Test Booklet Code

B

CBSE (Mains) - 2012

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 consists of **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 deduced from the total score. 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 handover 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 is 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.
9. Each candidate must show on demand his/her Admit Card to the Invigilator.
10. No candidate, without permission of the Superintendent or Invigilator, would leave his/her seat.
11. 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.
12. Use of Electronic/Manual Calculator is prohibited.
13. The candidates are governed by 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.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
15. The candidates will write the correct Test Booklet Code as given in the Test Booklet/Answer Sheet in the Attendance Sheet.

CBSE - 2012 (Mains)

CHEMISTRY, BIOLOGY & PHYSICS — TEST BOOKLET CODE-B

1. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 25°C are 200 mm Hg and 41.5 mm Hg respectively. Vapour pressure of the solution obtained by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at the same temperature will be:

(Molecular mass of $CHCl_3$ = 119.5 u and molecular mass of CH_2Cl_2 = 85 u)

(1) 285.5 mm Hg (2) 173.9 mm Hg (3) 615.0 mm Hg (4) 347.9 mm Hg

Sol: Ans [Bonus]

$$\underset{P_A^0=200}{CHCl_3}\ \Big|\ \underset{P_B^0=41.5}{CH_2Cl_2}$$

$P_T = P_A + P_B$

$$P_T = P_A^0 x_A + P_B^0 x_B = P_A^0 \times \frac{\frac{25.5}{119.5}}{\frac{25.5}{119.5}+\frac{40}{85}} + P_B^0 \times \frac{\frac{40}{85}}{\frac{25.5}{119.5}+\frac{40}{85}}$$

$$= 200 \times \frac{0.2133}{0.2133+0.4785} + 41.5 \times \frac{0.4785}{0.2133+0.4785}$$

$$P_T = \frac{42.66}{0.6918} + \frac{19.85775}{0.6918}$$

$$P_T = \frac{42.66}{0.6918} + \frac{19.85775}{0.6918} = \frac{62.51775}{0.6918} = 90.36968$$

2. The Gibbs energy for the decomposition of Al_2O_3 at 500°C is as follows:

$$\frac{2}{3}Al_2O_3 \longrightarrow \frac{4}{3}Al + O_2; \qquad \Delta_r G = +960 \text{kJ mol}^{-1}$$

The potential difference needed for the electrolytic reduction of aluminium oxide (Al_2O_3) at 500°C at least

(1) 5.0 V (2) 4.5 V (3) 3.0 V (4) 2.5 V

Sol: Ans [4]

$$\frac{2}{3}Al_2O_3 \longrightarrow \frac{4}{3}Al + O_2$$

$$Al_2O_6 \longrightarrow 2Al^{3+} + 3O^{2-}$$

$\Delta G = -nFE \Rightarrow 960 \times 10^3 = -6 \times 96500 \times E$

$$E = \frac{9.448}{6} = 1.65\text{V} \text{ required}$$

3. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^0_{M^{2+}/M}\right)$ value has a positive sign?

(1) Fe (Z = 26) (2) Co (Z = 27) (3) Ni (Z = 28) (4) Cu (Z = 29)

Sol: Ans [4]

Cu

$E^0_{Cu^{2+}/Cu} = 0.34$ volt

4. Which of the following exhibits only +3 oxidation state?

(1) Pa (2) U (3) Th (4) Ac

Sol: Ans [4]

$Ac \rightarrow [Rn]_{86}\ 7s^2 6d^1 5f^0$

5. Molar conductivities $\left(\wedge^0_m\right)$ at infinite dilution of NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 S cm^2 mol^{-1} respectively. $\wedge^0_m$ for CH_3COOH will be:

(1) 390.5 S cm^2 mol^{-1} (2) 425.5 S cm^2 mol^{-1}
(3) 180.5 S cm^2 mol^{-1} (4) 290.8 S cm^2 mol^{-1}

Sol: Ans [1]

$$\overset{0}{\wedge}_{m\,CH_3COOH} = \overset{0}{\wedge}_{m\,CH_3COONa} + \overset{0}{\wedge}_{m\,HCl} - \overset{0}{\wedge}_{m\,NaCl}$$

$= 91.0 + 425.9 - 126.4 = 390.5$

6. In which of the following arrangements the given sequence is not strictly according to the property indicated against it?

(1) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power
(2) HF < HCl < HBr < HI : increasing acidic strength
(3) $H_2O < H_2S < H_2Se < H_2Te$: increasing pK_a values
(4) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing acidic character

Sol: Ans [3]

7. Consider the reaction:

$$RCHO + NH_2NH_2 \longrightarrow RCH = N - NH_2$$

What sort of reaction is it?

(1) Nucleophilic addition - elimination reaction (2) Electrophilic addition - elimination reaction
(3) Free radical addition - elimination reaction (4) Electrophilic substitution elimination reaction

Sol: Ans [1]

$$R-\overset{\overset{\displaystyle O}{\|}}{C}-H + NH_2 - NH_2 \longrightarrow R-\overset{\overset{\displaystyle N}{|}}{C} = N = NH_2$$

Nucleophilic addition then elimination

8. During change of O_2 to O_2^- ion, the electron adds on which one of the following orbitals?

(1) σ orbital (2) π^* orbital (3) π orbital (4) σ^* orbital

Sol: Ans [2]

$$O_2 \longrightarrow O_2^-$$

Electron is added in π* orbital

9. Standard reduction potentials of the half reactions are given below:

$$F_{2(g)} + 2e^- \longrightarrow 2F^-_{(aq)}; \quad E^0 = +2.85V$$

$$Cl_{2(g)} + 2e^- \longrightarrow 2Cl^-_{(aq)}; \; E^0 = +1.36\ V$$

$$Br_{2(g)} + 2e^- \longrightarrow 2Br^-_{(aq)}; \; E^0 = +1.06\ V$$

$$I_{2(g)} + 2e^- \longrightarrow 2I^-_{(aq)}; \quad E^0 = +0.53\ V$$

The strongest oxidising and reducing agents respectively are:

(1) Cl_2 and I_2 (2) F_2 and I^- (3) Br_2 and Cl^- (4) Cl_2 and Br^-

Sol: Ans [2]

$$F_2 + 2e^- \longrightarrow 2F^- \quad E^0 = +2.85V$$

$$I_2 + 2e^- \longrightarrow 2I^- \quad E^0 = +0.53V$$

F_2 with highest reduction potential is the strongest oxidising agent.

