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B
CODE

All India Pre-Medical/Pre-Dental Common Entrance Examination Conducted by CBSE [AIPMT (MAINS)-2011]

Date : 15-05-2011 **Duration : 3 Hours** **Max. Marks : 480**

IMPORTANT INSTRUCTIONS

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **Side-1** and **Side-2** carefully with **blue/black** ball point pen only.

2. The test is of **3 hours** duration and Test Booklet contains **120 questions**. Each question carries 4 marks. For each correct response, the candidate will get **4 marks**. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **480**.

3. Use **Blue/Black Ball Point Pen** only for writing particulars on this page/marking responses.

4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.

5. **On completion of the test, the candidate must havdover the Answer Sheet to the invigilator in the Room/Hall. The candidates are allowed to take away this Test Booklet with them.**

6. The CODE for this Booklet if B. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklets and the Answer Sheets.

7. The Candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your roll no. anywhere else except in the specified space in the Test Booklet/Answer Sheet.

8. Use of white fluid for correction is NOT permissible on the Answer Sheet.

Name of the Candidate (in Capitals): _____

Roll Number : in figures _____

Centre of Examination (in Capitals) : _____

Candidate's Signature: _____ Invigilator's Signature: _____

Fascimile signature stamp of
Centre Superintendent : _____

PART - A (CHEMISTRY)

1. Which of the following is not a fat soluble vitamin ?

(1) Vitamin B complex (2) Vitamin D

(3) Vitamin E (4) Vitamin A

Ans. **(1)**

Sol. Vitamin B complex is fat insoluble

2. Which of the statements about "Denaturation" given below are correct ?

Statements

(a) Denaturation of proteins causes loss of secondary and tertiary structures of the protein.

(b) Denturation leads to the conversion of double strand of DNA into single strand

(c) Denaturation affects primary strucrture which gets distorted

Options :

(1) (b) and (c) (2) (a) and (c) (3) (a) and (b) (4) (a), (b) and (c)

Ans. **(3)**

Sol. During denaturation secondary and tertiary structures of protein destroyed but primary structures remains intact.

3. Which has the maximum number of molecules among the following ?

(1) 44 g CO_2 (2) 48 g O_3 (3) 8 g H_2 (4) 64 g SO_2

Ans. **(3)**

Sol.

No. of molecules

Moles of $CO_2 = \frac{44}{44} = 1$ N_A

Moles of $O_3 = \frac{48}{48} = 1$ N_A

Moles of $H_2 = \frac{8}{2} = 4$ $4N_A$

Moles of $SO_2 = \frac{64}{64} = 1$ N_A

4. The half life of a substance in a certain eznzyme-catalysed reaction is 138 s. The time required for the concentration of the substance to fall from 1.28 mg L^{-1} to 0.04 mg L^{-1}, is :

(1) 414 s (2) 552 s (3) 690 s (4) 276 s

Ans. **(3)**

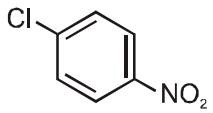
Sol. Enzyme catalysed reactions are initially follow first order kinetics

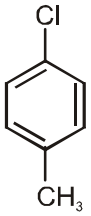
when concentration decreases 1.28 mg L^{-1} to 0.04 mg L^{-1}. Then five half life completed

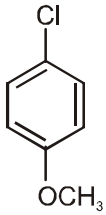
No. of half lives = 5

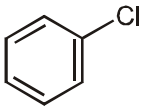
So, times required = 5 × 138 = 690 s.

5. Which of the following compounds undergoes nucleophilic substitution reaction most easily ?

(1) 

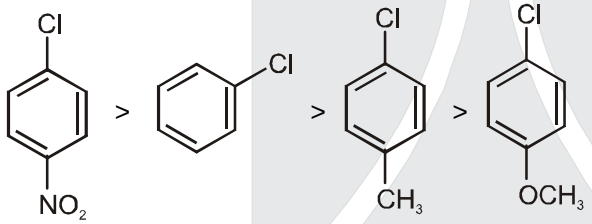
(2) 

(3) 

(4) 

Ans. **(1)**

Sol. The correct order of nucleophilic substitution reactions



6. Which of the following statements is **incorrect** ?

(1) Pure sodium metal dissolves in liquid ammonia to give blue solution.

(2) NaOH reacts with glass to give sodium silicate

(3) Aluminium reacts with excess NaOH to give $Al(OH)_3$

(4) $NaHCO_3$ on heating gives Na_2CO_3

Ans. **(3)**

Sol. $2Al(s) + 2NaOH\ (aq) + 6H_2O\ (\ell) \longrightarrow 2Na^+ [Al(OH)_4]^-\ (aq)$ (Sodium tetrahydroxoaluminate (III)) $+ 3H_2(g)$.

7. A 0.1 molal aqueous solution of a weak acid is 30% ionized. If K_f for water is 1.86°C/m, the freezing point of the solution will be :

(1) –0.18°C (2) –0.54°C (3) –0.36°C (4) –0.24°C

Ans. **(4)**

Sol. $\Delta T_f = i\, K_f\, m$

$HA \longrightarrow H^+ + A^-$

$1 - \alpha \quad \alpha \quad \alpha$

$1 - 0.3 \quad 0.3 \quad 0.3$

$i = 1 - 0.3 + 0.3 + 0.3$

$i = 1.3$

$\Delta T_f = 1.3 \times 1.86 \times 0.1 = 0.2418$

$T_f = 0 - 0.2418 = -0.2418$ °C

8. The rate of the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ can be written in three ways :

$$\frac{-d[N_2O_5]}{dt} = k\,[N_2O_5]$$

$$\frac{d[N_2O]}{dt} = k'\,[N_2O_5]$$

$$\frac{d[O_2]}{dt} = k''\,[N_2O_5]$$

The relationship between k and k' and between k and k'' are :

(1) k' = 2k ; k' = k (2) k' = 2k ; k' = k / 2

(3) k' = 2k ; k'' = 2k (4) k' = k ; k'' = k

Ans. **(2)**

Sol. $-\frac{1}{2}\frac{d(N_2O_5)}{dt} = \frac{1}{4}\frac{d(NO_2)}{dt} = \frac{d(O_2)}{dt}$

$$\frac{1}{2}K(N_2O_5) = \frac{1}{4}K'(N_2O_5) = K''(N_2O_5)$$

$$\frac{K}{2} = \frac{K'}{4} = K''$$

$K' = 2K, \qquad K'' = \frac{K}{2}$

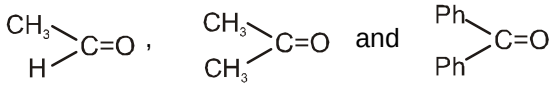
9. Which of the following carbonyls will have the strongest C–O bond ?

(1) $Mn(CO)_6^+$ (2) $Cr(CO)_6$ (3) $V(CO)_6^-$ (4) $Fe(CO)_5$

Ans. **(1)**

Sol. As + ve charge on the central metal atom increases, the less readily the metal can donate electron density into the π^* orbitals of CO ligand to weaken the C – O bond. Hence the C – O bond would be strongest in $Mn(CO)_6^+$.

10. The order of reactivity of phenyl magnesium bromide (PhMgBr) with the following compounds :

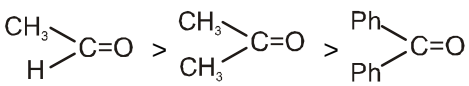


I II III

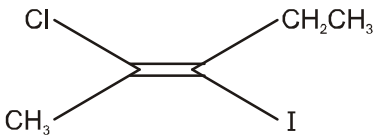
(1) III > II > I (2) II > I > III (3) I > III > II (4) I > II > III

Ans. **(4)**

Sol. Correct reactivity order for nucleophilic addition reaction with PhMgBr

 (due to steric crowding).

11. The IUPAC name of the following compound

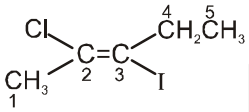


is

(1) trans-2-chloro-3-iodo-2-pentene
(2) cis-3-iodo-4-chloro-3-pentene
(3) trans-3-iodo-4-chloro-3-pentene
(4) cis-2-chloro-3-iodo-2-pentene

Ans. **(1)**

Sol.



Correct IUPAC name of above compound is trans-2-chloro-3-iodo-2-pentene

12. According to the Bohr Theory, which of the following transitions in the hydrogen atom will give rise to the least energetic photon ?

(1) n = 6 to n = 1
(2) n = 5 to n = 4
(3) n = 6 to n = 5
(4) n = 5 to n = 3

Ans. **(3)**

Sol. Energy of photon obtained from the transition n = 6 to n = 5 will have least energy.

$$\Delta E = 13.6Z^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

13. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be :

(1) 275.1 pm
(2) 322.5 pm
(3) 241.5 pm
(4) 165.7 pm

Ans. **(3)**

Sol. Radius ratio of NaCl like crystal = $\frac{r^+}{r^-}$ = 0.414

$$r^- = \frac{100}{0.414} = 241.5 \text{ pm}$$

14. Consider the following processes :

	ΔH (kJ/mol)
$1/2\ A \rightarrow B$	+150
$3B \rightarrow 2C + D$	–125
$E + A \rightarrow 2D$	+350

For $B + D \rightarrow E + 2C$, ΔH will be :

(1) 525 kJ/mol (2) –175 kJ/mol
(3) –325 kJ/mol (4) 325 kJ/mol

Ans. **(2)**

Sol.

