+} \right| Pt$

$E^o_{cell} = E^o_{RHS} - E^o_{LHS}$

$\qquad = 0.15 - (- 0.74)$

$\qquad = 0.89$ V

∴ **Correct choice : (2)**

27. The van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively:

(1) less than one and greater than one

(2) less than one and less than one

(3) greater than one and less than one

(4) greater than one and greater than one

Sol.: i > 1 for dissociation

i < 1 for association

∴ **Correct choice : (3)**

28. The Lassaigne's extract is boiled with conc. HNO_3 while testing for halogens. By doing so it:

(1) decomposes Na_2S and NaCN, if formed

(2) helps in the precipitation of AgCl

(3) increases the solubility product of AgCl

(4) increases the concentration of NO_3^- ion

∴ **Correct choice : (1)**

29. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e., λ_1 and λ_2 will be

(1) $\lambda_1 = \lambda_2$ (2) $\lambda_1 = 2\lambda_2$ (3) $\lambda_1 = 4\lambda_2$ (4) $\lambda_1 = \dfrac{1}{2} \lambda_2$

Sol.: Energy is inversely proportional to λ

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{25}{50} = \frac{\lambda_2}{\lambda_1} = \frac{1}{2}$$

$$\lambda_1 = 2\lambda_2$$

$\therefore$ **Correct choice : (2)**

30. A gaseous mixture was prepared by taking equal mole of CO and N_2. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N_2) in the mixture is :

(1) 0.5 atm   (2) 0.8 atm   (3) 0.9 atm   (4) 1 atm

Sol.: $P_{N_2} = \chi_{N_2} P_T = 0.5 \times 1$

$\qquad\qquad = 0.5$ atm

$\therefore$ **Correct choice : (1)**

31. Mole fraction of the solute in a 1.00 molal aqueous solution is :

(1) 0.1770   (2) 0.0177   (3) 0.0344   (4) 1.7700

Sol.: Mole fraction of solute $= \dfrac{n_2}{n_1 + n_2} = \dfrac{\left(\dfrac{W_2}{M_2}\right)}{\left(\dfrac{W_1}{M_1} + \dfrac{W_2}{M_2}\right)}$

$$= \frac{1}{\dfrac{1000}{18} + 1}$$

$$= \frac{1}{56.55} = 0.0177$$

$\therefore$ **Correct choice : (2)**

32. Clemmensen reduction of a ketone is carried out in the presence of which of the following?

(1) Glycol with KOH   (2) Zn-Hg with HCl

(3) Li AlH_4 (4) H_2 and Pt as catalyst

$\therefore$ **Correct choice : (2)**

33. Acidified $K_2Cr_2O_7$ solution turns green when Na_2SO_3 is added to it. This is due to the formation of :

(1) $Cr_2(SO_4)_3$　　　**(2)** CrO_4^{2-}　　　**(3)** $Cr_2(SO_3)_3$　　　**(4)** $CrSO_4$

Sol.: Reduced product, $Cr_2(SO_4)_3$ is green.

$\therefore$ **Correct choice : (1)**

34. Which of the following elements is present as the impurity to the maximum extent in the pig iron?

(1) Manganese　　　**(2)** Carbon　　　**(3)** Silicon　　　**(4)** Phosphorus

Sol.: Pig iron contains 2 – 5% carbon with traces of Si, Mn and P.

$\therefore$ **Correct choice : (2)**

35. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C, the entropy change for the process would be:

(1) 10 J mol^{-1} K^{-1}　　　　　　　　**(2)** 1.0 J mol^{-1} K^{-1}

(3) 0.1 J mol^{-1} K^{-1}　　　　　　　**(4)** 100 J mol^{-1} K^{-1}

Sol.: $\Delta S = \dfrac{\Delta H}{T} = \dfrac{30 \times 10^3 \, J}{300 \, K}$ per mole

$= 100$ J mol^{-1} K^{-1}

$\therefore$ **Correct choice : (4)**

36. Which of the following compounds has the lowest melting point?

(1) $CaCl_2$　　　**(2)** $CaBr_2$　　　**(3)** CaI_2　　　**(4)** CaF_2

Sol.: CaI_2 has the lowest melting point.

$\therefore$ **Correct choice : (3)**

37. The complexes $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are the examples of which type of isomerism?

(1) Linkage isomerism　　　　　　　**(2)** Ionization isomerism

(3) Coordination isomerism　　　　　**(4)** Geometrical isomerism

$\therefore$ **Correct choice : (3)**

38. The complex, $[Pt(Py)(NH_3) BrCl]$ will have how many geometrical isomers?

(1) 3　　　　　**(2)** 4　　　　　**(3)** 0　　　　　**(4)** 2

Sol.:
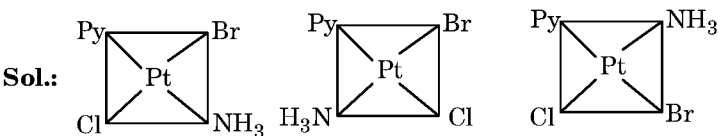
$\therefore$ **Correct choice : (1)**

39. Enthalpy change for the reaction, $4H_{(g)} \longrightarrow 2H_{2(g)}$ is -869.6 kJ. The dissociation energy of $H - H$ bond is:

(1) -434.8 kJ   **(2)** -869.6 kJ   **(3)** $+434.8$ kJ   **(4)** $+217.4$ kJ

Sol.: $2H - H \longrightarrow 4H : \Delta H = +869.6$ kJ

Bond dissociation energy $= \dfrac{869.6}{2} = 434.8$ kJ

$\therefore$ **Correct choice : (3)**

40. The d-electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and Co^{2+} are d^4, d^5, d^6 and d^7 respectively. Which one of the following will exhibit minimum paramagnetic behaviour?

(1) $[Mn(H_2O)_6]^{2+}$ **(2)** $[Fe(H_2O_6)]^{2+}$ **(3)** $[Co(H_2O)_6]^{2+}$ **(4)** $[Cr(H_2O)_6]^{2+}$
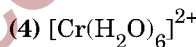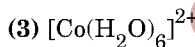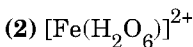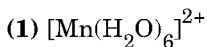
(At. nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

Sol.:

Complex	Unpaired electrons
$\left[Mn(H_2O)_6\right]^{2+}$	5
$\left[Fe(H_2O)_6\right]^{2+}$	4
$\left[Co(H_2O)_6\right]^{2+}$	3
$\left[Cr(H_2O)_6\right]^{2+}$	4
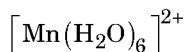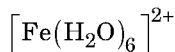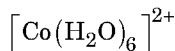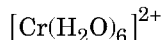
$\therefore$ **Correct choice : (3)**

41. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?

(1) $q = 0$, $\Delta T \neq 0$, $w = 0$ **(2)** $q \neq 0$, $\Delta T = 0$, $w = 0$

(3) $q = 0$, $\Delta T = 0$, $w = 0$ **(4)** $q = 0$, $\Delta T < 0$, $w \neq 0$

Sol.: For adiabatic free expansion $q = 0$, $\Delta T = 0$ and $w = 0$

$\therefore$ **Correct choice : (3)**

42. The value of ΔH for the reaction $X_{2(g)} + 4Y_{2(g)} \rightleftharpoons 2XY_{4(g)}$ is less than zero. Formation of $XY_{4(g)}$ will be favoured at :

(1) High temperature and high pressure   **(2)** Low pressure and low temperature

(3) High temperature and low pressure   **(4)** High pressure and low temperature

Sol.: $X_{2(g)} + 4Y_{2(g)} \rightleftharpoons 2XY_{4(g)}$; $\Delta H = -Ve$ exothermic.

$\Delta n = -3$

Formation of XY_4 is favoured by low temperature and high pressure.

$$\therefore \text{ Correct choice : (4)}$$

43. The correct order of increasing bond length of C – H, C – O, C – C and C = C is:

(1) $C - H < C = C < C - O < C - C$ **(2)** $C - C < C = C < C - O < C - H$

(3) $C - O < C - H < C - C < C = C$ **(4)** $C - H < C - O < C - C < C = C$

Sol.: $C - H < C = C < C - O < C - C$

$$\therefore \text{ Correct choice : (1)}$$

44. If the E^o_{cell} for a given reaction has a negative value, then which of the following gives the correct relationships for the values of $\Delta G°$ and K_{eq}?

(1) $\Delta G° > 0; K_{eq} > 1$ **(2)** $\Delta G° < 0; K_{eq} > 1$

(3) $\Delta G° < 0; K_{eq} < 1$ **(4)** $\Delta G° > 0; K_{eq} < 1$
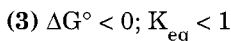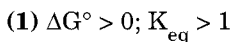
Sol.: $\Delta G° = -nFE^o = 2.303 \, RT \log K_{eq}$

When E^o_{cell} is $-ve$

$\Delta G°$ is $+ve$ i.e., non-spontaneous.