10. The catalytic activity of transition metals and their compounds is ascribed mainly to

(1) their chemical reactivity (2) their magnetic behaviour

(3) their unfilled d-orbitals (4) their ability to adopt variable oxidation states

Sol: Ans [4]

Catalytic action is due to variable oxidation state.

11. Equal volumes of two monoatomic gases, A and B, at same temperature and pressure are mixed. The ratio of specific heats (C_p/C_v) of the mixture will be

(1) 1.67 (2) 0.83 (3) 1.50 (4) 3.3

Sol: Ans [1]

C_p of the mixture = $2\times\frac{}{2}R$

C_v of the mixture = $2\times\frac{3}{2}R$

$\frac{C_p}{C_v}$ of the mixture = 1.67

12. Given that the equilibrium constant for the reaction

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature.

$$SO_{3(g)} \rightleftharpoons SO_{2(g)} + \frac{1}{2}O_{2(g)}$$

(1) 1.3×10^{-5} (2) 1.8×10^{-3} (3) 3.6×10^{-3} (4) 6.0×10^{-2}

Sol: Ans [4]

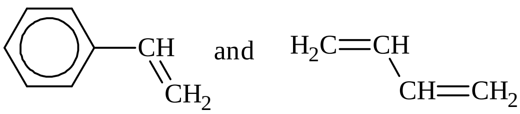
$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

$$K_{eq} = 278$$

$$SO_3 \rightleftharpoons SO_2 + \frac{1}{2}O_2$$

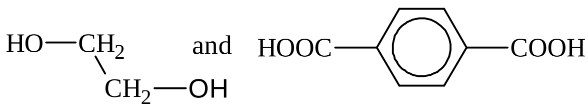
$$K'_{eq} = \sqrt{\frac{1}{K_{equilibrium}}} = \sqrt{\frac{1}{278}} = 5.99 \times 10^{-2}$$

13. Which one of the following sets forms the bidegradable polymer?

(1) 

(2) $H_2C{=}CH{-}CN$ and $H_2C{=}CH{-}CH{=}CH_2$

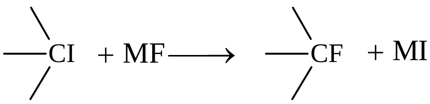
(3) $H_2N{-}CH_2{-}COOH$ and $H_2N{-}(CH_2)_5{-}COOH$

(4) 

Sol: Ans [3]

Biodegradable polymer are easily attacked by enzymes, like Ester or amide linkage polymer.

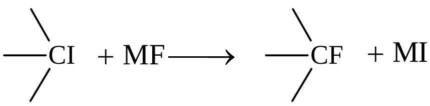
14. In the replacement reaction



The reaction will be most favourable if M happens to be:

(1) Li (2) Na (3) K (4) Rb

Sol: Ans [4]



M happens to be Rb

15. Activation energy (E_a) and rate constants (k_1 and k_2) of a chemical reaction of two different temperatures (T_1 and T_2) are related by:

(1) $\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

(2) $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

(3) $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

(4) $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} + \frac{1}{T_1}\right)$

Sol: Ans [1] and [3]

$$\ln\frac{k_2}{k_1}=\frac{E_a}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

16. Which one of the following does not correctly represent the correct order of the property indicated against it?

(1) Ti < V < Mn < Cr : increasing 2^{nd} ionization enthalpy

(2) Ti < V < Cr < Mn : increasing number of oxidation states

(3) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$: increasing magnetic moment

(4) Ti < V < Cr < Mn : increasing melting points

Sol: Ans [4]

Cr has highest melting point in the series.

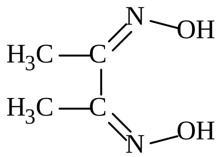
17. Red precipitate is obtained when ethanol solution of dimethylglyoxime is added to ammoniacal Ni(II). Which of the following statements is **not** true?

(1) Dimethylglyoxime functions as bidentate ligand

(2) Red complex has a square planar geometry

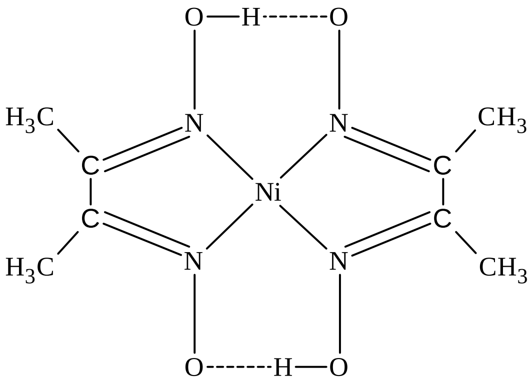
(3) Complex has symmetrical H-bonding

(4) Red complex has a tetrahedral geometry

(dimethylglyoxime = )

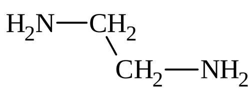
Sol: Ans [4]

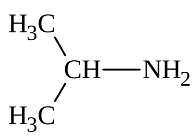
Red bis (dimethylglyoximato)nickel(II)

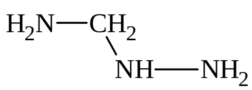


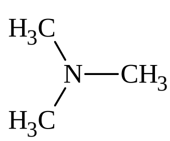
Square complex

18. An organic compound (C_3H_9N) (A), when treated with nitrous acid, gave an alcohol and N_2 gas was evolved. (A) on warming with $CHCl_3$ and caustic potash gave (C) which on reduction gave isopropylmethylamine. Predict the structure (A).