	ΔH	
$\frac{1}{2} A \longrightarrow B$	+150	..... (1)
$3B \longrightarrow 2C + D$	–125	..... (2)
$E + A \longrightarrow 2D$	+350	..... (3)

$B + D \longrightarrow E + 2C$

$2 \times$ eq.(1) + eq.(2) – eq.(3)

$\Delta H = 300 - 125 - 350 = -175$

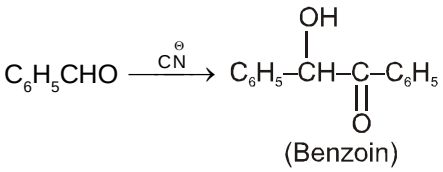
15. Match the compounds given in List-I with List-II and select the suitable option using the code given below :

List-I			**List-II**
(a)	Benzaldehyde	(i)	Phenolphthalein
(b)	Phthalic anhydride	(ii)	Benzoin condensation
(c)	Phenyl benzoate	(iii)	Oil of wintergreen
(d)	Methyl salicylate	(iv)	Fries rearrangement

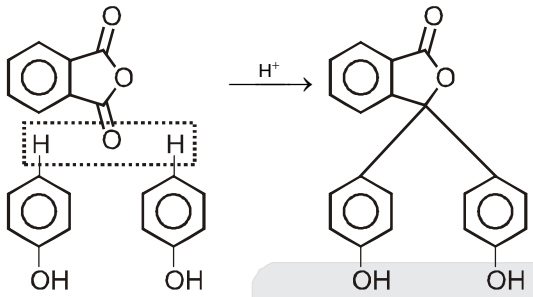
Code :

	(a)	(b)	(c)	(d)		(a)	(b)	(c)	(d)
(1)	(iv)	(i)	(iii)	(ii)	(2)	(iv)	(ii)	(iii)	(i)
(3)	(ii)	(iii)	(iv)	(i)	(4)	(ii)	(i)	(iv)	(iii)

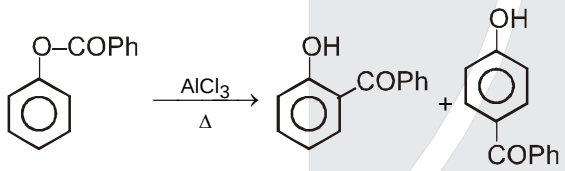
Ans. **(4)**

Sol. (a) 

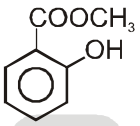
(Benzoin)

(b) 

Phenolphthalein

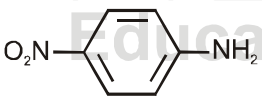
(c) 

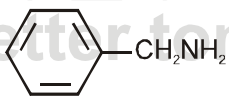
Fries rearrangement

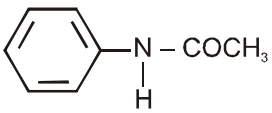
(d) 

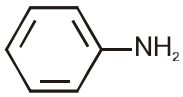
(Oil of wintergreen)

16. Which of the following compounds is most basic ?

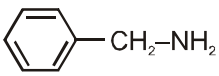
(1) 

(2) 

(3) 

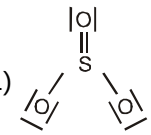
(4) 

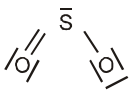
Ans. **(2)**

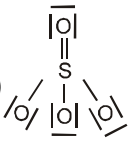
Sol. 

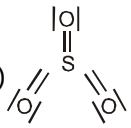
compound is most basic due to localized lone pair of electron on nitorgen atom while other compounds have delocalized lone pair of electron.

17. Which of the following structures is the most preferred and hence of lowest energy for SO_3 ?

(1) 

(2) 

(3) 

(4) 

Ans. **(4)**

Sol. **Formal charges help in the selection of the lowest energy structure from a number of possible Lewis structures for a given species.** Generally the lowest energy structure is the one with the smallest formal charges on the atoms.

18. A solution contains Fe^{2+}, Fe^{3+} and I^- ions. This solution was treated with iodine at 35°C. E° for Fe^{3+} / Fe^{2+} is + 0.77 V and E° for $I_2/2I^-$ = 0.536 V. The favourable redox reaction is :

(1) I_2 willbe reduced to I^- (2) There will be no redox reaction

(3) I^- will be oxidised to I_2 (4) Fe^{2+} will be oxidised to Fe^{3+}

Ans. **(3)**

Sol. $2(e^- + Fe^{+3} \longrightarrow Fe^{+2})$ $E^\circ = 0.77$ V

$2I^- \longrightarrow I_2 + 2e^-$ $E^\circ = 0.536$ V

$2Fe^{+3} + 2I^- \longrightarrow 2Fe^{+2} + I_2$ $E^\circ = E^\circ_{ox} + E^\circ_{red}$

$= 0.77 - 0.536$

$= 0.164$ V

So, Reaction will taken place.

19. What is the value of electron gain enthalpy of Na^+ if IE_1 of Na = 5.1 eV ?

(1) –5.1 eV (2) –10.2 eV (3) +2.55 eV (4) +10.2 eV

Ans. **(1)**

Sol. IE_1 of Na = – Electron given enthalpy of Na^+ = – 5.1 Volt.

20. The unit of rate constant for a zero order reaction is :

(1) mol L^{-1} s^{-1} (2) L mol^{-1} s^{-1} (3) L^2 mol^{-2} s^{-1} (4) s^{-1}

Ans. **(1)**

Sol. Rate = $K(A)^0$

Unit of K = mol l^{-1} sec^{-1}

21. In qualitative analysis, the metals of Group I can be separated from other ions by precipitating them as chloride salts. A solution initially contains Ag^+ and Pb^{2+} at a concentration of 0.10 M. Aqueous HCl is added to this solution until the Cl^- concentration is 0.10 M. What will the concentrations of Ag^+ and Pb^{2+} be at equilibrium ? (K_{SP} for AgCl = 1.8×10^{-10}, K_{SP} for $PbCl_2$ = 1.7×10^{-5})

(1) $[Ag^+] = 1.8 \times 10^{-7}$ M ; $[Pb^{2+}] = 1.7 \times 10^{-6}$ M (2) $[Ag^+] = 1.8 \times 10^{-11}$ M ; $[Pb^{2+}] = 8.5 \times 10^{-5}$ M

(3) $[Ag^+] = 1.8 \times 10^{-9}$ M ; $[Pb^{2+}] = 1.7 \times 10^{-3}$ M (4) $[Ag^+] = 1.8 \times 10^{-11}$ M ; $[Pb^{2+}] = 8.5 \times 10^{-4}$ M

Ans. **(3)**

Sol. $K_{sp} = [Ag^+]\,[Cl^-]$

$1.8 \times 10^{-10} = [Ag^+]\,[0.1]$

$[Ag^+] = 1.8 \times 10^{-9}$ M

$K_{sp} = [Pb^{+2}]\,[Cl^-]^2$

$1.7 \times 10^{-5} = [Pb^{+2}]\,[0.1]^2$

$[Pb^{+2}] = 1.7 \times 10^{-3}$ M

22. A bubble of air is underwater at temperature 15°C and the pressure 1.5 bar. If the bubble rises to the surface where the temperature is 25°C and the pressure is 1.0 bar, what will happen to the volume of the bubble ?

(1) Volume will become greater by a factor of 1.6.

(2) Volume will become greater by a factor of 1.1.

(3)Volume will become smaller by a factor of 0.70.

(4) Volume will become greater by a factor of 2.5.

Ans. **(1)**

Sol. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{1.5 \times V}{288} = \frac{1 \times V_2}{298}$

$V_2 = 1.55$ V i.e. volume of bubble will be almost 1.6 time to initial volume of bubble.

23. Match List – I with List – II for the compositions of substances and select the correct answer using the code given below the lists :

List–I **Substances**		List–II **Composition**	
(A)	Plaster of paris	(i)	$CaSO_4.2H_2O$
(B)	Epsomite	(ii)	$CaSO_4.½\ H_2O$
(C)	Kieserite	(iii)	$MaSO_4.7\ H_2O$
(D)	Gypsum	(iv)	$MgSO_4.\ H_2O$
		(v)	$CaSO_4$

Code :

	(A)	**(B)**	**(C)**	**(D)**
(1)	(iii)	(iv)	(i)	(ii)
(2)	(ii)	(iii)	(iv)	(i)
(3)	(i)	(ii)	(iii)	(v)
(4)	(iv)	(iii)	(ii)	(i)

Ans. **(2)**

Sol. (A) Plaster of paris = $CaSO_4.\frac{1}{2}H_2O$ (B) Epsomite = $MgSO_4.7H_2O$

(C) Kieserite = $MgSO_4.H_2O$ (D) Gypsum = $CaSO_4.2H_2O$

24. The pairs of species of oxygen and their magnetic behaviours are noted below. Which of the following presents the correct description ?