$K_{eq} < 1$

$$\therefore \text{ Correct choice : (4)}$$

45. Which one is a nucleophilic substitution reaction among the following?

(1) $CH_3 - CH = CH_2 + H_2O \xrightarrow{H^+} CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3$

(2) $RCHO + R'MgX \longrightarrow R - \underset{\underset{OH}{|}}{CH} - R'$

(3) $CH_3 - CH_2 - \underset{\overset{|}{CH_3}}{CH} - CH_2Br + NH_3 \longrightarrow CH_3 - CH_2 - \underset{\overset{|}{CH_3}}{CH} - CH_2NH_2$

(4) $CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$
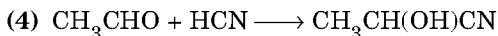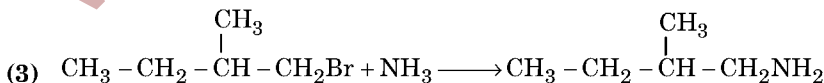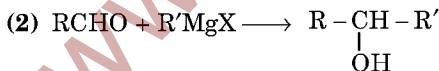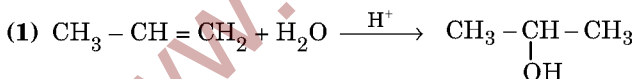
Sol.: In compound (3),

Br is substituted by NH_2 by S_N2 reaction.

$$\therefore \text{ Correct choice : (3)}$$

46. Which of the following pairs of metals is purified by van Arkel method?

(1) Ga and In   (2) Zr and Ti   (3) Ag and Au   (4) Ni and Fe

Sol.: Zr and Ti are purified by van Arkel Method.

$\therefore$ **Correct choice : (2)**

47. For the reaction $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2\,NO_{2(g)}$. What is K for the reaction $NO_{2(g)} \rightleftharpoons \dfrac{1}{2}N_{2(g)} + O_{2(g)}$?

(1) $\dfrac{1}{(2K_1K_2)}$ (2) $\dfrac{1}{(4K_1K_2)}$ (3) $\left[\dfrac{1}{K_1K_2}\right]^{1/2}$ (4) $\dfrac{1}{(K_1K_2)}$

Sol.:
$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)} \;;\; K_1$$
$$\underline{2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \;;\; K_2}$$
$$N_{2(g)} + 2O_{2(g)} \rightleftharpoons 2NO_{2(g)} \;;\; K_1K_2$$

$$NO_{2(g)} \rightleftharpoons \dfrac{1}{2}N_{2(g)} + O_{2(g)} \;;\; \left[\dfrac{1}{K_1K_2}\right]^{\frac{1}{2}}$$
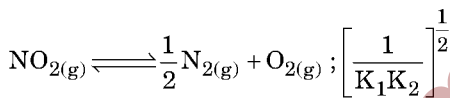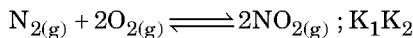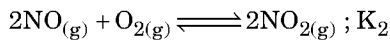
$\therefore$ **Correct choice : (3)**

48. Which one of the following is present as an active ingredient in bleaching powder for bleaching action?

(1) $CaOCl_2$ (2) $Ca(OCl)_2$ (3) CaO_2Cl (4) $CaCl_2$
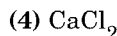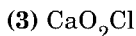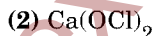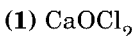
Sol.: $Ca\!\!\begin{array}{c} \diagup Cl \\ \diagdown OCl \end{array}$ bleaching powder.

$\therefore$ **Correct choice : (1)**

49. Of the following which one is classified as polyester polymer?

(1) Terylene   (2) Bakelite   (3) Melamine   (4) Nylon-66

Sol.: Terylene is a polyester.

$\therefore$ **Correct choice : (1)**

50. If n = 6, the correct sequence for filling of electrons will be:

(1) $ns \longrightarrow (n-2)f \longrightarrow (n-1)d \longrightarrow np$

(2) $ns \longrightarrow (n-1)d \longrightarrow (n-2)f \longrightarrow np$

(3) $ns \longrightarrow (n-2)f \longrightarrow np \longrightarrow (n-1)d$

(4) $ns \longrightarrow np(n-1)d \longrightarrow (n-2)f$
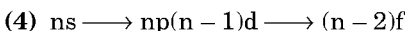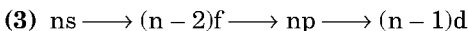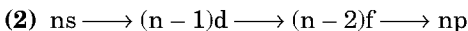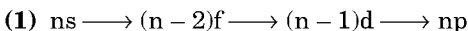
Sol.: $6s < 4f < 5d < 6p$.

$\therefore$ **Correct choice : (1)**

BIOLOGY

51. What will you look for to identify the sex of the following?

    (1) Female **Ascaris** – Sharply curved posterior end

    (2) Male frog – A copulatory pad on the first digit of the hind limb

    (3) Female cockroach – Anal cerci

    (4) Male shark – Claspers borne on pelvic fins

              ∴ **Correct Choice: (4)**

52. Filiform apparatus is a characteristic feature of:

    (1) Suspensor   **(2)** Egg   **(3)** Synergid   **(4)** Zygote

              ∴ **Correct Choice: (3)**

53. "Jaya" and "Ratna" developed for green revolution in India are the varieties of:

    (1) Maize   **(2)** Rice   **(3)** Wheat   **(4)** Bajra

              ∴ **Correct Choice: (2)**

54. A prokaryotic autotrophic nitrogen fixing symbiont is found in:

    (1) Alnus   **(2) Cycas**   **(3) Cicer**   **(4) Pisum**

              ∴ **Correct Choice: (2)**

55. One very special feature in the earthworm **Pheretima** is that:

    (1) Fertilisation of eggs occurs inside the body

    (2) The typhlosole greatly increases the effective absorption area of the digested food in the intestine

    (3) The S-shaped setae embedded in the integument are the defensive weapons used against the enemies

    (4) It has a long dorsal tubular heart

              ∴ **Correct Choice: (2)**

56. What type of human population is represented by the following age pyramid?
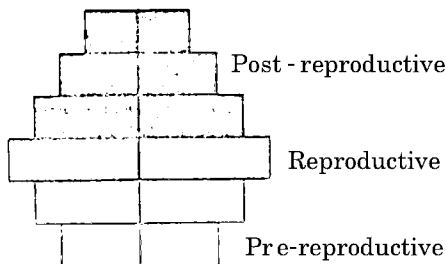
    (1) Vanishing population   **(2)** Stable population

    (3) Declining population   **(4)** Expanding population

              ∴ **Correct Choice: (2)**

57. Mass of living matter at a trophic level in an area at any time is called:

(1) Standing crop   **(2)** Detritus   **(3)** Humus   **(4)** Standing state

∴ **Correct Choice: (1)**

58. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it?

5′ _____ GAATTC _____ 3′

3′ _____ CTTAAG _____ 5′

(1) Replication completed   **(2)** Deletion mutation

(3) Start codon at the 5′ end   **(4)** Palindromic sequence of base pairs

∴ **Correct Choice: (4)**

59. The most common substrate used in distilleries for the production of ethanol is:

(1) Corn meal   **(2)** Soya meal   **(3)** Ground gram   **(4)** Molasses

∴ **Correct Choice: (1)**

Because of its abundance corn meal is commonly used in distilleries for ethanol production.

60. Ground tissue includes:

(1) All tissues external to endodermis

(2) All tissues except epidermis and vascular bundles

(3) Epidermis and cortex

(4) All tissues internal to endodermis

∴ **Correct Choice: (2)**

61. Eutrophication is often seen in:

(1) Deserts   **(2)** Fresh water lakes

(3) Ocean   **(4)** Mountains

∴ **Correct Choice: (2)**

62. Which one of the following elements in plants is **not** remobilized?

(1) Phosphorus   **(2)** Calcium   **(3)** Potassium   **(4)** Sulphur

∴ **Correct Choice: (2)**

63. Where will you look for the sporozoites of the malarial parasite?

(1) Saliva of infected female **Anopheles** mosquito

(2) Red blood corpuscles of humans suffering from malaria

(3) Spleen of infected humans

(4) Salivary glands of freshly moulted female **Anopheles** mosquito

∴ **Correct Choice: (1)**

64. 'Himgiri' developed by hybridization and selection for disease resistance against rust pathogens is a variety of:

(1) Chilli   (2) Maize   (3) Sugarcane   (4) Wheat

∴ **Correct Choice: (4)**

65. Of the total incident solar radiation the proportion of PAR is:

(1) About 70%   (2) About 60%   (3) Less than 50%   (4) More than 80%

∴ **Correct Choice: (3)**

The visible light or photosynthetically active radiation consists of 400 – 700 nm wavelength of light and forms 45.1 – 46.7% of total solar radiation.