(1) 

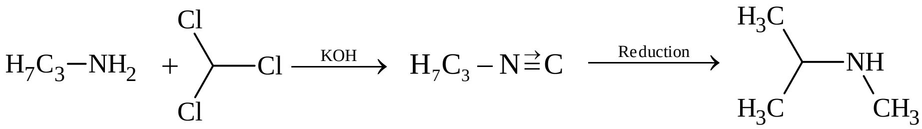
(2) 

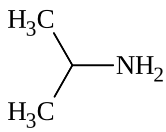
(3) 

(4) 

Sol: Ans [2]

$$\underset{A(1^\circ \text{ amine})}{C_3H_9N} \xrightarrow{HONO} C_3H_7OH + N_2$$



A =


19. Structure of a mixed oxide is cubic close-packed (c.c.p). The cubic unit cell of mixed oxide is composed of oxide ions. One fourth of the tetrahedral voids are occupied by divalent metal A and the octahedral voids are occupied by a monovalent metal B. The formula of the oxide is:

(1) AB_2O_2 (2) ABO_2 (3) A_2BO_2 (4) $A_2B_3O_4$

Sol: Ans [1]

O^{2-} makes c.c.p.

So No. of O^{2-} = 4

And $\frac{1}{4}$th of tetrahedal void = $\frac{1}{4} \times 8 = 2$ occupied by A^{2+}

And octahedral voids = 4 occupied by B^+

So formula is $A_2B_4O_4$ on AB_2O_2

20. The orbital angular momentum of a p-electron is given as:

(1) $\sqrt{6}, \frac{h}{2\pi}$ (2) $\frac{h}{2\pi}$ (3) $\sqrt{3}, \frac{h}{2\pi}$ (4) $\sqrt{\frac{3}{2}}, \frac{h}{\pi}$

Sol: Ans [2]

Orbital angular momentum $= \sqrt{l(l+1)} \cdot \frac{h}{2\pi} = \sqrt{1(1+1)} \cdot \frac{h}{2\pi} = \sqrt{2} \times \frac{h}{2\pi} = \frac{h}{\sqrt{2}\pi}$

21. Four diatomic species are listed below. Identify the correct order in which the bond order is increasing in them:

(1) $He_2^+ < O_2^- < NO < C_2^{2-}$ (2) $NO < O_2^- < C_2^{2-} < He_2^+$

(3) $O_2^- < NO < C_2^{2-} < He_2^+$ (4) $C_2^{2-} < He_2^+ < O_2^- < NO$

Sol: Ans [1]

B.O. He_2^+ = 0.5; B.O. NO = 2.5; B.O. O_2^- = 1.5; B.O. C_2^{2-} = 3

22. Which of the following compounds can be used as antifreeze in automobile radiators?

(1) Ethyl alcohol (2) Methyl alcohol (3) Glycol (4) Nitrophenol

Sol: Ans [3]

Glycol is used as antifreeze

23. For real gases van der Waals equation is written as

$$\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$$

where 'a' and 'b' are van der Waals constants.

Two sets of gases are:

I. O_2, CO_2, H_2 and He

II. CH_4, O_2 and H_2

The gases given in set-I in increasing order of 'b' and gases given in set-II in decreasing order of 'a', are arranged below. Select the correct order from the following:

(1) (I) $H_2 < O_2 < He < CO_2$ (II) $O_2 > CH_4 > H_2$

(2) (I) $He < H_2 < CO_2 < O_2$ (II) $CH_4 > H_2 > O_2$

(3) (I) $O_2 < He < H_2 < CO_2$ (II) $H_2 > O_2 > CH_4$

(4) (I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$

Sol: Ans [4]

(I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$

24. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be:

(1) 9 u (2) 27 u (3) 36 u (4) 64 u

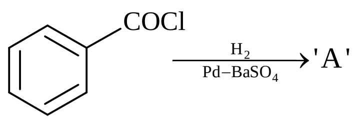
Sol: Ans [3]

$$\frac{V_{gas}/t_{gas}}{V_{He}/t_{He}}=\sqrt{\frac{M_{He}}{M_{gas}}}$$

$$\Rightarrow \frac{t_{He}}{t_{gas}}=\sqrt{\frac{4}{M_{gas}}} \Rightarrow \left(\frac{1}{3}\right)^2=\frac{4}{M_{gas}}$$

$$\Rightarrow M_{gas}=4\times 9=36$$

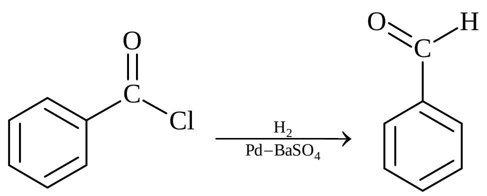
25. Consider the following reaction:



The product 'A' is

(1) C_6H_5Cl (2) C_6H_5CHO (3) C_6H_5OH (4) $C_6H_5COCH_3$

Sol: Ans [2]