(1) O_2^-, O_2^{2-} – Both diamagnetic (2) O^+, O_2^{2-} – Both paramagnetic

(3) O_2^+, O_2 – Both paramagnetic (4) O, O_2^{2-} – Both paramagnetic

Ans. **(3)**

Sol. MOT configurations of O_2 and O_2^+:

O_2 : $(\sigma 1s)^2$ $(\sigma^* 1s)^2$ $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p^2_x = \pi 2p^2_y)$ $(\pi^* 2p_x^1 = \pi^* 2p^1_y)$

Number of unpaired electrons = 2, so paramagnetic.

O_2^+ : $(\sigma 1s)^2$ $(\sigma^* 1s)^2$ $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p^2_x = \pi 2p^2_y)$ $(\pi^* 2p_x^1 = \pi^* 2p^0_y)$

Number of unpaired electrons = 1, so paramagnetic.

25. Consider the reactions :

(i) $(CH_3)_2CH-CH_2Br \xrightarrow{C_2H_5OH} (CH_3)_2CH-CH_2OC_2H_5 + HBr$

(ii) $(CH_3)_2CH-CH_2Br \xrightarrow{C_2H_5O^-} (CH_3)_2CH-CH_2OC_2H_5 + Br^-$

The mechanisms of reactions (i) and (ii) are respectively :

(1) S_N1 and S_N2 (2) S_N1 and S_N1 (3) S_N2 and S_N2 (4) S_N2 and S_N1

Ans. **(1)**

Sol. First reaction is S_N1 reaction because C_2H_5OH used as solvent which is a weak nucleophile.

Second reaction is S_N2 reaction because $C_2H_5O^-$ is strong nucleophile.

26. Which of the following complex compounds will exhibit highest paramagnetic behaviour ?

(At. No. : Ti = 22, Cr = 24, Co = 27, Zn = 30)

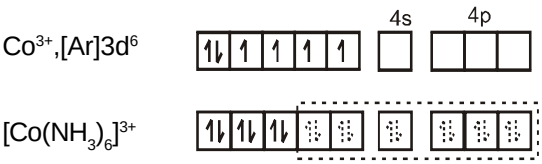
(1) $[Ti(NH_3)_6]^{3+}$ (2) $[Cr(NH_3)_6]^{3+}$ (3) $[Co(NH_3)_6]^{3+}$ (4) $[Zn(NH_3)_6]^{2+}$

Ans. **(2)**

Sol. (1) $[Ti(NH_3)_6]^{3+}$: $3d^1$ configuration and thus has one unpaired electron.

(2) $[Cr(NH_3)_6]^{3+}$: The complex is inner orbital complex but $3d^3$ configuration has three unpaired electrons with weak as well as with strong field ligand.

(3) $[Co(NH_3)_6]^{3+}$: The cobalt ion is in +3 oxidation state with $3d^6$ configuration and thus is diamagnetic octahedral complex, $[Co(NH_3)_6]^{3+}$, and has the electronic configuration represented as shown below.



(inner orbital or low spin complex) d^2sp^3 hybrid orbital

Six pairs of electrons from six NH_3 molecules.

(4) $[Zn(NH_3)_6]^{2+}$: Because of $3d^{10}$ configuration no (n – 1)d orbital is available for d^2sp^3 hybridisation and thus forms outer orbital complex. The complex is diamagnetic.

27. 200 mL of an aqueous solution of a protein contains its 1.26 g. The Osmotic pressure of this solution at 300 K is found to be 2.57×10^{-3} bar. The molar mass of protein will be (R = 0.083 L bar mol^{-1} K^{-1}) :

(1) 51022 g mol^{-1} (2) 122044 g mol^{-1} (3) 31011 g mol^{-1} (4) 61038 g mol^{-1}

Ans. **(4)**

Sol. $\pi = CRT = \frac{wt \times 1000}{GMM \times V} RT$

$2.57 \times 10^{-3} = \frac{1.26 \times 1000}{GMM \times 200} \times 0.083 \times 300$

GMM = 61038 g

28. Which of the following oxide is amphoteric ?

(1) SnO_2 (2) CaO (3) SiO_2 (4) CO_2

Ans. **(1)**

Sol. SnO_2 is an amphoteric oxide because it reacts with acids as well as bases to form corresponding salts.

$SnO_2 + 2H^+ \longrightarrow Sn^{4+} + 2H_2O$

$SnO_2 + 6OH^- \longrightarrow [Sn(OH)_6]^{2-}$ or SnO_3^{2-} (stannate)

29. The following reactions take place in the blast furnace in the preparation of impure iron. Identify the reaction pertaining to the formation of the slag.

(1) $Fe_2O_3(s) + 3\,CO(g) \rightarrow 2\,Fe\,(l) + 3\,CO_2\,(g)$

(2) $CaCo_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$

(3) $CaO\,(s) + SiO_2(s) \rightarrow CaSiO_3(s)$

(4) $2C(s) + O_2(g) \rightarrow 2\,CO(g)$

Ans. **(3)**

Sol. Slag can be defined as a fusible mass, which is obtained when a flux reacts with an infusible acidic or basic impurity present in the oxide ore.

$CaO(s)$ (basic flux) + $SiO_2\,(s)$ (acidic flux) $\longrightarrow$ $CaSiO_3\,(s)$ (slag)

30. An organic compound 'A' on treatment with NH_3 gives 'B' which on heating gives 'C', 'C' when treated with Br_2 in the presence of KOH produces ethylamine. Compound 'A' is :

(1) CH_3COOH (2) $CH_3\,CH_2\,CH_2\,COOH$ (3) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}}COOH$ (4) $CH_3\,CH_2COOH$

Ans. **(4)**

Sol. $\underset{(A)}{CH_3–CH_2–COOH} \xrightarrow{NH_3} \underset{(B)}{CH_3–CH_2–\overset{-}{C}OO\overset{+}{N}H_4} \xrightarrow{\Delta} \underset{(C)}{CH_3–CH_2–CONH_2} \xrightarrow[\text{Hoffmann bromamide reaction}]{KOH+Br_2} \underset{\text{(Ethylamine)}}{CH_3–CH_2–NH_2}$

PART - B (BIOLOGY)

31. The technique called gamete intrafallopian transfer (GIFT) is recommended for those females:
(1) who cannot produce an ovum
(2) who cannot retain the foetus inside uterus.
(3) whose cervical canal is too narrow to allow passage for the sperms
(4) who cannot provide suitable environment for fertilisation

Ans. (1)

32. Which one of the following is a possibility for most of us in regard to breathing, by making a *conscious effort*?
(1) One can breathe out air totally without oxygen.
(2) One can breathe out air through eustachian tubes by closing both the mose and the mouth.
(3) One can consiously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.
(4) The lungs can be made fully empty by forcefully breathing out all air from them
Ans. (2)

Hint : Eustachian tube connect middle ear cavity (Tympanic cavity) with pharynx

33. Bacillus thuringiensis forms protein crystals which contain insecticidal protein.
(1) Binds with epithelial cells of midgut of the insect pest ultimately killing it
(2) is coded by several genes including the gene *cry*
(3) is activated by acid pH of the foregut of the insect pest.
(4) does not kill the carrier bacterium which is itself resistant to this toxin
Ans. (1)

34. Which one of the following pairs is *wrongly* matched while the remaining three are correct?
(1) Penicillium - Conidia
(2) Water hyacinth - Runner
(3) Bryophyllum - Leaf buds
(4) Agave - Bulbils

Ans. (2)

Hint : Water hyacinth is offset.

35. Which one of the following diagrams represents the placentation in Dianthus?

(1) 

(2) 

(3) 

(4) 

Ans. (2)

Hint : Free central placentation occurs in Dianthus

36. Which one of the following statements is totally wrong about the occurrence of notochord, while the other three are correct?
(1) It is present only in larval tail in Ascidians
(2) It is replaced by a vertebral column in adult frog
(3) It is absent throughout life in humans from the very begining
(4) It is present throughout life in Amphioxus

Ans. (3)

Hint : Because get changed or replaced by vertibral column

37. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time?
(1) Sparrow (2) Lion (3) Goat (4) Frog

Ans. (1)

Hint : It feeds upon grains hence called primary consumer and also insects hence called secondary consumer

38. Both, hydrarch and xerarch successions lead to:
(1) Medium water conditions (2) Xeric conditions
(3) Highly dry conditions (4) Excessive wet conditions

Ans. (1)

39. What happens during fertilisation in humans after many sperms reach close to the ovum?
(1) Secretions of acrosome helps one sperm enter cytoplasm of ovum througth zona pellucida
(2) All sperms except the one nearest to the ovum lose their tails
(3) Cells of corona radiata trap all the sperms except one
(4) Only two sperms nearest the ovum penetrate zona pellucida

Ans. (1)

40. About which day in a normal human menstrual cycle does rapid secretion of LH (Popularly called LH-surge) normally occurs?
(1) 14^{th} day (2) 20^{th} day (3) 5^{th} day (4) 11^{th} day

Ans. (1)

41. The cells lining the blood vessels belong to the category of:
(1) Smooth muscle tissue (2) Squamous epithelium
(3) Columnar epithelium (4) Connective tissue

Ans. (2)

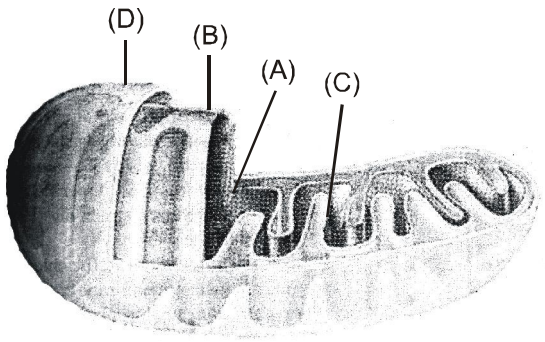
Hint : Inner most lining of Blood vessels in endothelium and is a type of squamous epithelia.