66. Which one of the following is **not** a part of a renal pyramid?

(1) Peritubular capillaries   (2) Convoluted tubules

(3) Collecting ducts   (4) Loops of Henle

∴ **Correct Choice: (1)**

67. Which one of the following expanded forms of the following acronyms is **correct?**

(1) IPCC = International Panel for Climate Change

(2) UNEP = United Nations Environmental Policy

(3) EPA = Environmental Pollution Agency

(4) IUCN = International Union for Conservation of Nature and Natural Resources

∴ **Correct Choice: (4)**

68. Which one of the following pairs of gases are the major cause of "Greenhouse effect"?

(1) CO_2 and O_3 (2) CO_2 and CO   (3) CFCs and SO_2 (4) CO_2 and N_2O

∴ **Correct Choice: (4)**

69. Which one of the following conditions **correctly** describes the manner of determining the sex in the given example?

(1) Homozygous sex chromosomes (ZZ) determine female sex in Birds.

(2) XO type of sex chromosomes determine male sex in grasshopper

(3) XO condition in humans as found in Turner Syndrome, determines female sex

(4) Homozygous sex chromosomes (XX) produce male in **Drosophila**

∴ **Correct Choice: (2)**

70. Nucellar polyembryony is reported in species of:

(1) **Citrus**   (2) **Gossypium**   (3) **Triticum**   (4) **Brassica**

∴ **Correct Choice: (1)**

71. Important site for formation of glycoproteins and glycolipids is:

(1) Vacuole   (2) Golgi apparatus   (3) Plastid   (4) Lysosome

∴ **Correct Choice: (2)**

72. Which one of the following is **not** a biofertilizer?

(1) Agrobacterium **(2) Rhizobium** **(3) Nostoc** **(4)** Mycorrhiza

∴ **Correct Choice: (4)**

73. Secondary sewage treatment is mainly a:

(1) Physical process **(2)** Mechanical process

(3) Chemical process **(4)** Biological process

∴ **Correct Choice: (4)**

74. At which stage of HIV infection does one usually show symptoms of AIDS?

(1) When the infecting retrovirus enters host cells

(2) When viral DNA is produced by reverse transcriptase

(3) When HIV replicates rapidly in helper T-lymphocytes and damages large number of these

(4) Within 15 days of sexual contact with an infected person

∴ **Correct Choice: (3)**

75. In which one of the following pollination is autogamous?

(1) Geitonogamy **(2)** Xenogamy **(3)** Chasmogamy **(4)** Cleistogamy

∴ **Correct Choice: (4)**

76. The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function?
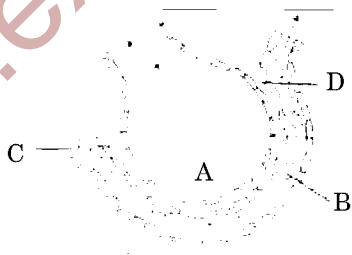
Options:

(1) C: arterial capillary – passes oxygen to tissues

(2) A: alveolar cavity – main site of exchange of respiratory gases

(3) D: Capillary wall – exchange of O_2 and CO_2 takes place here

(4) B: red blood cell – transport of CO_2 mainly

∴ **Correct Choice: (2)**

84. Which one of the following groups of animals is **correctly** matched with its one characteristic feature without even a single exception?

   (1) Reptilia: possess 3-chambered heart with one incompletely divided ventricle

   (2) Chordata: possess a mouth provided with an upper and a lower jaw

   (3) Chondrichthyes: possess cartilaginous endoskeleton

   (4) Mammalia: give birth to young ones

∴ **Correct Choice: (3)**

85. Large Woody Vines are more commonly found in:

   (1) Temperate forests   **(2)** Mangroves

   (3) Tropical rainforests   **(4)** Alpine forests

∴ **Correct Choice: (3)**

86. An organism used as a biofertilizer for raising soyabean crop is:

   (1) Azotobacter   **(2) Azospirillum**   **(3) Rhizobium**   **(4) Nostoc**

∴ **Correct Choice: (3)**

87. Which one of the following plasma proteins is involved in the coagulation of blood?

   (1) An albumin   **(2)** Serum amylase   **(3)** A globulin   **(4)** Fibrinogen

∴ **Correct Choice: (4)**

88. Ethanol is commercially produced through a particular species of:

   (1) Saccharomyces (2) Clostridium   **(3) Trichoderma**   **(4) Aspergillus**

∴ **Correct Choice: (1)**

89. Which one of the following structural formulae of two organic compounds is **correctly** identified along with its related function?

   (1) B: Adenine – a nucleotide that makes up nucleic acids

   (2) A: Triglyceride – major source of energy

   (3) B: Uracil – a component of DNA

   (4) A: Lecithin – a component of cell membrane

∴ **Correct Choice: (4)**

90. Which one of the following organisms is **not** an example of eukaryotic cells?

(1) Paramecium caudatum   **(2) Escherichia coli**

(3) Euglena viridis   **(4) Amoeba proteus**

∴ **Correct Choice: (2)**

91. Given below is an incomplete table about certain hormones, their source glands and one major effect of each on the body in humans. Identify the correct option for the three blanks A, B and C.

GLAND	SECRETION	EFFECT ON BODY
A	Oestrogen	Maintenance of secondary sexual characters
Alpha cells of Islets of Langerhans	B	Raises blood sugar level
Anterior pituitary	C	Over secretion leads to gigantism

Options:

	A	B	C
(1)	Ovary	Glucagon	Growth hormone
(2)	Placenta	Insulin	Vasopressin
(3)	Ovary	Insulin	Calcitonin
(4)	Placenta	Glucagon	Calcitonin

∴ **Correct Choice: (1)**

92. What are those structures that appear as 'beads-on-string' in the chromosomes when viewed under electron microscope?

(1) Genes   **(2)** Nucleotides   **(3)** Nucleosomes   **(4)** Base pairs

∴ **Correct Choice: (3)**

93. Nitrifying bacteria:

(1) oxidize ammonia to nitrates

(2) convert free nitrogen to nitrogen compounds

(3) convert proteins into ammonia

(4) reduce nitrates to free nitrogen

∴ **Correct Choice: (1)**

94. Archegoniophore is present in:

(1) Marchantia   **(2) Chara**   **(3) Adiantum**   **(4) Funaria**

∴ **Correct Choice: (1)**

95. There is a restriction endonuclease called EcoRI. What does "co" part in it stand for?

   (**1**) colon   (**2**) coelom   (**3**) coenzyme   (**4**) coli

∴ **Correct Choice: (4)**

96. A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O_2:

   (**1**) acts as a reserve during muscular exercise

   (**2**) raises the pCO_2 of blood to 75 mm of Hg

   (**3**) is enough to keep oxyhaemoglobin saturation at 96%

   (**4**) helps in releasing more O_2 to the epithelial tissues

∴ **Correct Choice: (4)**

97. In land plants, the guard cells differ from other epidermal cells in having:

   (**1**) Cytoskeleton   (**2**) Mitochondria

   (**3**) Endoplasmic reticulum   (**4**) Chloroplasts

∴ **Correct Choice: (4)**

98. Which one of the following is the most widely accepted method of contraception in India, as at present?

   (**1**) Cervical caps   (**2**) Tubectomy

   (**3**) Diaphragms   (**4**) IUDs' (Intra uterine devices)

∴ **Correct Choice: (4)**

99. The ciliated columnar epithelial cells in humans are known to occur in:

   (**1**) Eustachian tube and stomach lining

   (**2**) Bronchioles and Fallopian tubes

   (**3**) Bile duct and oesophagus

   (**4**) Fallopian tubes and urethra

∴ **Correct Choice: (2)**

100. Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing have been due to improper movement of:

   (**1**) Epiglottis   (**2**) Diaphragm   (**3**) Neck   (**4**) Tongue

∴ **Correct Choice: (1)**

101. What would be the number of chromosomes of the aleurone cells of a plant with 42 chromosomes in its root tip cells?

(1) 42   **(2)** 63   **(3)** 84   **(4)** 21

∴ **Correct Choice: (2)**

102. Consider the following four conditions (a – d) and select the **correct** pair of them as adaptation to environment in **desert lizards**.

The conditions:

(a) burrowing in soil to escape high temperature

(b) losing heat rapidly from the body during high temperature

(c) bask in sun when temperature is low

(d) insulating body due to thick fatty dermis

Options:

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

∴ **Correct Choice: (2)**

103. Maximum number of existing transgenic animals is of:

(1) Fish   **(2)** Mice   **(3)** Cow   **(4)** Pig

∴ **Correct Choice: (2)**

104. Which one of the following statements is **correct** for secondary succession?

(1) It begins on a bare rock.