Rosenmunds Reduction

26. Which of the following reagents will be able to distinguish between 1-butyne and 2-butyne?

(1) Br_2 (2) $NaNH_2$ (3) HCl (4) O_2

Sol: Ans [2]

$$\underset{\text{1-butyne}}{H-C\equiv C-C_2H_5}\xrightarrow{NaNH_2}Na^+\overset{-}{\ddot{C}}\equiv C-C_2H_5+NH_3$$

It has one acidic hydrogen

$$CH_3-C\equiv C-CH_3\xrightarrow{NaNH_2}$$

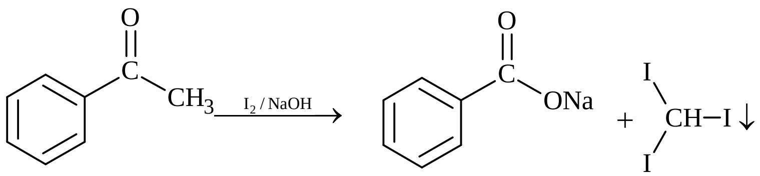
No acidic hydrogen

27. Which of the following compounds will give a yellow precipitate with iodine and alkali?

(1) 2-Hydroxypropane (2) Acetophenone (3) Methyl acetate (4) Acetamide

Sol: Ans [2]

Yellow ppt is given by $-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3$ group compounds.



28. Chloroamphenicol is an:

(1) antibiotic - broad spectrum (2) antifertility drug

(3) antihistaminic (4) antiseptic and disinfectant

Sol: Ans [1]

Chloroamphenicol is antibiotic broad spectrum

29. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound $AB_{(g)}$.

$$A_{2(g)}+B_{2(g)}=2AB_{(g)}$$

At equilibrium, the concentration

of $A_2 = 3.0 \times 10^{-3}$ M

of $B_2 = 4.2 \times 10^{-3}$ M

of $AB = 2.8 \times 10^{-3}$ M

If the reaction takes place in a sealed vessel at 527°C, then the value of K_c will be:

(1) 4.5 (2) 2.0 (3) 1.9 (4) 0.62

Sol: Ans [4]

$$A_2+B_2 \rightleftharpoons 2AB$$

$$K_c=\frac{[AB]^2}{[A_2][B_2]}$$

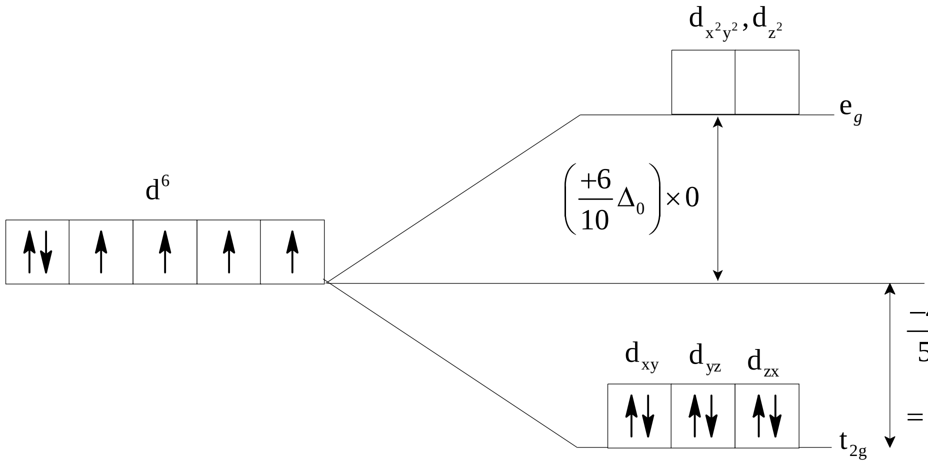
$$K_c=\frac{[AB]^2}{[A_2][B_2]}=\frac{[2.8\times10^{-3}]^2}{[3\times10^{-3}][4.2\times10^{-3}]}=0.62$$

30. Low spin complex of d^6 - cation in an octahedral field will have the following energy:

(1) $\frac{-2}{5}\Delta_0+P$ (2) $\frac{-12}{5}\Delta_0+P$ (3) $\frac{-12}{5}\Delta_0+3P$ (4) $\frac{-2}{5}\Delta_0+2P$

(D_0 = Crystal Field Splitting Energy in an octahedral field, P = Electron pairing energy)

Sol: Ans [3]



$$\frac{-4}{5}\times 3\Delta_0 + 3P$$

$$= \frac{-12}{5}\times \Delta_0 + 3P$$

$$\frac{-4}{10}\times 6\Delta_0 + 3P$$

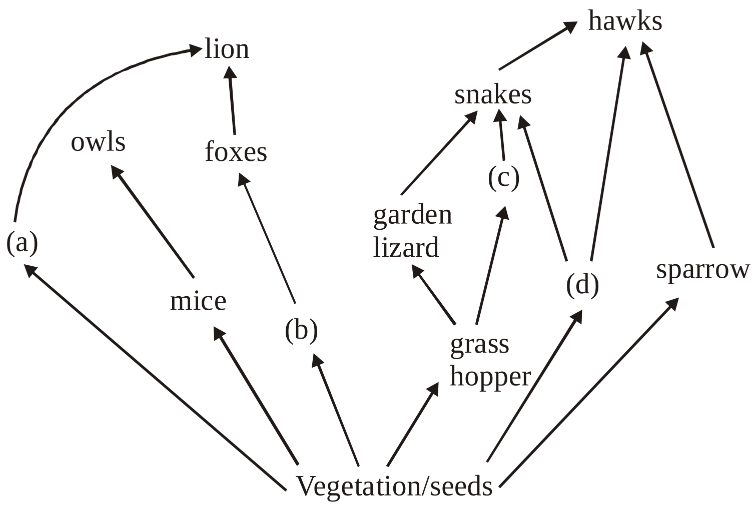
$$= \frac{12}{5}\Delta_0 + 3P$$

31. In the five-kingdom classification, *Chlamydomonas* and *Chlorella* have been included in

(1) Monera (2) Protista (3) Algae (4) Plantae

Sol: Ans [2]