42. The pathogen Microsporum responsible for ringworm disease in humans belongs to the same Kingdom of organisms as that of:
(1) Taenia, a tapeworm (2) Wuchereria, a filarial worm
(3) Rhizopus, a mould (4) Ascaris, a round worm

Ans. (3)

Hint : Micorosporum is a member of Deuteromycetes of fungi & Rizopus is also fungi and member of Zygomycetes.

43. The figure below shows the structure of a mitochondrion with its four parts labelled (A), (B), (C) and (D). Select the part correctly matched with its function.



(1) Part (D): Outer membrane – gives rise to inner membrane by splitting
(2) Part (B): Inner membrane – forms infoldings called cristae
(3) Part (C): Cristae – possess single circular DNA molecule and ribosomes
(4) Part (A): Matrix – major site for respiratory chain enzymes

Ans. (2)

44. Read the following statement having two blanks (A and B):
"A drug used for --------(A)-------- patients is obtained from a species of the organism --------(B)--------."
The one correct option for the two blanks is:

	Blank - A	**Blank - B**
(1)	Heart	Penicillium
(2)	Organ-transplant	Trichoderma
(3)	Swine flu	Monascus
(4)	AIDS	Pseudomonas

Ans. (2)

Hint : Cyclosporin A is immunosuppressive drug obtained from Trichoderma and use in organ transplantation

45. Silencing of mRNA has been used in producing transgenic plants resistant to:
(1) Bollworms (2) Nematodes (3) White rusts (4) Bacterial blights

Ans. (2)

Hint : It occur through RNA i

46. At metaphase, chromosomes are attached to the spindle fibres by their:
(1) Satellites (2) Secondary constrictions
(3) Kinetochores (4) Centromere

Ans. (3)

47. Consider the following statements (A-D) about organic farming:
(A) Utilizes genetically modified crops like Bt cotton
(B) Uses only naturally produced inputs like compost
(C) Does not use pesticides and urea
(D) Produces vegetables rich in vitamins and minerals
Which of the above statements are correct?
(1) (B), (C) and (D) (2) (C) and (D) only
(3) (B) and (C) only (4) (A) and (B) only

Ans. (3)

48. One of the constituents of the pancreatic juice while poured into the duodenum in humans, is:
(1) Trypsinogen (2) Chymotrypsin (3) Trypsin (4) Enterokinase
Ans. (1)
Hint : Because it is inactive form and we know that all enzymes of pancrease secreted in this form

49. Frogs differ from humans in possessing:
(1) paired cerebral hemispheres (2) hepatic portal system
(3) nucleated red blood cells (4) thyroid as well as parathyroid

Ans. (3)

Hint : Human possesses enucleated RBC in mature state

50. Which one of the following option gives the correct matching of a disease with its causative organism and mode mode of infection.

	Disease	**Gausative Organisms**	**Mode of Infection**
1	Typhoid	Salmonella typhi	With inspirad air
2	Pneumonia	Sreptococcus pneumoniae	Droplet infection
3	Elephantiasis	Wuchereria bancrofti	infected water and food
4	Malaria	Plasmodium vivax	Bite of male anopheles mosquito

Ans. (2)

51. Function of companion cells is
(1) Providing energy to sieve elements for active transport
(2) Proiding water to phloem
(3) Loading of sucrose in to sieve elements by passive transport
(4) Loading of sucrose into sieve elements
Ans. (4)

52. Test cross in plants or in Drosophila involves crossing
(1) between two genotypes with recessive trait (2) between two F_1 hybrids

(3) the F_1 hybrid with a double recessive genotype. (4) between two genotypes with dominant trait

Ans. (3)
Hint : It is a defination of test cross

53. Some vascular bundles are described as open because these
(1) are surrounded by pericycle but to endodermis
(2) are capable of producing secondary xylem and phloem
(3) possess conjunctive tissue between xylem and phloem
(4) are not surrounded by pericycle

Ans. (2)

Hint : Open means presence of cambium during sec. growth. Vascular cambium divides to form secondary xylem towards Inner side while sec. Phloem towards outside

54. In mitochondria, protons accumulate in the
(1) Outer membrane (2) Inner membrane (3) Intermembrane space (4) Matrix

Ans. (3)

55. The breakdown of detritus into smaller particles by earthworm is a process called
(1) Humification (2) Fragmentation (3) Mineralisation (4) Catabolism

Ans. (2)

56. Whorled, simple leaves with reticulate venation are present in
(1) Calotropis (2) Neem (3) China Rose (4) Alstonia

Ans. (4)
Hint : Whorled phyllotaxy is feature of Nerium and Alstonia. In Alstonia five leaves present in a whorl while in Nerium three leaves present in a whorl

57. Sweet potato is homolgous to
(1) Potato (2) Colocasia (3) Ginger (4) Turnip

Ans. (4)
Hint : Sweet potato and turnip both are roots

58. The unequivocal proof of DNA as the genetic material came from the studies on a
(1) Bacterium (2) Fungus (3) Viroid (4) Bacterial virus

Ans. (4)

Hint : Bacteriophage used by Hershay and Chase to prove D.N.A. as genetic matterial.

59. Consider the following four statements whether they are correct of wrong
(A) The sporophyte in liverworts is more elaborate than that in mosses
(B) Salvinia is heterosporous
(C) The life- cycle in all seed-bearing plants is diplontic
(D) In pinus male and female cones are borne on different trees
(1) Statements (A) and (C) (2) Statements (A) and (D)
(3) Statements (B) and (C) (4) Statements (A) and (B)

Ans. (2)

Hint : **(A)** Sporophyte is more developed in mosses rather than liver wort.
(B) Pinus is Monoecious in which male & female cones are borne on different branch.

60. Consider the following four statements (A-D) related to the common frog Rana tigrina, and select the correct option stating which ones are **true (T)** and which ones are **false (F)**
Statements :
(A) On dry land it would die due to lack of O_2 its mouth is forcibly kept closed for a few days
(B) It has four- chambered heart
(C) On day land it turns uricotelic from ureotelic
(4) Its life-history is carried out in pond water
Options :

	(A)	(B)	(C)	(D)
(1)	T	F	F	T
(2)	T	T	F	F
(3)	F	F	T	T
(4)	F	T	T	F

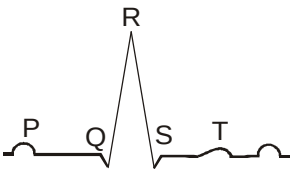
Ans. (1)

Hint : **(A)** Dry skin cause ceased cutaneous respiration
(B) Three chembered heart.
(C) Frog never be uricotalic
(D) External fertilization and in water

61. In Kranz anatomy, the bundle sheath cells have
(1) Thin walls, many intercellular spaces and no chloroplasts
(2) Thick walls, no intercellular spaces and large number of chloroplasts
(3) Thin walls, no intercellular spaces and several chloroplasts
(4) Thick walls, many intercellular spaces and few chloroplasts

Ans. (2)

62. Given below is the ECG of a normal human. Which one of its components is human, Which one of its components is **correctly** interpreted below



(1) Complex QRS-One complete Pulse
(2) Peak T - Initiation of total cardiac contraction
(3) Peak P and Peak R together - systolic and diastolic blood pressures
(4) Peak P- Initiation of left atrial contraction only

Ans. (3)

Hint : Peak P-causes diastolic phase in ventricle while R-Peak causes systole in ventricle means diastolic and systolic phases represented by P & R and same Diastolic and systolic B.P.

63. Which one of the following structures in Pheretima is correctly matched with its function
(1) Clitellum - secretes cocoon (2) Gizzard - absorbs digested food
(3) Setae- defence against predators (4) Typhlosole - storage of extra nutrients

Ans. (1)

Hint : Clitellum - secretes cocoon during breading season of earthworm. Gizzard -grinding of food particles. setae help in locomotion. Typhlosole increases the absorption area in intestine

64. Selaginella and Salvinia are considered to represent a significant step toward evolution of seed habit because:
(1) Female gametophyte is free and gets dispersed like seeds
(2) Female gametophyte lacks archegonia.
(3) Megaspores possess endosperm and embryo surrounded by seed coat.
(4) Embryo develops in female gametophyte which is retained on parent sporophyte.