(2) It occurs on a deforested site.

(3) It follows primary succession.

(4) It is similar to primary succession except that it has a relatively fast pace.

∴ **Correct Choice: (2)**

105. In eubacteria, a cellular component that resembles eukaryotic cell is:

(1) Plasma membrane   **(2)** Nucleus

(3) Ribosomes   **(4)** Cell wall

∴ **Correct Choice: (3)**

106. A collection of plants and seeds having diverse alleles of all the genes of a crop is called:

(1) Herbarium   **(2)** Germplasm   **(3)** Gene library   **(4)** Genome

∴ **Correct Choice: (2)**

Germ plasm is the sum total of all the alleles of gene present in a crop and its related species that include old local or desi varieties, improved varieties that may not be in cultivation.

107. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will **not** be transported from:

(1) testes to epididymis

(2) epididymis to vas deferens

(3) ovary to uterus

(4) vagina to uterus

∴ **Correct Choice: (1)**

108. Which one of the following **correctly** explains the function of a specific part of a human nephron?

(1) **Podocytes:** Create minute spaces (slit pores) for the filtration of blood into the Bowman's capsule.

(2) **Henle's loop:** most reabsorption of the major substances from the glomerular filtrate.

(3) **Distal convoluted tubule:** reabsorption of K^+ ions into the surrounding blood capillaries

(4) **Afferent arteriole:** carries the blood away from the glomerulus towards renal vein.

∴ **Correct Choice: (1)**

109. The **correct** floral formula of chilli is:

(1) $\oplus \, \male\female \, K_{(5)} C_5 A_5 G_{\underline{(2)}}$

(2) $\oplus \, \male\female \, K_{(5)} \overset{\frown}{C_{(5)}} A_5 G_{\underline{(2)}}$

(3) $\oplus \, \male\female \, K_{(5)} C_{(5)} A_{(5)} G_{\underline{2}}$

(4) $\oplus \, \male\female \, K_5 \overset{\frown}{C_5} A_{(5)} G_{\underline{2}}$

∴ **Correct Choice: (2)**

110. Arteries are best defined as the vessels which:

(1) supply oxygenated blood to the different organs

(2) carry blood away from the heart to different organs

(3) break up into capillaries which reunite to form a vein

(4) carry blood from one visceral organ to another visceral organ

∴ **Correct Choice: (2)**

111. Which one of the following is categorised as a **parasite** in **true sense**?

(1) The female **Anopheles** bites and sucks blood from humans.

(2) Human foetus developing inside the uterus draws nourishment from the mother.

(3) Head louse living on the human scalp as well as laying eggs on human hair.

(4) The cuckoo (koel) lays its eggs in crow's nest

∴ **Correct Choice: (2)**

112. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for:

(1) maintaining the scrotal temperature lower than the internal body temperature

(2) escaping any possible compression by the visceral organs

(3) providing more space for the growth of epididymis

(4) providing a secondary sexual feature for exhibiting the male sex

∴ **Correct Choice: (1)**

113. Which one of the following statements is correct with respect to kidney function regulation ?

(1) When someone drinks lot of water, ADH release is suppressed.

(2) Exposure to cold temperature stimulates ADH release.

(3) An increase in glomerular blood flow stimulates formation of Angiotensin II.

(4) During summer when body loses lot of water by evaporation, the release of ADH is suppressed.

∴ **Correct Choice: (1)**

Following drinking of water there is decrease in the osmolarity of blood. This decreases secretion of ADH by feedback inhibition.

114. Agarose extracted from sea weeds finds use in:

(1) Spectrophotometry   **(2)** Tissue Culture

(3) PCR   **(4)** Gel electrophoresis

Agarose is linear polymer of d-galactose and 3, 6-anhydro-L-galactose extracted from sea weeds

∴ **Correct Choice: (4)**

115. Which of the following is **correctly** stated as it happens in the common cockroach ?

(1) Malpighian tubules are excretory organs projecting out from the colon.

(2) Oxygen is transported by haemoglobin in blood.

(3) Nitrogenous excretory product is urea.

(4) The food is ground by mandibles and gizzard

∴ **Correct Choice: (4)**

116. Which one of the following also acts as a catalyst in a bacterial cell?

(1) 5 sr RNA   **(2)** sn RNA   **(3)** hn RNA   **(4)** 23 sr RNA

∴ **Correct Choice: (4)**

117. Which one of the following acts as a physiological barrier to the entry of microorganisms in human body?

(1) Epithelium of Urogenital tract   **(2)** Tears

(3) Monocytes   **(4)** Skin

∴ **Correct Choice: (2)**

118. The function of leghaemoglobin in the root nodules of legumes is:

(1) inhibition of nitrogenase activity   **(2)** oxygen removal

(3) nodule differentiation   **(4)** expression of **nif** gene

∴ **Correct Choice: (2)**

119. The process of RNA interference has been used in the development of plants resistant to:

(1) Nematodes   **(2)** Fungi   **(3)** Viruses   **(4)** Insects

∴ **Correct Choice: (1)**

120. Compared with the gametophytes of the bryophytes, the gametophytes of vascular plants tend to be:

(1) smaller but to have larger sex organs

(2) larger but to have smaller sex organs

(3) larger and to have larger sex organs

(4) smaller and to have smaller sex organs

∴ **Correct Choice: (4)**

121. The gametophyte is **not** an independent, free-living generation in:

(1) Polytrichum   **(2) Adiantum**   **(3) Marchantia**   **(4) Pinus**

∴ **Correct Choice: (4)**

122. The cork cambium, cork and secondary cortex are collectively called:

(1) Phelloderm   **(2)** Phellogen   **(3)** Periderm   **(4)** Phellem

∴ **Correct Choice: (3)**

123. Which one of the following statements for pyramid of energy is **incorrect,** whereas the remaining three are correct?

(1) Its base is broad

(2) It shows energy content of different trophic level organisms

(3) It is inverted in shape

(4) It is upright in shape

∴ **Correct Choice: (3)**

124. Select the **correct** option with respect to mitosis.

(1) Chromatids separate but remain in the centre of the cell in anaphase.

(2) Chromatids start moving towards opposite poles in telophase.

(3) Golgi complex and endoplasmic reticulum are still visible at the end of prophase.

(4) Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase

∴ **Correct Choice: (4)**

125. Uricotelic mode of passing out nitrogenous wastes is found in:

(1) Reptiles and Birds

(2) Birds and Annelids

(3) Amphibians and Reptiles

(4) Insects and Amphibians

∴ **Correct Choice: (1)**

126. Flowers are Zygomorphic in:

(1) Mustard

(2) Gulmohur

(3) Tomato

(4) Datura

∴ **Correct Choice: (2)**

127. Which one of the following statements is **correct** regarding blood pressure:

(1) 130/90 mmHg is considered high and requires treatment

(2) 100/55 mmHg is considered an ideal blood pressure

(3) 105/50 mmHg makes one very active

(4) 190/110 mmHg may harm vital organs like brain and kidney

∴ **Correct Choice: (4)**

128. Medical Termination of Pregnancy (MTP) is considered safe up to how many weeks of pregnancy ?

(1) Eight weeks

(2) Twelve weeks

(3) Eighteen weeks

(4) Six weeks

∴ **Correct Choice: (2)**

129. The ovary is half inferior in flowers of:

(1) Peach   (2) Cucumber   (3) Cotton   (4) Guava

∴ **Correct Choice: (1)**

130. When two unrelated individuals or lines are crossed, the performance of F_1 hybrid is often superior to both its parents. This phenomenon is called:

(1) Heterosis   (2) Transformation

(3) Splicing   (4) Metamorphosis

∴ **Correct Choice: (1)**

131. Mutations can be induced with:

(1) Infra Red radiations   (2) IAA

(3) Ethylene   (4) Gamma radiations

∴ **Correct Choice: (4)**

132. Which one of the following helps in absorption of phosphorus from soil by plants?

(1) **Glomus**   (2) **Rhizobium**   (3) **Frankia**   (4) **Anabaena**

∴ **Correct Choice: (1)**

133. When a neuron is in resting state i.e., not conducting any impulse, the axonal membrane is:

(1) Comparatively more permeable to Na^+ ions and nearly impermeable to K^+ ions

(2) Equally permeable to both Na^+ and K^+ ions

(3) Impermeable to both Na^+ and K^+ ions

(4) Comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions

∴ **Correct Choice: (4)**

134. A certain patient is suspected to be suffering from Acquired Immuno Deficiency Syndrome. Which diagnostic technique will you recommend for its detection?