32. Indentify the likely organisms (a), (b) (c) and (d) in the food web shown below



Options :

	(a)	(b)	(c)	(d)
(1)	squirrel	cat	rat	pigeon
(2)	deer	rabbit	frog	rat
(3)	dog	squirrel	bat	deer
(4)	rat	dog	tortoise	crow

Sol: Ans [2]

33. A test cross is carried out to

(1) determine whether two species or varieties will breed successfully

(2) determine the genotype of a plant at F_2

(3) predict whether two traits are linked

(4) assess the number of alleles of a gene

Sol: Ans [3]

34. Read the following five statements (A – E) and answer as asked next to them.

(A) In *Equisetum* the female gametophyte is retained on the parent sporophyte

(B) In *Ginkgo* male gametophyte is not independent

(C) The sporophyte in *Riccia* is more developed than that in *Polytrichum*

(D) Sexual reproduction in *Volvox* is isogamous

(1) One (2) Two (3) Three (4) Four

Sol: Ans [1]

35. Which one of the following human organs is often called the "graveyard" of RBCs ?

(1) Liver (2) Gall bladder (3) Kidney (4) Spleen

Sol: Ans [4]

36. Which one of the following generally acts as an antagonist to gibberellins ?

(1) IAA (2) Zeatin (3) Ethylene (4) ABA

Sol: Ans [4]

37. Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produced (in the host cells).

(1) A toxic protein (2) Both sense and anti-sense RNA

(3) A particular hormone (4) An antifeedant

Sol: Ans [2]

38. How many plants in the list given below have marginal placentation ?

Mustard, Gram, Tulip, Asparagus, Arhar, Sun hemp, Chilli, Colchicine, Onion, Moong, Pea, Tobacco, Lupin

(1) Three (2) Four (3) Five (4) Six

Sol: Ans [4]

39. For its activity, carboxypeptidase requires

(1) Copper (2) Zinc (3) Iron (4) Niacin

Sol: Ans [2]

40. The second stage of hydrosere is occupied by plants like

(1) *Vallisneria* (2) *Azolla* (3) *Typha* (4) *Salix*

Sol: Ans [1]

41. Which one of the following structures is an organelle within an organelle ?

(1) Mesosome (2) Ribosome (3) Peroxisome (4) ER

Sol: Ans [2]

42. In gobar gas, the maximum amont is that of

(1) Carbon dioxide (2) Butane (3) Methane (4) Propane

Sol: Ans [3]

43. The first clinical gene therapy was given for treating

(1) Adenosine deaminase deficiency (2) Diabetes mellitus

(3) Chicken pox (4) Rheumatoid arthritis

Sol: Ans [1]

44. Which one of the following biomolecules is **correctly** characterised ?

(1) Alanine amino acid – Contains an amino group and an acidic group anywhere in the molecule

(2) Licithin – a phosphorylated glyceride found in cell membrane

(3) Palmitic acid – an unsaturated fatty acid with 18 carbon atoms

(4) Adenylic acid – adenosine with a glucose phosphate molecule

Sol: Ans [2]

45. Green revolution in India occurred during

(1) 1950's (2) 1960's (3) 1970's (4) 1980's

Sol: Ans [2]

46. *Cuscuta* is an example of

(1) Endoparasitism (2) Ecotoparasitism (3) Brood parasitism (4) Predation

Sol: Ans [2]

47. Consider the following four statements (a–d) and select the option which includes all the correct ones only

(a) Single cell *Spirulina* can produce large quantities of food rich in protein, minerals, vitamins etc

(b) Body weight-wise the microorganism *Methylophilus methylotrophus* may be able to produce several times more proteins than the cows per day

(c) Common button mushrooms are a very rich source of vitamin C

(d) A rice variety has been developed which is very rich in calcium

Options

(1) Statements (a), (b) (2) Statements (c), (d)

(3) Statements (a), (c) and (d) (4) Statements (b), (c) and (d)

Sol: Ans [1]

48. How many organisms in the list given below are *autotrophs* ?

Lactobacillus, Nostoc, Chara, Nitrosomonas, Nitrobacter, Streptomyces, Sacharomyces, Trypanosoma, Porphyra, Walfia

(1) Three (2) Four (3) Five (4) Six

Sol: Ans [4]

49. Which one of the following categories of animals, is correctly described with no single exception in it ?

(1) All mammals are viviparous and possess diaphragm for breathing

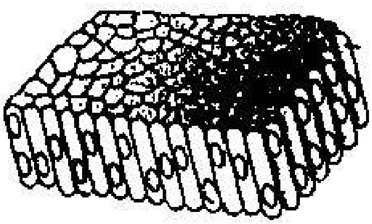
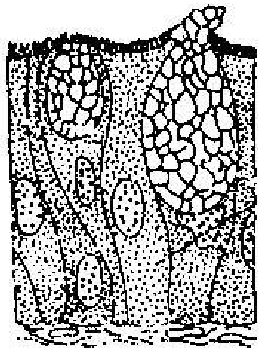
(2) All reptiles possess scales, have a three chambered heart and are cold blooded (poikilothermal)