Ans. (4)

65. Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as
(1) bicarbonate in blood plasma and RBCs
(2) Free CO_2 in blood plasma
(3) 70% carbamino- haemogolobin and 30% as bicarbonate
(4) Carbamino-haemoglobin in RBCs

Ans. (1)

Hint : 70% to 75% CO_2 is transported as $NaHCO_3$ by plasma and $KHCO_3$ by RBCs

66. In angiosperms, Functional megaspore develops into
(1) Embryo sac (2) Ovule (3) Endosperm (4) Pollen sac

Ans. (1)

Hint : During megagametogenesis functional megaspore (mostly chalazal) gives rise to embryo sac.

67. Consider the following statements (A)-(D) each with one or two blanks.
(A) Bears go into __(1)__ during winter to __(2)__ cold weather
(B) A conical age pyramid with a broad base represents __(3)__ human population
(C) A wasp pollinating a fig flower is an example of __(4)___
(D) An area with high levels of species richness is known as __(5)___
Which one of the following options give the correct fill ups the respective blank numbers from (1) to (5) in the statements

(1) (2) - stable (4) commensalism, (5) marsh
(2) (1) - aestivation, (5) - escape, (3) - stable, (4) - mutualism
(3) (3) - expanding, (4) - commensalism, (5) biodiversity park
(4) (1)- hibernation, (2) - escape, (3) - expanding, (5) hot spot

Ans. (4)

68. What is common between vegetative reproduction and Apomixis
(1) Both are applicable to only dicot plants
(2) Both bypass the flowering phase
(3) Both occur round the year
(4) Both produces progeny identical to the parent

Ans. (4)

Hint : The progeny are genetically similar to parent and called clone

69. Common cold is not cured by antibiotics because it is
(1) caused by a virus (2) caused by a Gram-positive bacterium
(3) caused by a Gram-negative bacterium (4) not an infectious disease

Ans. (1)

Hint : Common cold is due to rhinovirus.

70. Which one of the following is not an essential mineral element for plants while the remaining three are
(1) Iron (2) Manganese (3) Cadmium (4) Phosphorus

Ans. (3)

Hint : Cadmium is not essential element for plants

71. Biodiversity of a geographical region represents
(1) Endangered species found in the region.
(2) The diversity in the organisms living in the region.
(3) Genetic diversity present in the dominant species of the region.
(4) Species endemic to the region.

Ans. (2)

72. Which one of the following is not considered as a part of the endomembrane system ?
(1) Golgi complex (2) Peroxisome (3) Vacuole (4) Lysosome

Ans. (2)
Hint : Except peroxisome the remaining three and ER are the parts of Endomembrane system.

73. Which one of the following correctly represents the normal adult human dental formula ?

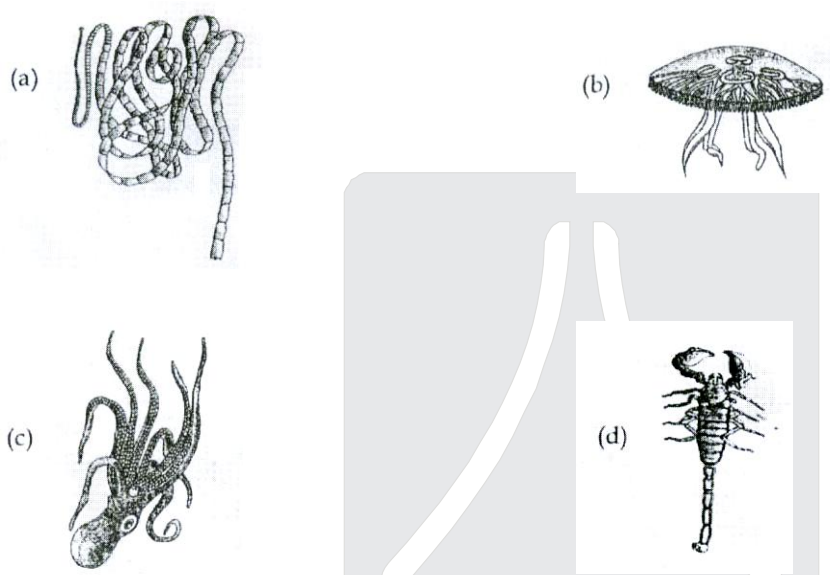
(1) $\frac{3}{3},\frac{1}{1},\frac{3}{2},\frac{1}{1}$ (2) $\frac{2}{2},\frac{1}{1},\frac{3}{2},\frac{3}{3}$ (3) $\frac{2}{2},\frac{1}{1},\frac{2}{2},\frac{3}{3}$ (4) $\frac{3}{3},\frac{1}{1},\frac{3}{3},\frac{3}{3}$

Ans. (3)

74. Select the correct statement with respect to diseases and immunisation :
(1) If due to some reason B-and T-lymphocytes are damaged, the body will not produce antibodies against a pathogen
(2) Injection of dead / inactivated pathogens causes passive immunity
(3) Certain protozoans have been used to mass produce hepatitis B vaccine.
(4) Injection of snake antivenom against snake bite is an example of active immunisation

Ans. (1)

75. The figure shows four animals (a), (b), (c) and (d). Select the correct answer with respect to a common characteristics of two of these animals.



(1) (a) and (d) respire mainly through body wall (2) (b) and (c) show radial symmetry
(3) (a) and (b) have cnidoblasts for self-defense (4) (c) and (d) have a true coelom

Ans. (4)

Hint : From Annaelida to chordata all are Eucoelomate **C**-Mollusca (Octopus), **D**-Arthropoda (Scorpion)

76. In history of biology, human genome project led to the development of :
(1) Biotechnology
(2) Biomonitoring
(3) Bioinformatics
(4) Biosystematics

Ans. (3)

77. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child ?

(1) two X chromosomes
(2) only one Y chromosome
(3) only one X chromosome
(4) one X and one Y chromosome

Ans. (1)

78. Which one of the following is essential for photolysis of water ?
(1) Manganese (2) zinc (3) copper (4) Boron

Ans. (1)

79. Which one of the following techniques made it possible to genetically engineer living organism ?
(1) Recombinant DNA techniques (2) X-ray diffraction
(3) Heavier isotope labelling (4) Hybridization

Ans. (1)

80. Ureters act as urogenital ducts in :
(1) human males (2) human females
(3) frog's both males and females (4) frog's males

Ans. (4)

81. The type of muscles present in our :
(1) heart are involuntary and unstriated smooth muscles
(2) intestine are striated and involuntary
(3) thigh are striated and voluntary
(4) upper arm are smooth muscle fibres fusiform in shape

Ans. (3)

Hint : Thigh muscles are skeletal muscle that are striated and voluntary.

82. Read the following four statements (A-D) about certain mistakes in two of them
(A) The first transgenic buffalo, Rosie produced milk which was human alpha-lactal bumin enriched.
(B) Restriction enzymes are used in isolation of DNA from other macro-molecules.
(C) Downstream processing is one of the steps of R-DNA technology.
(D) Disarmed pathogen vectors are also used in transfer of R-DNA into the host.

Which are the two statements having mistakes ?

(1) Statement (B) and (C) (2) Statement (C) and (D)
(3) Statement (A) and (C) (4) Statement (A) and (B)

Ans. (4)

Hint : Transgenic Rosie is actually cow Restriction enzymes cut the DNA at specific site The separation of DNA is performed by Gel electrophorasis.

83. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone :
(1) calcitonin (2) prolactin (3) adrenaline (4) melatonin

Ans. (4)

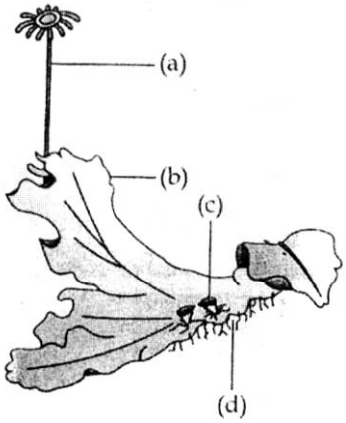
Hint : Responsible for circadian cycle

84. Guttation is the result of :
(1) Diffusion (2) Transpiration (3) Osmosis (4) Root pressure

Ans. (4)

Hint : Guttation is due to root pressure.

85. Examine the figure given below and select the right option giving all the four parts (a, b, c and d) correctly identified.



	(a)	(b)	(c)	(d)
(1)	Archegoniophore	Female' thallus	Gemmacup	Rhizoids
(2)	Archegoniophore	Female' thallus	Bud	Foot
(3)	Seta	Sporophyte	Protonema	Rhizoids
(4)	Antheridiophore	Male thallus	Globule	Roots

Ans. (1)

86. Three of the following pairs of the human skeletal parts are correctly matched with their respective inclusive skeletal category and one pair is not matched. Identify the non-matching pair.

	Pairs of skeletal parts	**Category**
(1)	Sternum and Ribs	Axial skeleton
(2)	Clavicle and Glenoid Cavity	Pelvic girdle
(3)	Humerus and ulna	Appendicular skeleton
(4)	Malleus and stapes	Ear ossicles

Ans. (2)

Hint : Glenoid cavity found in pectoral girdle.