(1) ELISA   (2) MRI   (3) Ultra sound   (4) WIDAL

∴ **Correct Choice: (1)**

135. Continuous addition of sugars in 'fed batch' fermentation is done to:

(1) produce methane   (2) obtain antibiotics

(3) purify enzymes   (4) degrade sewage

∴ **Correct Choice: (2)**

136. The purplish red pigment rhodopsin contained in the rods type of photoreceptor cells of the human eye, is a derivative of:

(**1**) Vitamin B$_1$ (**2**) Vitamin C   (**3**) Vitamin D   (**4**) Vitamin A

∴ **Correct Choice: (4)**

137. Wind pollination is common in:

(**1**) Legumes   (**2**) Lilies   (**3**) Grasses   (**4**) Orchids

∴ **Correct Choice: (3)**

138. Which one of the following is **wrongly** matched?

(**1**) Root pressure – Guttation   (**2**) **Puccinia** – Smut

(**3**) Root – Exarch protoxylem   (**4**) **Cassia** – Imbricate aestivation

∴ **Correct Choice: (2)**

139. A drupe develops in:

(**1**) Mango   (**2**) Wheat   (**3**) Pea   (**4**) Tomato

∴ **Correct Choice: (1)**

140. Which one of the following enzymes carries out the initial step in the digestion of milk in humans?

(**1**) Pepsin   (**2**) Rennin   (**3**) Lipase   (**4**) Trypsin

∴ **Correct Choice: (2)**

141. CAM helps the plants in:

(**1**) Conserving water   (**2**) Secondary growth

(**3**) Disease resistance   (**4**) Reproduction

∴ **Correct Choice: (1)**

142. Which one of the following animals is **correctly** matched with its particular named taxonomic category ?

(**1**) Tiger - **tigris**, the species   (**2**) Cuttlefish - Mollusca, a class

(**3**) Humans - Primata, the family   (**4**) Housefly - **Musca**, an order

∴ **Correct Choice: (1)**

143. Organisms called Methanogens are most abundant in a:

(**1**) Sulphur rock   (**2**) Cattle yard   (**3**) Polluted stream   (**4**) Hot spring

∴ **Correct Choice: (2)**

144. What was the most significant trend in the evolution of modern man (**Homo sapiens**) from his ancestors?

(**1**) Upright posture   (**2**) Shortening of jaws

(**3**) Binocular vision   (**4**) Increasing brain capacity

∴ **Correct Choice: (4)**

145. In which one of the following the genus name, its two characters and its class/phylum are **correctly** matched?

	Genus name		Two characters	Class/Phylum
(1)	**Ascaris**	(a)	Body segmented	Annelida
		(b)	Males and females distinct	
(2)	**Salamandra**	(a)	A tympanum represents ear	Amphibia
		(b)	Fertilization is external	
(3)	**Pteropus**	(a)	Skin possesses hair	Mammalia
		(b)	Oviparous	
(4)	**Aurelia**	(a)	Cnidoblasts	Coelenterata
		(b)	Organ level of organization	

∴ **Correct Choice: (2)**

146. Which one of the following statements is **wrong** in case of Bhopal tragedy?

(**1**) Methyl Isocyanate gas leakage took place.

(**2**) Thousands of human beings died.

(**3**) Radioactive fall out engulfed Bhopal

(**4**) It took place in the night of December 2/3, 1984.

∴ **Correct Choice: (3)**

147. Which one of the following shows maximum genetic diversity in India?

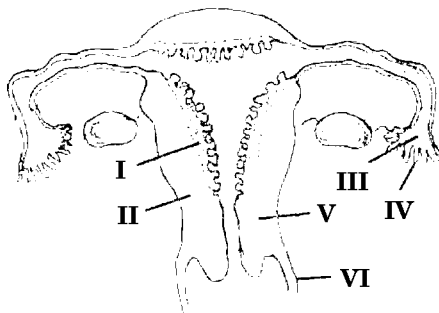(**1**) Groundnut   (**2**) Rice

(**3**) Maize   (**4**) Mango

∴ **Correct Choice: (2)**

148. The **Figure** given below depicts a diagrammatic sectional view of the female reproductive system of humans. Which one set of three parts out of I – IV have been **correctly** identified?

(1) **(II)** Endometrium, **(III)** Infundibulum, **(IV)** Fimbriae

(2) **(III)** Infundibulum, **(IV)** Fimbriae **(V)** Cervix

(3) **(IV)** Oviducal funnel, **(V)** Uterus, **(VI)** Cervix

(4) **(I)** Perimetrium, **(II)** Myometrium, **(III)** Fallopian tube

∴ **Correct Choice: (2)**

149. A person with **unknown** blood group under ABO system, has suffered much blood loss in an accident and needs immediate blood transfusion. His one friend who has a valid certificate of his own blood type, offers for blood donation without delay. What would have been the type of blood group of the donor friend?

(1) Type B   (2) Type AB   (3) Type O   (4) Type A

∴ **Correct Choice: (3)**

150. The curve given below shows enzymatic activity with relation to three conditions (pH, temperature and substrate concentration)

What do the two axises (x and y) represent?

	x-axis	**y-axis**
(1)	enzymatic activity,	pH
(2)	temperature,	enzyme activity
(3)	substrate concentration,	enzymatic activity
(4)	enzymatic activity,	temperature

∴ **Correct Choice: (2)**

PHYSICS
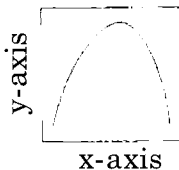
151. Photoelectric emission occurs only when the incident light has more than a certain minimum:

(1) Power   **(2)** Wavelength   **(3)** Intensity   **(4)** Frequency

Sol.: Max. K.E. = $h\nu - \phi$, $\nu > \nu_0 \left(= \dfrac{\phi}{h}\right)$

$$\therefore \text{ Correct choice : (4)}$$

152. A current carrying closed loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$, the force on the arm AC is:

(1) $-\sqrt{2}\,\vec{F}$ **(2)** $-\vec{F}$ **(3)** $\vec{F}$ **(4)** $\sqrt{2}\,\vec{F}$

Sol.:

$$\vec{F} = I\left(\overrightarrow{BC} \times \vec{B_o}\right) = I\,\overrightarrow{BC}\,\vec{B_o}$$

$$\vec{F}_{AC} = I\left(\overrightarrow{AC} \times \vec{B_o}\right) = I\,\overrightarrow{AC}\,\vec{B_o} \times \frac{1}{\sqrt{2}}$$

$$= I\left(\sqrt{2}\right)\overrightarrow{BC} \times \frac{\vec{B_o}}{\sqrt{2}}$$

$$= \vec{F}$$
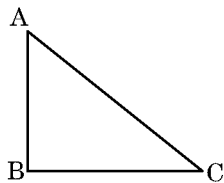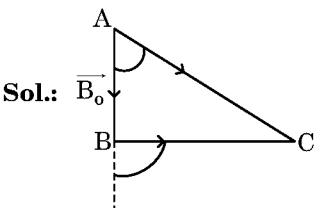
$$\therefore \text{ Correct choice : (3)}$$

153. A particle moves in a circle of radius 5 cm with constant speed and time period 0.2π s. The acceleration of the particle is:

(1) 15 m/s^2 **(2)** 25 m/s^2 **(3)** 36 m/s^2 **(4)** 5 m/s^2

Sol.: Acceleration = $r\omega^2 = 5 \times 10^{-2} \times \left(\dfrac{2\pi}{0.2\,\pi}\right)^2 = 5 \times 10^{-2} \times 100 = 5 \text{ ms}^{-2}$

$$\therefore \text{ Correct choice : (4)}$$

154. Which of the following is **not** due to total internal reflection?

    (1) Working of optical fibre.

    (2) Difference between apparent and real depth of a pond.

    (3) Mirage on hot summer days.

    (4) Brilliance of diamond.

                                      $\therefore$ **Correct choice : (2)**

155. A missile is fired for maximum range with an initial velocity of 20 m/s. If $g = 10$ m/s^2, the range of the missile is:

    (1) 40 m   **(2)** 50 m   **(3)** 60 m   **(4)** 20 m

Sol.: $R_{max} = \dfrac{u^2}{g} = \dfrac{20 \times 20}{10} = 40$ m

                                        $\therefore$ **Correct choice : (1)**

156. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a hydrogen like ion. The atomic number Z of hydrogen like ion is:

    (1) 3   **(2)** 4   **(3)** 1   **(4)** 2

Sol.: $\dfrac{1}{\lambda_L} = R_H \left[\dfrac{1}{1^2} - \dfrac{1}{2^2} \right]$, $\dfrac{1}{\lambda_B} = R_H Z^2 \left(\dfrac{1}{2^2} - \dfrac{1}{4^2} \right)$

    $\lambda_L = \lambda_B \Rightarrow \dfrac{3}{4} R_H = \dfrac{3\, R_H Z^2}{16}$

    $\therefore Z^2 = 4$ or $Z = 2$

                                        $\therefore$ **Correct choice : (4)**

157. The half life of a radioactive isotope 'X' is 50 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio of 1 : 15 in a sample of a given rock. The age of the rock was estimated to be:

    (1) 150 years   **(2)** 200 years   **(3)** 250 years   **(4)** 100 years

Sol.: Ratio 1 : 15 $\Rightarrow N = \dfrac{1}{16} = \dfrac{1}{2^n}$

    $\Rightarrow n = 4 \therefore t = 4T = 200$ years

                                        $\therefore$ **Correct choice : (2)**

158. The potential energy of a system increases if work is done:

    (1) upon the system by a nonconservative force.