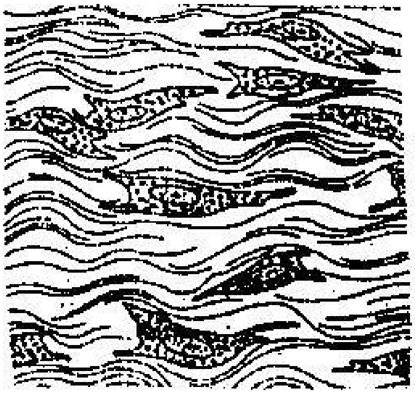
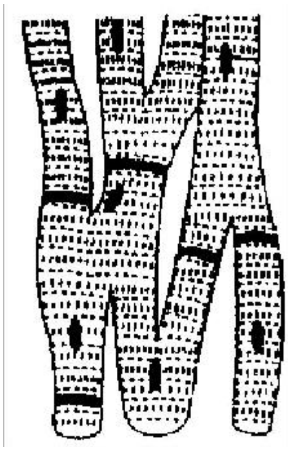
(3) All bony fishes have four pairs of gills and an operculum on each side

(4) All sponges are marine and have collared cells

Sol: Ans [3]

50. The four sketches (A, B, C and D) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given, along with its correct location and function ?

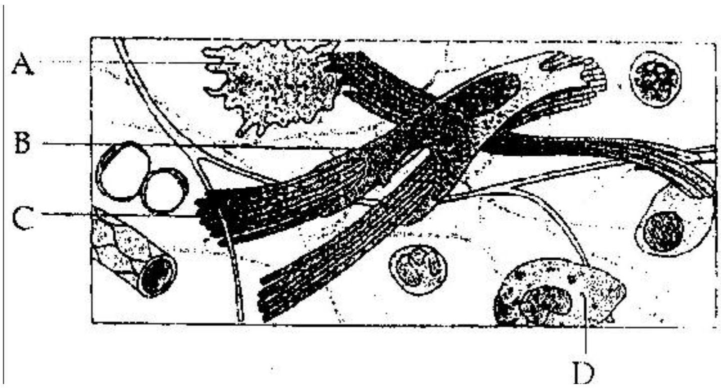
(A)  (B) 

(C)  (D) 

		Tissue	Location	Function
(1)	(A)	Columnar epithelium	Nephron	Secretion and absorption
(2)	(B)	Glandular epithelium	Intestine	Secretion
(3)	(C)	Collagen fibres	Cartilage	Attach skeletal muscles to bones
(4)	(D)	Smooth muscle tissue	Heart	Heart contraction

Sol: Ans [2]

51. Given below is the diagrammatic sketch of a certain type of connective tissue. Identify the parts labelled A, B, C and D, and select the right option about them.



Options :

	Part-A	Part-B	Part-C	Part-D
(1)	Mast Cell	Collagen fibres	Fibroblast	Macro-phage
(2)	Macro-phage	Fibroblast	Collagen fibres	Mast Cell
(3)	Mast Cell	Macro-phage	Fibroblast	Collagen fibres
(4)	Macro-phage	Collagen fibres	Fibroblast	Mast Cell

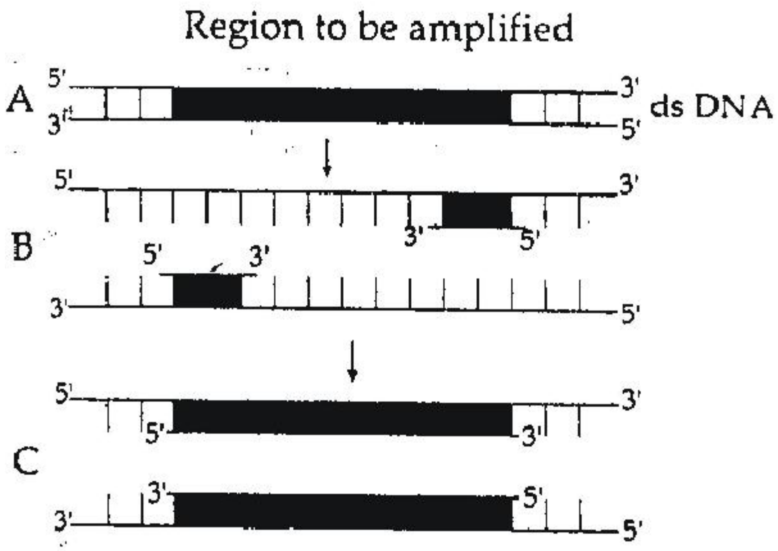
Sol: Ans [2]

52. Sacred groves are specially useful in

(1) Conserving rare and threatened species
(2) Generating environmental awareness
(3) Preventing soil erosion
(4) Year-round flow of water in rivers

Sol: Ans [1]

53. The figure below shows three steps (A, B, C) of Polymerase Chain Reaction (PCR). Select the option giving correct identification together with what it represents ?



Options :

(1) A – Annealing with two sets of primers

(2) B – Denaturation at a temperature of about 98°C separatiing the two DNA strands

(3) A – Denaturation at a temperature of about 50°C

(4) C – Extension in the presence of heat stable DNA polymerase

Sol: Ans [4]

54. The rate of formation of new organic matter by rabbit in a grassland, is called

(1) Gross primary probductivity
(2) Net productiivty
(3) Secondary productivity
(4) Net primary productivity

Sol: Ans [3]

55. Which one of the following organisms is scientifically correctly named, correctly printed according to the International Rules of Nomenclature and correctly described ?