87. Which one of the following aspects is an exclusive characteristic of living things ?
(1) Isolated metabolic reactions occur in vitro
(2) Increase in mass from inside only
(3) Perception of events happening in the environment and their memory
(4) Increase in mass by accumulation of material both on surface as well as internally.

Ans. (3)

88. "Good ozone " is found in the :
(1) Mesosphere (2) Troposphere (3) Stratosphere (4) Ionosphere

Ans. (3)

Hint : Ozone of Stratosphere provides protection from UV rays.

89. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct ?
(1) Yeast - statins
(2) Acetobacter aceti - acid
(3) Clostridium butylicum - lactic acid
(4) Aspergillus niger - citric acid

Ans. (3)

Hint : Clostridium butylicum form butyric acid.

90. The logistic population growth is expressed by the equation :

(1) $dt/dN = Nr\left(\frac{K-N}{K}\right)$

(2) $dN/dt = rN\left(\frac{K-N}{K}\right)$

(3) $dN/dt = rN$

(4) $dN/dt = rN\left(\frac{N-K}{N}\right)$

Ans. (2)

PART - C (PHYSICS)

91. Two identical piano wires kept under the same tension T have a fundamental frequency of 600 Hz. The fractional increase in the tension of one of the wires which will lead to occurrence of 6 beats/s when both the wires oscillate together would be :

(1) 0.02 (2) 0.03 (3) 0.04 (4) 0.01

Ans. (1)

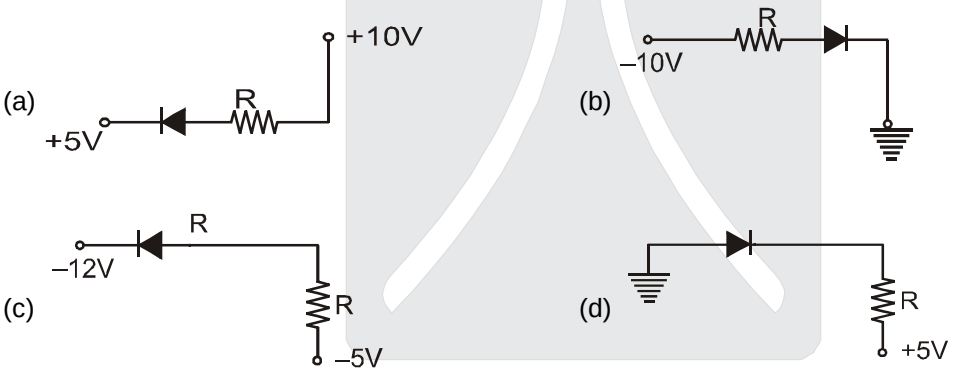
Sol. $\frac{1}{2\ell}\sqrt{\frac{F}{\mu}} = f$ (for fundamental mode)

ℓ & μ are constant

Taking ℓn on both side & differentiating

$$= \frac{dF}{2F} = \frac{df}{f} \quad \Rightarrow \quad \frac{dF}{F} = \frac{2\times df}{f} = 2 \times \frac{6}{600} = 0.02.$$

92. In the following figure, the diodes which are forward biased, are :



(1) (c) only (2) (c) and (a) (3) (b) and (d) (4) (a), (b) and (d)

Ans. (2)

Sol. Only in (a) and (c)

Diodes are forward biased

As p–type should be higher potential & n–type at lower potential.

93. The threshold frequency for a photosensitive metal is 3.3×10^{14} Hz. If light of frequency 8.2×10^{14} Hz is incident on this metal, the cut-off voltage for the photoelectric emission is nearly :

(1) 2V (2) 3V (3) 5V (4) 1V

Ans. (1)

Sol. K.E. = $hv - hv_{th} = eV_0$ (V_0 = cutoff voltage)

$$V_0 = \frac{h}{e}(8.2 \times 10^{14} - 3.3 \times 10^{14})$$

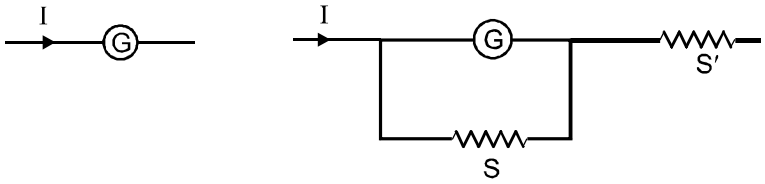
$$= \frac{6.6\times10^{-34}\times4.9\times10^{14}}{1.6\times10^{-19}} \approx 2V .$$

94. A galvanometer of resistance, G is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is :

(1) $\frac{S^2}{(S+G)}$ (2) $\frac{SG}{(S+G)}$ (3) $\frac{G^2}{(S+G)}$ (4) $\frac{G}{(S+G)}$

Ans. (3)

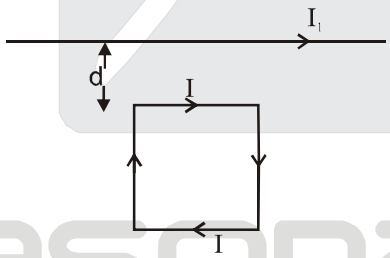
Sol.



$$G = \left(\frac{GS}{G+S}\right) + S'$$

$$G - \frac{GS}{G+S} = S' \qquad \therefore \qquad S' = \frac{G^2}{G+S}.$$

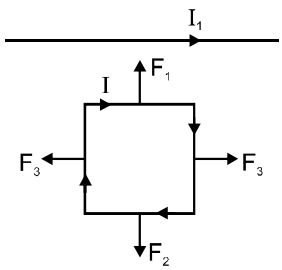
95. A square loop, carrying a steady current I, is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance d from the conductor as shown in figure. The loop will experience :



(1) a net repulsive force away from the conductor
(2) a net torque acting upward perpendicular to the horizontal plane
(3) a net torque acting ddownward normal to the horizontal plane
(4) a net attractive force towards the conductor

Ans. (4)

Sol.



$F_1 > F_2$. hence net attraction force will be towards conductor.

96. A thermocouple of negligible resistance produces an e.m.f. of 40 μV/°C in the linear range of temperature. A galvanometer of resistance 10 ohm whose sensitivity is 1μA/div, is employed with the termocouple. The smallest value of temperature difference that can be detected by the system will be :

(1) 0.5°C (2) 1°C (3) 0.1°C (4) 0.25°C

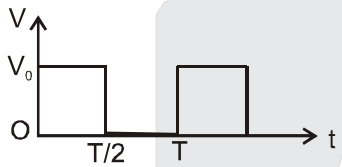
Ans. (4)

Sol. 1division ≡ 1μA

Current for 1ºC = $\frac{40\mu v}{10}$ = 4μA

1μA ≡ $\frac{1}{4}$ºC = 0.25ºC.

97. The r.m.s. value of potential difference V shown in the figure is :



(1) V_0 (2) $V_0/\sqrt{2}$ (3) $V_0/2$ (4) $V_0/\sqrt{3}$

Ans. (2)

Sol. $V_{rms} = \sqrt{\frac{(T/2)V_0^2 + 0}{T}} = \frac{V_0}{\sqrt{2}}$.

98. A coil has resistance 30 ohm and inductive reactance 20 Ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be :

(1) 4.0 A (2) 8.0 A (3) $\frac{20}{\sqrt{13}}$A (4) 2.0 A

Ans. (1)

Sol. If ω = 50 × 2π then ωL = 20Ω
If ω′ = 100 × 2π then ω′L = 40Ω

$I = \frac{200}{Z}\ \frac{200}{\sqrt{R^2 + (\omega' L)^2}} = \frac{200}{\sqrt{30^2 + (40)^2}}$

I = 4 A.

99. A particle of mass m is thrown upwards from the surface of the earth, with a velocity u. The mass and the radius of the earth are , respectively, M and R. G is gravitational constant and g is acceleration due to gravity on the surface of the earth. The minimum value of u so that the particle does not return back to earth, is :

(1) $\sqrt{\frac{2GM}{R}}$ (2) $\sqrt{\frac{2GM}{R^2}}$ (3) $\sqrt{2gR^2}$ (4) $\sqrt{\frac{2GM}{R^2}}$

Ans. (1)

Sol. $GM = gR^2$

$V_e = \sqrt{2gR} = \sqrt{2\frac{GM}{R^2}R} = \sqrt{\frac{2GM}{R}}$.

100. Pure Si at 500K has equal number of electron (n_e) and hole (n_h) concentrations of 1.5×10^{16} m^{-3}. Doping by indium increases n_h to 4.5×10^{22} m^{-3}. The doped semiconductor is of :

(1) n–type with electron concentration $n_e = 5 \times 10^{22}$ m^{-3}

(2) p–type with electron concentration $n_e = 2.5 \times 10^{10}$ m^{-3}

(3) n–type with electron concentration $n_e = 2.5 \times 10^{23}$ m^{-3}

(4) p–type having electron concentrations $n_e = 5 \times 10^{9}$ m^{-3}

Ans. (4)

Sol. $n_i^2 = n_e n_h$

$(1.5 \times 10^{16})^2 = n_e(4.5 \times 10^{22})$

$n_e = 0.5 \times 10^{10}$

$n_e = 5 \times 10^{9}$

$n_h = 4.5 \times 10^{22}$

$n_h >> n_e$

Semiconductor is p–type and $n_e = 5 \times 10^{9}$ m^{-3} .