    (2) by the system against a conservative force.

    (3) by the system against a nonconservative force.

    (4) upon the system by a conservative force.

Sol.: $(W.D)_{\text{by conservative}} = -\Delta U$. For $\Delta U > 0$, $(W.D) < 0$

    $\therefore$ U increases if W.D. against conservative force.

                                        $\therefore$ **Correct choice : (2)**

159. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will:

(1) increase four times   **(2)** be reduced to half

(3) remain the same   **(4)** be doubled

$$\therefore \textbf{ Correct choice : (3)}$$

160. The power obtained in a reactor using U^{235} disintegration is 1000 kW. The mass decay of U^{235} per hour is:

(1) 10 microgram   **(2)** 20 microgram   **(3)** 40 microgram   **(4)** 1 microgram

Sol.: Power = 1000 kW $\longrightarrow$ Energy per hour = $10^6 \times 60 \times 60$ J

Mass $M = \dfrac{10^8 \times 36}{9 \times 10^{16}} = \dfrac{36}{9} \times 10^{-8} = 4 \times 10^{-8}$ kg

[Take P = 1000 MW, M = 40×10^{-6} kg = 40 microgram]

$$\therefore \textbf{ Correct choice : (3)}$$

161. A radioactive nucleus of mass M emits a photon of frequency ν and the nucleus recoils. The recoil energy will be:

(1) $Mc^2 - h\nu$ **(2)** $h^2\nu^2/2Mc^2$ **(3)** zero   **(4)** $h\nu$

Sol.: Initial energy = Mc^2, Recoil energy = $Mc^2 - h\nu$

$$\therefore \textbf{ Correct choice : (1)}$$

162. The electric and the magnetic field, associated with an e.m. wave, propagating along the + z-axis, can be represented by:

(1) $\left[\vec{E} = E_o\ \hat{i}, \vec{B} = B_o\ \hat{j}\right]$ **(2)** $\left[\vec{E} = E_o\ \hat{k}, \vec{B} = B_o\ \hat{i}\right]$

(3) $\left[\vec{E} = E_o\ \hat{j}, \vec{B} = B_o\ \hat{i}\right]$ **(4)** $\left[\vec{E} = E_o\ \hat{j}, \vec{B} = B_o\ \hat{k}\right]$

Sol.: $\vec{S} = \left(\vec{E} \times \vec{B}\right) K \qquad \vec{S} \longrightarrow \hat{k}$ (z-axis)

$$\therefore \vec{E} \longrightarrow \hat{i}, \vec{B} \longrightarrow \hat{j}$$
$$\quad\ \ (x) \qquad\ \ (y)$$

$$\therefore \textbf{ Correct choice : (1)}$$

163. During an isothermal expansion, a confined ideal gas does – 150 J of work against its surroundings. This implies that:

(1) 150 J of heat has been removed from the gas

(2) 300 J of heat has been added to the gas

(3) no heat is transferred because the process is isothermal

(4) 150 J of heat has been added to the gas

Sol.: Q = ΔU + W

For isothermal, ΔU = 0

If W = – 150 J, Q = – 150 J

∴ 150 J of heat has been removed

∴ **Correct choice : (1)**

164. Two waves are represented by the equations y_1 = a sin (ωt + kx + 0.57) m and y_2 = a cos (ωt + kx) m, where x is in meter and t in sec. The phase difference between them is:

(1) 1.0 radian   **(2)** 1.25 radian   **(3)** 1.57 radian   **(4)** 0.57 radian

Sol.: y_1 = a sin (ωt + kx + 0.57) m

y_2 = a cos (ωt + kx) m

$$= a \sin \left(\omega t + kx + \frac{\pi}{2} \right) m$$

∴ phase difference = $\frac{\pi}{2} - 0.57 = \frac{3.14}{2} - 0.57 = 1.57 - 0.57 = 1$ rad

∴ **Correct choice : (1)**

165. The instantaneous angular position of a point on a rotating wheel is given by the equation θ(t) = $2t^3 - 6t^2$

The torque on the wheel becomes zero at:

(1) t = 1 s   **(2)** t = 0.5 s   **(3)** t = 0.25 s   **(4)** t = 2 s

Sol.: θ(t) = $2t^3 - 6t^2$

$\dot{\theta} = 6t^2 - 12t$, $\ddot{\theta} = 12t - 12 = 0$ (when t = 1 s)

∴ **Correct choice : (1)**

166. A boy standing at the top of a tower of 20 m height drops a stone. Assuming $g = 10 \text{ ms}^{-2}$, the velocity with which it hits the ground is:

(1) 10.0 m/s   **(2)** 20.0 m/s   **(3)** 40.0 m/s   **(4)** 5.0 m/s

Sol.: $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = \sqrt{400} = 20 \text{ ms}^{-1}$

$$\therefore \text{ Correct choice : (2)}$$

167. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its midpoint and perpendicular to its length is I_o. Its moment of inertia about an axis passing through one of its ends and perpendicular to its length is:

(1) $I_o + ML^2/2$ **(2)** $I_o + ML^2/4$ **(3)** $I_o + 2ML^2$ **(4)** $I_o + ML^2$

Sol.: Parallel axis theorem $\Rightarrow I_o + M\dfrac{L^2}{4}$

$$\therefore \text{ Correct choice : (2)}$$

168. A nucleus $^{m}_{n}X$ emits **one** α particle and **two** β^- particles. The resulting nucleus is:

(1) $^{m-6}_{n-4}Z$ **(2)** $^{m-6}_{n}Z$ **(3)** $^{m-4}_{n}X$ **(4)** $^{m-4}_{n-2}Y$

Sol.: $^{m}_{n}X \longrightarrow \, ^{m-4}_{n}X$

$$\therefore \text{ Correct choice : (3)}$$

169. A parallel plate condenser has a uniform electric field E (V/m) in the space between the plates. If the distance between the plates is d(m) and area of each plate is A(m^2) the energy (joules) stored in the condenser is:

(1) E^2Ad/ε_o **(2)** $\dfrac{1}{2}\varepsilon_o E^2$ **(3)** $\varepsilon_o EAd$ **(4)** $\dfrac{1}{2}\varepsilon_o E^2Ad$

Sol.: Energy density is $\dfrac{1}{2}\varepsilon_o E^2Ad$

$$\therefore \text{ Correct choice : (4)}$$

170. A planet moving along an elliptical orbit is closest to the sun at a distance r_1 and farthest away at a distance of r_2. If v_1 and v_2 are the linear velocities at these points respectively, then the ratio $\dfrac{v_1}{v_2}$ is:

(1) $\left(\dfrac{r_1}{r_2}\right)^2$ **(2)** $\dfrac{r_2}{r_1}$ **(3)** $\left(\dfrac{r_2}{r_1}\right)^2$ **(4)** $\dfrac{r_1}{r_2}$

Sol.: By the law of conservation of angular momentum

$$mv_1r_1 = mv_2r_2$$

$$\therefore \frac{v_1}{v_2} = \frac{r_2}{r_1}$$

∴ **Correct choice : (2)**

171. A body is moving with velocity 30 m/s towards east. After 10 seconds its velocity becomes 40 m/s towards north. The average acceleration of the body is:
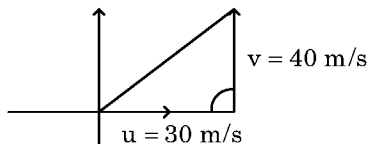
(1) 1 m/s^2　　　**(2)** 7 m/s^2　　　**(3)** $\sqrt{7}$ m/s^2　　　**(4)** 5 m/s^2

Sol.:

Change in velocity = $v\hat{j} - u\hat{i}$

| Change in velocity | = $\sqrt{40^2 + 30^2}$

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

$$= 50 \text{ m/s}$$

$\therefore$ acceleration = $\dfrac{50}{10}$ = 5 m/s^2

∴ **Correct choice : (4)**

172. Fusion reaction takes place at high temperature because:

(1) nuclei break up at high temperature

(2) atoms get ionised at high temperature

(3) kinetic energy is high enough to overcome the coulomb repulsion between nuclei

(4) molecules break up at high temperature

∴ **Correct choice : (3)**

173. A body projected vertically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest:

(1) at the highest position of the body.