(1) *E.coli* – Full name *Entamoeba coli*, a commonly occuring bacterium in human intestine

(2) *Musca domestica* – The common house lizard, a reptile

(3) *Plasmodium falciparum* – A protozoan pathogen causing the most serious type of malaria

(4) *Felis tigris* – The Indian tiger, well protected in Gir forests

Sol: Ans [3]

56. Which one of the following represents palindromic sequence in DNA ?

(1) 5´ - GATACC - 3´ 3´ - CCTAAG - 5´ (2) 5´ - GAATTC - 3´ 3´ - CTTAAG - 5´ (3) 5´ - CCAATG - 3´ 3´ - GAATCC - 5´ (4) 5´ - CATTAG - 3´ 3´ - GATAAC - 5´

Sol: Ans [2]

57. Vernalisation stimulates flowering in

(1) Ginger (2) Zamikand (3) Turmeric (4) Carrot

Sol: Ans [4]

58. Which one of the following statements is correct with respect to immunity ?

(1) Rejection of a kidney graft is the function of B-lymphocytes

(2) Preformed antibodies need to the injected to treat the bite by a viper snake

(3) The antibodies against small pox pathogen are produced by T-lymphocytes

(4) Antibodies are protein molecules, each of which has four light chains

Sol: Ans [2]

59. Which one of the following sets of items in the options 1 - 4 are correctly categorised with one exception in it ?

	ITEMS	**CATEGORY**	**EXCEPTION**
(1)	Typhoid, Pneumonia, Diphtheria	Bacterial diseases	Diphtheria
(2)	UAA, UAG, UGA	Stop codons	UAG
(3)	Kangaroo, Koala, Wombat	Australian marsupials	Wombat
(4)	*Plasmodium, Cuscuta, Trypanosoma*	Protozoan parasites	*Cuscuta*

Sol: Ans [4]

60. Which one of the following pairs is wrongly matched ?

(1) Mustard – Synergids (2) *Ginkgo* – Archegonia (3) *Salvinia* – Prothallus (4) Viroids – RNA

Sol: Ans [3]

61. Which one of the following is a wrong statement regarding mutations ?

(1) Change in a single base pair of DNA does not cause mutation

(2) Deletion and insertion of base pairs cause frame-sheft mutations

(3) Cancer cells commonly show chromosomal aberrations

(4) UV and Gamma rays are mutagens

Sol: Ans [1]

62. Read the following four statements (A – D)

(A) Both, photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane

(B) In dicot stems, a new cambium originates from cells of pericycle at the time of secondary growth

(C) Stamens in flowers of *Gloriosa* and *Petunia* are polyndrous

(D) Symbiotic nitrogen-fixers occur in free-living state also in soil

How many of the above statements are right ?

(1) One (2) Two (3) Three (4) Four

Sol: Ans [2]

63. Where do certain symbiotic microorganisms normally occur in human body ?

(1) Duodenum (2) Caecum

(3) Oral lining and tongue surface (4) Vermiform appndix and rectum

Sol: Ans [2]

64. The secretory phase in the human menstrual cycle in also called

(1) follicular phase and lasts for about 13 days (2) luteal phase and lasts for about 6 days

(3) follicular phase lasting for about 6 days (4) luteral phase and lasts for about 13 days

Sol: Ans [4]

65. Biolistics (gene-gun) is suitable for

(1) DNA finger printing

(2) Disarming pathogen vectors

(3) Transformation of plant cells

(4) Constructing recombinant DNA by joing whith vectors

Sol: Ans [3]

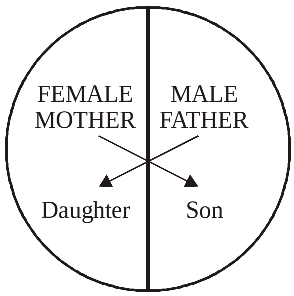
66. A fall in glomeruclar filtration rat (GFR) activates

(1) Posterior pituitary ot release vasopressin (2) Juxtra glomerular cells to release renin

(3) Adrenal cortex to release aldosterone (4) Adrenal medulla to release adrenaline

Sol: Ans [2]

67. Represented below is the inheritance pattern of a certain type of traits in humans. Which one of the following conditions could be an example of this pattern ?



(1) Thalassemia (2) Phenylketonuria

(3) Sickle cell anaemia (4) Haemophilia

Sol: Ans [4]

68. Which one of the following cellular parts is correctly described ?
(1) Lysosomes - optimally active at a pH of about 8.5
(2) Thylakoids - flattened membranous sacs forming the grana of chloroplasts
(3) Centrioles - sites for active RNA synthesis
(4) Ribosomes - those on chloroplasts are larger (80s) while those in the cytoplasm are smaller (70s)

Sol: Ans [2]

69. Which one of the following options gives the correct categorisation of six animals according to the type of nitrogenous wastes (A, B, C), they give out ?

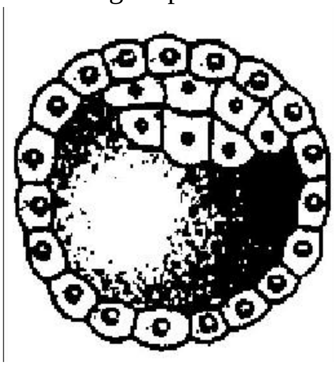
	A AMMONOTELIC	B UREOTELIC	C URICOTELIC
(1)	Aquatic Amphibia	Cockroach, humans	Frog, Pigeon, Lizards
(2)	Pigeon, Humans	Aquatic Amphibia, Lizards	Cockroach, Frog
(3)	Frog, Lizards	Aquatic Amphibia, Humans	Cockroach, Pigeon
(4)	Aquatic Amphibia	Frog, Humans	Pigeon, Lizards Cockroach

Sol: Ans [4]

70. Which one of the following characteristics is common both in humans and adult frogs ?
(1) Ureotelic mode of excretion
(2) Four - chambered heart
(3) Internal fertilisation
(4) Nucleated RBCs

Sol: Ans [1]

71. Identify the human developmental stage shown below as well as the related ritght palce of its occurrence in a normal pregnant woman, and select the right option for the two together.