101. Charge q is uniformly spread on a thin ring of radius R. The ring rotates about its axis with a uniform frequency f Hz. The magnitude of magnetic induction at the centre of the ring is

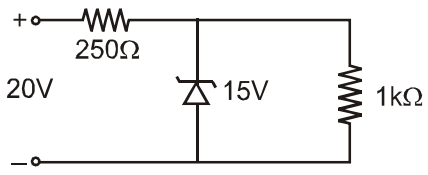
(1) $\frac{\mu_0 qf}{2R}$ (2) $\frac{\mu_0 q}{2fR}$ (3) $\frac{\mu_0 q}{2\pi fR}$ (4) $\frac{\mu_0 qf}{2\pi R}$

Ans. (1)

Sol. $B = \frac{\mu_0 I}{2R}$, $I = \frac{q}{T} = qf$

$B = \frac{\mu_0 qf}{2R}$.

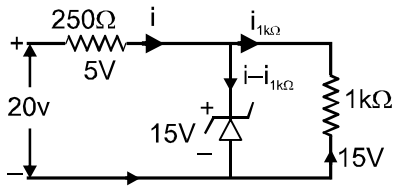
102. A zener diode, having breakdown voltage equal to 15V, is used in a voltage regulator circuit shown in figure. The current through the diode is :



(1) 10 mA (2) 15 mA (3) 20 mA (4) 5 mA

Ans. (4)

Sol. Voltage across zener diode is constant



$(i)_{1k\Omega} = \frac{15 \text{ volt}}{1k\Omega} = 15 \text{ mA}$

$(i)_{250\Omega} = \frac{(20-15)V}{250\Omega} = \frac{5V}{250\Omega} = \frac{20}{1000} A = 20 \text{ mA}$

$\therefore \quad (i)_{\text{zener diode}} = (20 - 15) = 5 \text{ mA}.$

103. A particle covers half of its total distance with speed v_1 and the rest half distance with speed v_2. Its average speed during the complete journey is :

(1) $\frac{v_1 v_2}{v_1 + v_2}$ (2) $\frac{2v_1 v_2}{v_1 + v_2}$ (3) $\frac{2v_1^2 v_2^2}{v_1^2 + v_2^2}$ (4) $\frac{v_1 + v_2}{2}$

Ans. (2)

Sol. $V_{av} = \frac{S+S}{\frac{S}{V_1}+\frac{S}{V_2}} = \frac{2V_1V_2}{V_1+V_2}.$

104. The electric potential V at any point (x, y, z), all in meters in space is given by $V = 4x^2$ volt. The electric field at the point (1, 0, 2) in volt/meter is :

(1) 8 along positive X-axis (2) 16 along negative X-axis
(3) 16 along positive X-axis (4) 8 along negative X-axis

Ans. (4)

Sol. $\vec{E} = -\frac{dV}{dx}\hat{i}$

$= -8x\,\hat{i}$ volt/meter

$\vec{E}_{(1,0,2)} = -8\hat{i}$ V/m

105. A short bar magnet of magnetic moment 0.4J T^{-1} is place in a uniform magnetic field of 0.16 T. The magnet is stable equilibrium when the potential energy is:

(1) –0.64 J (2) zero (3) – 0.082 J (4) 0.064

Ans. (1)

Sol. For stable equilibrium

$U = -MB$

$= -(0.4)(0.16)$

$= -0.064$ J

106. A thin prism of angle 15º made of glass of refractive index $\mu_1 = 1.5$ is combined with another prism of glass of refractive index $\mu_2 = 1.75$. the combination of the prism produces dispersion without deviation . The angle of the second prism should be:

(1) 7º (2) 10º (3) 12º (4) 5º

Ans. (2)

Sol. Deviation = zero

So, $\delta = \delta_1 + \delta_2 = 0$

$(\mu_1 - 1)A_1 + (\mu_2 - 1)A_2 = 0$

$A_2(1.75 - 1) = -(1.5 - 1)15º$

$$A_2 = -\frac{0.5}{0.75} \times 15º$$

$A_2 = -10º$.

107. A conveyor belt is moving at a constant speed of 2m/s. A box is gently dropped on it. The coefficient of friction between them is μ= 0.5. The distance that the box will move relative to belt before coming to rest on it taking $g = 10\ ms^{-2}$, is :

(1) 1.2 m (2) 0.6 m (3) zero (4) 0.4 m

Ans. (4)

Sol. $a = \mu g = 5$

$v^2 = u^2 + 2as$

$0 = 2^2 + 2 \times (5)s$

$$s = -\frac{2}{5} \text{ w.r.t. belt}$$

or distance = 0.4 m

108. A mass of diatomic gas ($\gamma = 1.4$) at a pressure of 2 atmospheres is compressed adiabatically so that its temperature rise from 27ºC to 927ºC. The pressure of the gas is final state is :

(1) 28 atm (2) 68.7atm (3) 256 atm (4) 8 atm

Ans. (3)

Sol. PV^γ = constant $T_1 = 273 + 27 = 300K$

$$P\left(\frac{T}{P}\right)^\gamma = \text{constant} \qquad T_2 = 273 + 927 = 1200K$$

$P^{1-\gamma} T^\gamma$ = constant

$\Rightarrow P_1^{1-\gamma} T_1^{\gamma} = P_2^{1-\gamma} T_2^{\gamma}$

$\Rightarrow 2^{1-1.4}(300)^{1.4} = P_2^{1-1.4}.(1200)^{1.4}$

$$\Rightarrow \left(\frac{P_2}{P_1}\right)^{1-\gamma} = \left(\frac{T_1}{T_2}\right)^{\gamma} \qquad \Rightarrow \qquad \frac{P_2}{P_1} = \left(\frac{T_1}{T_2}\right)^{\frac{\gamma}{1-\gamma}}$$

$$\left(\frac{P_1}{P_2}\right)^{1-\gamma} = \left(\frac{T_2}{T_1}\right)^{\gamma}$$

$$\left(\frac{P_1}{P_2}\right)^{1-1.4} = \left(\frac{1200}{300}\right)^{1.4}$$

$$\left(\frac{P_1}{P_2}\right)^{-0.4} = (4)^{1.4}$$

$$\left(\frac{P_2}{P_1}\right)^{0.4} = 4^{1.4}$$

$$P_2 = P_1\ 4^{\left(\frac{1.4}{0.4}\right)} = P_1\ 4^{\left(\frac{7}{2}\right)}$$

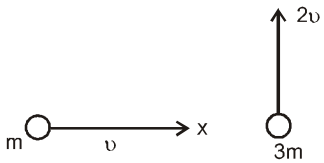
$$= P_1(2^7) = 2 \times 128 = 256$$

109. A mass m moving horizontally (along the x-axis) with velocity v collides and sticks to mass of 3m moving vertically upward (along the y-axis) with velocity 2v. The final velocity of the combination is :

(1) $\frac{1}{4}v\hat{i} + \frac{3}{2}v\hat{j}$ (2) $\frac{1}{3}v\hat{i} + \frac{2}{3}v\hat{j}$ (3) $\frac{2}{3}v\hat{i} + \frac{1}{3}v\hat{j}$ (4) $\frac{3}{2}v\hat{i} + \frac{1}{4}v\hat{j}$

Ans. (1)

Sol.



From momentum conservation

$$m\upsilon\hat{i} + 3m(2\upsilon)\hat{j} = (4m)\,\vec{\upsilon}$$

$$\vec{\upsilon} = \frac{\upsilon}{4}\hat{i} + \frac{6}{4}\upsilon\hat{j}$$

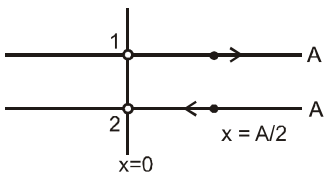
$$= \frac{\upsilon}{4}\hat{i} + \frac{3}{2}\upsilon\hat{j}$$

110. Two particle are oscillating along two close parallel straight lines side by side, with the same frequency and amplitudes. They pass each other, moving in opposite directions when their displacement is half of the amplitude. The mean positions of the two particles lie on a straight line perpendicular to the paths of the two particles. The phase difference is :

(1) 0 (2) $2\pi/3$ (3) π (4) $\pi/6$

Ans. (2)

Sol.



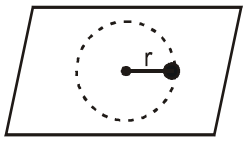
$$\phi_1 = \frac{\pi}{6}$$

$$\phi_2 = \pi - \frac{\pi}{6} = \frac{5\pi}{6}$$

$$\phi_1 = \phi_2 - \phi_1$$

$$= \frac{4\pi}{6} = \frac{2\pi}{3}$$

111. A small mass attached to a string rotates on frictionless table top as shown. If the tension is the string is increased by pulling the string causing the radius of the circular motion to decrease by a factor of 2, the kinetic energy of the mass will:



(1) remain constant
(2) increase by a factor of 2
(3) increase by a factor of 4
(4) decrease by a factor of 2

Ans. (3)

Sol. K.E. = $\frac{L^2}{2I}$

$\because$ From angular momemtum conservation about centre

$L \rightarrow$ constant

$I = mr^2$

K.E.′ = $\frac{L^2}{2(mr'^2)}$ $\qquad r' = \frac{r}{2}$

K.E.′ = 4 K.E.