(2) at the instant just before the body hits the earth.

(3) it remains constant all through.

(4) at the instant just after the body is projected.

Sol.: Power exerted $P = F \times v$

$\therefore$ **Correct choice : (4)**

174. The dimensions of $(\mu_o \, \varepsilon_o)^{-\frac{1}{2}}$ are:

(1) $[L^{\frac{1}{2}} \, T^{-\frac{1}{2}}]$ **(2)** $[L^{-1} \, T]$ **(3)** $[L \, T^{-1}]$ **(4)** $[L^{-\frac{1}{2}} \, T^{\frac{1}{2}}]$

Sol.: $(\mu_o \varepsilon_o)^{-\frac{1}{2}} = \dfrac{1}{\sqrt{\mu_o \varepsilon_o}} \Rightarrow \left[LT^{-1} \right]$

$\therefore$ **Correct choice : (3)**

175. An ac voltage is applied to a resistance R and an inductor L in series. If R and the inductive reactance are both equal to 3 Ω, the phase difference between the applied voltage and the current in the circuit is:

(1) $\dfrac{\pi}{6}$ **(2)** $\dfrac{\pi}{4}$ **(3)** $\dfrac{\pi}{2}$ **(4)** zero

Sol.: Phase difference $\phi = \tan^{-1}\left(\dfrac{\omega L}{R} \right) = \tan^{-1}\left(\dfrac{3}{3} \right)$

$$= 45° = \dfrac{\pi}{4}$$

$\therefore$ **Correct choice : (2)**

176. A transistor is operated in common emitter configuration at $V_C = 2$ V such that a change in the base current from 100 μA to 300 μA produces a change in the collector current from 10 mA to 20 mA. The current gain is:

(1) 50   **(2)** 75   **(3)** 100   **(4)** 25

Sol.: Current gain $= \left| \dfrac{\Delta I_C}{\Delta I_E} \right|_V = \dfrac{20 - 10}{(300 - 100) \times 10^{-3}} = \dfrac{10 \times 10^3}{200}$

$$= 50$$

$\therefore$ **Correct choice : (1)**

177. In forward biasing of the p-n junction:

     (1) the positive terminal of the battery is connected to p-side and the depletion region becomes thick.

     (2) the positive terminal of the battery is connected to n-side and the depletion region becomes thin.

     (3) the positive terminal of the battery is connected to n-side and the depletion region becomes thick.

     (4) the positive terminal of the battery is connected to p-side and the depletion region becomes thin.

$\therefore$ **Correct choice : (4)**

178. There are four light-weight-rod samples A, B, C, D separately suspended by threads. A bar magnet is slowly brought near each sample and the following observations are noted:

 (i) A is feebly repelled

(ii) B is feebly attracted

(iii) C is strongly attracted

(iv) D remains unaffected

Which one of the following is **true** ?

(1) B is of a paramagnetic material

(2) C is of a diamagnetic material

(3) D is of a ferromagnetic material

(4) A is of a non-magnetic material

Sol.: B is of a paramagnetic material. Because it is feebly attracted.

∴ **Correct choice : (1)**

179. A person of mass 60 kg is inside a lift of mass 940 kg and presses the button on control panel. The lift starts moving upwards with an acceleration 1.0 m/s^2. If g = 10 ms^{-2}, the tension in the supporting cable is:

(1) 8600 N   **(2)** 9680 N   **(3)** 11000 N   **(4)** 1200 N

Sol.: F.B.D.
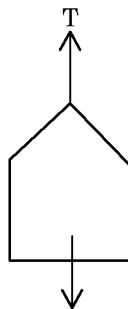
$$w = 940 + 60 = (1000 \text{ kg} \times 10)$$

$$T - w = ma$$

$$\therefore \ T = w + 1000 \times 1$$

$$= 10000 + 1000 = 11000 \text{ N}$$

∴ **Correct choice : (3)**

180. Symbolic representation of four logic gates are shown as:

(i)

(ii)

(iii)

(iv)
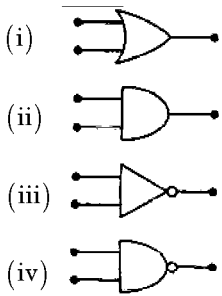
Pick out which ones are for AND, NAND and NOT gates, respectively:

(1) (ii), (iii) and (iv)   **(2)** (iii), (ii) and (i)

(3) (iii), (ii) and (iv)   **(4)** (ii), (iv) and (iii)

∴ **Correct choice : (4)**

181. In an ac circuit an alternating voltage $e = 200\sqrt{2} \sin 100\, t$ volts is connected to a capacitor of capacity 1 μF. The r.m.s. value of the current in the circuit is:

(1) 10 mA   **(2)** 100 mA   **(3)** 200 mA   **(4)** 20 mA

Sol.: The rms value of current in the a.c. circuit is

$$= \frac{\left(\dfrac{200\sqrt{2}}{\sqrt{2}}\right)}{\dfrac{1}{100 \times 1 \times 10^{-6}}}$$

$$= 200 \times 100 \times 10^{-6}$$

$$= 2 \times 10^{-2}\ \text{A}$$

$$= 20\ \text{mA}$$

∴ **Correct choice : (4)**

182. A current of 2 A flows through a 2 Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9 Ω resistor. The internal resistance of the battery is:

(1) 0.5 Ω   **(2)** 1/3 Ω

(3) 1/4 Ω   **(4)** 1 Ω
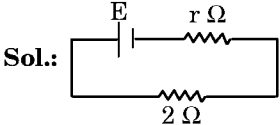
$$\frac{E}{r+2} = 2$$

Also $\dfrac{E}{r+9} = \dfrac{1}{2}$

$$\therefore 2(r+2) = \frac{(r+9)}{2}$$

$$\therefore 4(r+2) = r+9$$

$$4r+8 = r+9$$
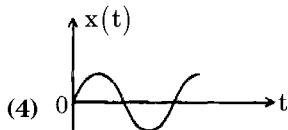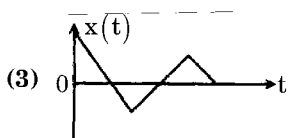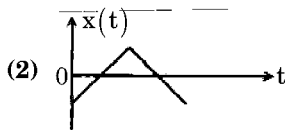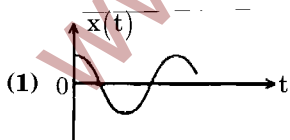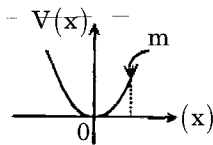
$$3r = 1$$

$$\therefore r = \frac{1}{3}\,\Omega$$

$\therefore$ **Correct choice : (2)**

183. A particle of mass m is released from rest and follows a parabolic path as shown. Assuming that the displacement of the mass from the origin is small, which graph correctly depicts the position of the particle as a function of time ?
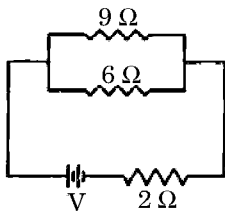

(1)

(2)

(3)

(4)

Sol.: $F = -\dfrac{dV}{dx}$

Force is zero at the origin. Since the mass is released from rest displacement is zero at t = 0. From (4) we find x(t) is zero at t = 0 ⇒ SHM about origin.

∴ **Correct choice : (4)**

184. If power dissipated in the 9 Ω resistor in the circuit shown is 36 W, the potential difference across the 2 Ω resistor is:

   (1) 4 V   **(2)** 8 V   **(3)** 10 V   **(4)** 2 V

Sol.: $I^2 R = 36$ W

i.e., $I^2 \times 9 = 36$

∴ $I = 2$ A

Current through $6\,\Omega = \dfrac{18}{6} = 3$ A

∴ total current = 5 A

Potential difference across 2 Ω = 10 V

∴ **Correct choice : (3)**

185. A biconvex lens has a radius of curvature of magnitude 20 cm. Which one of the following options describe best the image formed of an object of height 2 cm placed 30 cm from the lens?