K.E. is increased by a factor of 4.

112. The density of material in CGS system of units is $4 g/cm^3$. In a system of units in which unit of lengths is 10 cm and unit of mass is 100 g, the value of density of material will be :

(1) 0.4 (2) 40 (3) 400 (4) 0.04

Ans. (2)

Sol. In CGS

$d = 4 \frac{g}{cm^3}$

If unit of mass is 100 g

and unit of distance is 10 cm

so density = $\frac{4\left(\frac{100g}{100}\right)}{\left(\frac{10}{10}cm\right)^3}$

$= \frac{\left(\frac{4}{100}\right)}{\left(\frac{1}{10}\right)^3} \frac{(100g)}{(10cm)^3} = 40$ unit

113. An electron in the hydrogen atom jumps from excited state n to the ground state. The wavelength so emitted illuminates a photosensitive material having work function 2.75 eV. If the stopping potential of the photoelectron is 10 V, the value of n is :

(1) 3 (2) 4 (3) 5 (4) 2

Ans. (2)

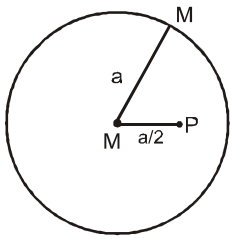
Sol. $KE_{max} = 10$ eV
$\phi = 2.75$ eV
$E = \phi + KE_{max} = 12.75$ eV = Energy difference between n = 4 and n = 1
$\Rightarrow$ value of n = 4

114. A particle of mass M is situated at the centre of spherical shell of mass and radius a. The magnitude of the gravitational potential at a point situated at a/2 distance from the centre, will be:

(1) $\frac{2GM}{a}$ (2) $\frac{3GM}{a}$ (3) $\frac{4GM}{a}$ (4) $\frac{GM}{a}$

Ans. (2)

Sol.



$V_P = V_{sphere} + V_{partical}$

$= \frac{GM}{a} + \frac{GM}{a/2} = \frac{3GM}{a}$

115. Two radioactive nuclei P and Q, in a given sample decay into a stable nucleolus R. At time t = 0, number of P species are $4N_0$ and that of Q are N_0. Half-life of P (for conversion to R) is 1 minute where as that of Q is 2 minutes. Initially there are no nuclei of R present in the sample. When number of nuclei of P and Q are equal, the number of nuclei of R present in the sample would be -

(1) $3N_0$ (2) $\frac{9N_0}{2}$ (3) $\frac{5N_0}{2}$ (4) $2N_0$

Ans. (2)

Sol. Initially $P \rightarrow 4N_o$
$Q \rightarrow N_o$
Half life $T_P = 1$ min.
$T_Q = 2$ min.
Let after time t number of nuclie of P and Q are equal

that is $\frac{4N_o}{2^{t/1}} = \frac{N_o}{2^{t/2}}$

or $\frac{4}{2^{t/2}} = 1$ or t = 4 min

so at t = 4 min

$N_P = \frac{(4N_o)}{2^{4/1}} = \frac{N_o}{4}$

at t = 4 min. $N_Q = \frac{N_o}{2^{4/2}} = \frac{N_o}{4}$

or population of R

$= \left(4N_o - \frac{N_o}{4}\right) + \left(N_o - \frac{N_o}{4}\right)$

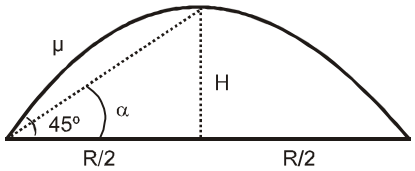
$= \frac{9N_o}{2}$

116. A projectile is fired at an angle of 45º with the horizontal. Elevation angle of the projectile at its highest point as seen from the point of projection is :

(1) 60º (2) $\tan^{-1}\frac{1}{2}$ (3) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (4) 45º

Ans. (2)

Sol.



$H = \frac{u^2 \sin^2 45^\circ}{2g} = \frac{u^2}{4g}$ .....(1)

$R = \frac{u^2 \sin 90^\circ}{g} = \frac{u^2}{g}$

$\therefore \frac{R}{2} = \frac{u^2}{2g}$ .....(2)

$\therefore \tan\alpha = \frac{H}{R/2}$

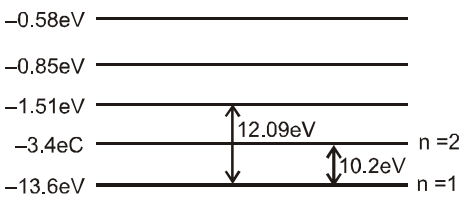
$= \frac{\frac{u^2}{4g}}{\frac{u^2}{2g}} = \frac{1}{2}$ $\therefore$ $\alpha = \tan^{-1}\left(\frac{1}{2}\right)$

117. Out of the following which one is not a possible energy for a photon to be emitted by hydrogen atom according to Bohr's atomic model?

(1) 1.9 eV (2) 11.1 eV (3) 13.6 eV (4) 0.65 eV

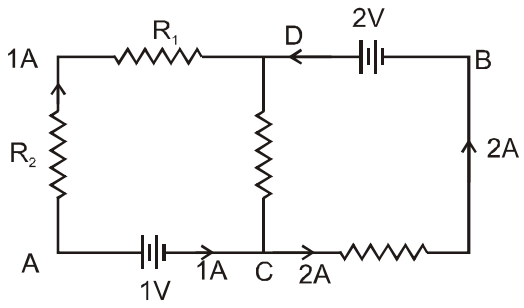
Ans. (2)

Sol.



Obviously difference of 11.1eV is not possible.

118. In the circuit shown in the figure, if potential at point A is taken to be zero the potential at point B is :



(1) –1V (2) + 2V (3) – 2V (4) + 1V

Ans. (4)

Sol. Current from D to C = 1 A

$\therefore\ V_D - V_C = 2 \times 1 = 2V$

$V_A = 0\ \ \therefore\ V_C = 1V,\ \therefore\ V_D - V_C = 2 \quad \Rightarrow V_D - 1 = 2\ \ \therefore\ V_D = 3V$

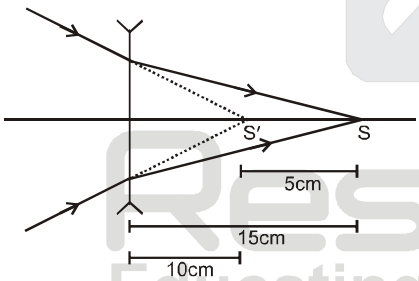
$\therefore\ V_D - V_B = 2\ \ \therefore\ 3 - V_B = 2\ \ \therefore\ V_B = 1V$

119. A conversing beam of rays is incident on a diverging lens. Having passed though the lens the rays intersect at a point 15 cm from the lens on the opposite side. If the lens is removed the point where the rays meets will move 5 cm closer to the lens. The focal length of the lens is :

(1) – 10 cm (2) 20 cm (3) – 30 cm (4) 5 cm

Ans. (3)

Sol.



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

u = 10

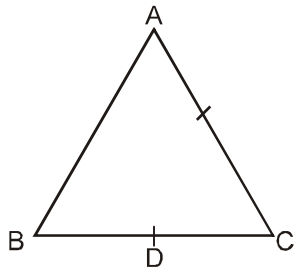
v = 15

f = ?

$\frac{1}{15} - \frac{1}{10} = \frac{1}{f}$

$\frac{10-15}{150} = \frac{1}{f} \quad \therefore\ f = -\frac{150}{5} = -30$ cm

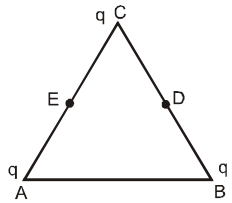
120. Three charges, each +q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, 2a. D and E are the mid points of BC and CA. The work done in taking a charge Q from D to E is:



(1) $\frac{eqQ}{8\pi \in_0 a}$ (2) $\frac{qQ}{4\pi \in_0 a}$ (3) zero (4) $\frac{3qQ}{4\pi \in_0 a}$

Ans. (3)

Sol.



AC = BC

$V_D = V_E$

$W = Q(V_E - V_D)$

$W = 0$

Read carefully the following instructions:

1. Each candidate must show on demand his/her Admission Card to the Invigilator.

2. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.

3. The Candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. Cases where a candidate has not signed the Attendance Sheet the second time will be deemed not to have handed over Answer Sheet and dealt with as an unfair means case.

4. Use of Electronic/Manual Calculator is prohibited.

5. The Candidates are governed by all Rules and Regulations of the Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the Board.

6. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.

7. The candidates will write the Correct Test Booklet Code as given in Test Booklet/Answer Sheet in The Attendance Sheet.