(1) Virtual, upright, height = 1 cm

(2) Virtual, upright, height = 0.5 cm

(3) Real, inverted, height = 4 cm

(4) Real, inverted, height = 1 cm

Sol.: $|m| = \dfrac{v}{u}$

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

$\dfrac{1}{f} = (\mu - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right),\ \left(\mu = \dfrac{3}{2}\right)$

$$\frac{1}{f} = \frac{1}{2} \cdot \frac{2}{R} = \frac{1}{R}$$

$$f = 20 \text{ cm}$$

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

$$= \frac{1}{20} - \frac{1}{30}$$

$$= \frac{1}{60}$$

$$\therefore v = 60 \text{ cm}$$

$$\therefore m = \frac{60}{30}$$

$$= 2$$

∴ Correct choice : (3)

186. In the Davisson and Germer experiment, the velocity of electrons emitted from the electron gun can be increased by:

(1) increasing the potential difference between the anode and filament

(2) increasing the filament current

(3) decreasing the filament current

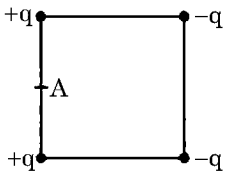**(4)** decreasing the potential difference between the anode and filament

∴ Correct choice : (1)

187. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is:

(1) microwave, infrared, ultraviolet, gamma rays

(2) gamma rays, ultraviolet, infrared, microwave

(3) microwave, gamma rays, infrared, ultraviolet

(4) infrared, microwave, ultraviolet, gamma rays

∴ Correct choice : (1)

188. Four electric charge +q, +q, − q and − q are placed at the corners of a square of side 2L (see figure). The electric potential at point A, midway between the two charge +q and +q is:

(1) $\dfrac{1}{4\pi\varepsilon_o}\,\dfrac{2q}{L}\,(1+\sqrt{5})$

(2) $\dfrac{1}{4\pi\varepsilon_o}\,\dfrac{2q}{L}\left(1+\dfrac{1}{\sqrt{5}}\right)$

(3) $\dfrac{1}{4\pi\varepsilon_o}\,\dfrac{2q}{L}\left(1-\dfrac{1}{\sqrt{5}}\right)$

(4) Zero

Sol.: $V = \dfrac{q}{4\pi\varepsilon_o}\left[\dfrac{1}{L}+\dfrac{1}{L}-\dfrac{1}{\sqrt{5}\,L}-\dfrac{1}{\sqrt{5}\,L}\right]$

$= \dfrac{2q}{4\pi\,\varepsilon_o\,L}\left[1-\dfrac{1}{\sqrt{5}}\right]$

∴ **Correct choice : (3)**

189. When 1 kg of ice at 0°C melts to water at 0°C, the resulting change in its entropy, taking latent heat of ice to be 80 cal/°C is :

(1) 273 cal/K   **(2)** 8×10^{4} cal/K   **(3)** 80 cal/K   **(4)** 293 cal/K

Sol.: $\Delta S = \dfrac{\Delta Q}{T} = \dfrac{80 \times 1000}{273} = 293$ cal/K

∴ **Correct choice : (4)**

190. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron:

(1) will turn towards right of direction of motion

(2) speed will decrease

(3) speed will increase

(4) will turn towards left of direction of motion

∴ **Correct choice : (3)**

191. Sound waves travel at 350 m/s through a warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air:

(1) decreases by a factor 10

(2) increases by a factor 20

(3) increases by a factor 10

(4) decreases by a factor 20

Sol.: $\dfrac{v_1}{v_2} = \dfrac{\lambda_1}{\lambda_2}$

$\therefore \lambda_2 = \lambda_1 \cdot \dfrac{v_2}{v_1} = \lambda_1 \times 10$

$\therefore$ **Correct choice : (3)**

192. Light of two different frequencies whose photons have energies 1 eV and 2.5 eV respectively illuminate a metallic surface whose work function is 0.5 eV successively. Ratio of maximum speeds of emitted electrons will be:

(1) 1 : 4   **(2)** 1 : 2   **(3)** 1 : 1   **(4)** 1 : 5

Sol.: $\dfrac{v_1^2}{v_2^2} = \dfrac{K_1}{K_2} = \dfrac{0.5}{2.0} = \dfrac{1}{4}$

$\therefore \dfrac{v_1}{v_2} = \dfrac{1}{2}$

$\therefore$ **Correct choice : (2)**

193. A body of mass M hits normally a rigid wall with velocity V and bounces back with the same velocity. The impulse experienced by the body is:

(1) MV   **(2)** 1.5MV   **(3)** 2MV   **(4)** Zero

Sol.: Impulse = MV – (– MV) = 2MV

$\therefore$ **Correct choice : (3)**

194. Electrons used in an electron microscope are accelerated by a voltage of 25 kV. If the voltage is increased to 100 kV then the de Broglie wavelength associated with the electrons would:

(1) increase by 2 times   **(2)** decrease by 2 times

(3) decrease by 4 times   **(4)** increase by 4 times

Sol.: $\dfrac{\lambda_1}{\lambda_2} = \sqrt{\dfrac{v_2}{v_1}} = 2 \quad \therefore \lambda_2 = \dfrac{\lambda_1}{2}$

$\therefore$ **Correct choice : (2)**

195. Out of the following functions representing motion of a particle which represents SHM:

(A) $y = \sin \omega t - \cos \omega t$

(B) $y = \sin^3 \omega t$

(C) $y = 5 \cos \left(\dfrac{3\pi}{4} - 3\omega t \right)$

(D) $y = 1 + \omega t + \omega^2 t^2$

(1) Only (A)

(2) Only (D) does not represent SHM

(3) Only (A) and (C)

(4) Only (A) and (B)

Sol.: (D) is algebraic function and (B) is not harmonic being the product of sin ωt (thrice). But (A) and (C) are simple harmonic functions. Hence (A) and (C) represent SHM.

∴ **Correct choice : (3)**

196. In photoelectric emission process from a metal of work function 1.8 eV, the kinetic energy of most energetic electrons is 0.5 eV. The corresponding stopping potential is:

(1) 1.8 V　　　　　**(2)** 1.3 V　　　　　**(3)** 0.5 V　　　　　**(4)** 2.3 V

Sol.: K.E. = 0.5 eV

Hence stopping potential = 0.5 V

∴ **Correct choice : (3)**

197. The rate of increase of thermo-e.m.f. with temperature at the neutral temperature of a thermocouple:

(1) is positive
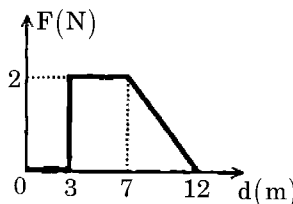
(2) is zero

(3) depends upon the choice of the two materials of the thermocouple

(4) is negative

Sol.: At the neutral temperature $\dfrac{dE}{dT} = 0$

∴ **Correct choice : (2)**

198. Force F on a particle moving in a straight line varies with distance d as shown in the figure. The work done on the particle during its displacement of 12 m is:
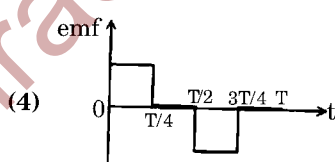

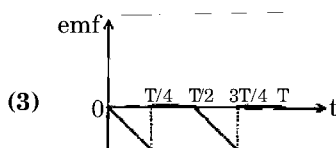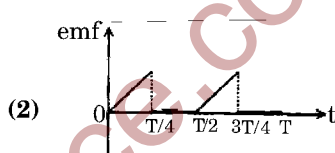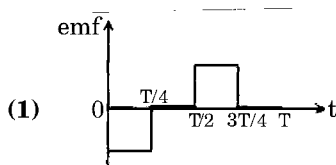**(1)** 18 J　　　　　**(2)** 21 J　　　　　**(3)** 26 J　　　　　**(4)** 13 J

Sol.: Work done $= 0 + 4 \times 2 + \dfrac{1}{2} \times 5 \times 2$

$$= 8 + 5 = 13 \text{ J}$$

$$\therefore \textbf{ Correct choice : (4)}$$

199. The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be:

(1)

(2)

(3)

(4)
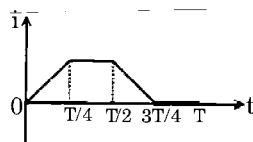
Sol.: 0 to $\dfrac{T}{4} \longrightarrow$ emf is $- \dfrac{di}{dt} = -$ (constant factor)

$\dfrac{T}{4}$ to $\dfrac{T}{2} \longrightarrow$ emf is 0, $\dfrac{di}{dt} = 0$

$\dfrac{T}{2}$ to $\dfrac{3T}{4} \longrightarrow$ emf is $-\left(-\dfrac{di}{dt}\right) = +$ (constant factor)

$\dfrac{3T}{4}$ to $T \longrightarrow \dfrac{di}{dt} = 0$

$$\therefore \textbf{ Correct choice : (1)}$$

200. If a small amount of antimony is added to germanium crystal:

(1) it becomes a p-type semiconductor

(2) the antimony becomes an acceptor atom

(3) there will be more free electrons than holes in the semiconductor

(4) its resistance is increased

$$\therefore \textbf{ Correct choice : (1)}$$