Options :

	Developmental stage	Site of occurrence
(1)	8 - celled morula	Starting point of Fallopian tube
(2)	Late morula	Middle part of fallopian tube
(3)	Blastula	End part of Fallopian tube
(4)	Blastocyst	Uterine wall

Sol: Ans [4]

72. What is the function of germ pore ?

(1) Release of male gametes (2) Emergence of radicle

(3) Absorption of water for seed germination (4) Initiation of pollen tube

Sol: Ans [4]

73. For its action, nitrogenase requires

(1) Super oxygen radicals (2) Higth input of energy

(3) Light (4) Mn^{2+}

Sol: Ans [2]

74. In genetic engineering, the antibiotics are used

(1) To keep the cultures free of infection (2) As selectable markers

(3) To select healthy vectors (4) As sequences from where replicaton starts

Sol: Ans [3]

75. Through their effect on plant growth regulators, what do the temperature and light control in the plants?

(1) Fruit elongation (2) Apical dominance (3) Flowering (4) Closure of stomata

Sol: Ans [3]

76. What is it that forms the basis of DNA fingerprinting ?

(1) Satellite DNA occuring as hightly repeated short DNA segments

(2) The relative proportions of purines and pyrimidines in DNA

(3) The relative difference in the DNA occurrence in blood, skin and saliva

(4) The relative amount of DNA in the ridges and grooves of the fingerprints

Sol: Ans [1]

77. Select the correct statements bout biodiversity

(1) Conservation of biodiversity is just a fad pursued by the developed countries

(2) The desert areas of Rajasthan and Gujarat have a very high level of desert animal species as well as numerous rare animals

(3) Large scale planting of Bt cotton has no adverse effect on biodiversity

(4) Western Ghats have a very high degree of species richness and endemism

Sol: Ans [4]

78. The domestic sewage in large cities

(1) Have very high amounts of suspended solids and dissolved salts

(2) Has a high BOD as it contains both aerobic and anaerobic bacteria

(3) Is processed by aerobic and then anaerobic bacteria in the secondary treatment is Sewage Treatment Plants (STPs)

(4) When treated in STPs does not really require the aeration step as the sewage contains adequate oxygen

Sol: Ans [3]

79. Plants with ovaries having only one or a few ovules, are generally pollinated by

(1) Wind (2) Bees (3) Butterflies (4) Birds

Sol: Ans [1]

80. Read the following four statements (A - D)

(A) Colostrum is recommended for the new born because it is rich in antigens

(B) Chikengunya is caused by a Gram negative bacterium

(C) Tissue culture has proved useful in obtaining virus-free plants

(D) Beer is manufactured by distillation of fermented grape juice

How many of the above statement are worng ?

(1) One (2) Two (3) Three (4) Four

Sol: Ans [3]

81. The supportive skeletal structures in the human external ears and in the nose tip are examples of

(1) Cartilage (2) Ligament (3) Areolar tissue (4) Bone

Sol: Ans [1]

82. As compared to a dicot root, a monocot root has

(1) Relatively thicker periderm (2) More abundant secondary xylem

(3) Many xylem bundles (4) Inconspicuous annual rings

Sol: Ans [3]

83. Which one of the following organisms is correctly matched with its three characteristics ?

(1) Maize : C_3 pathway, Closed vascular bundles, Scutellum

(2) Pea : C_3 pathway, Endospermic seed, Vexillary aestivation

(3) Tomato : Twisted aestivation, Axile placentation, Berry

(4) Onion : Bulb, Imbricate aestivation, Axile placentation

Sol: Ans [3]

84. Which one of the following pairs of chemical substances, is correctly categorised ?

(1) Secretin and rhodopsin - Polypeptide hormones

(2) Calcitonin and thymosin - Thyroid hormones

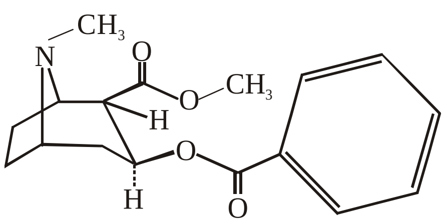
(3) Pepsin and prolactin - Two digestive enzymes secreted in stomach

(4) Troponin and myosin - Complex proteins in striated muscles

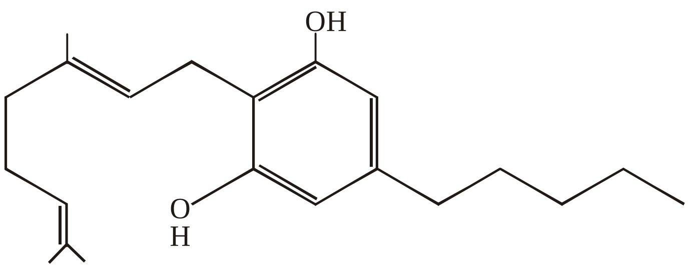
Sol: Ans [4]

85. Indenfity the molecules (a) and (b) shown below and select the right option giving their source and use

(a)



(b)



Options

	Molecule	Source	Use
(1)	(a) Morphine	*Papaver somniferum*	Sedative and pain killer
(2)	(b) Cocaine	*Erythroxylum coca*	Accelerates the transport of dopamine
(3)	(c) Heroin	*Cannabis sativa*	Depressant and slows down body functions
(4)	(d) Cannabinoid	*Atropa belladona*	Produces hallucinations

Sol: Ans [1]

86. Indentify the meiotic stage in which the homologous chromosomes separate while the sister chromatids remain associated at their centromeres

(1) Anaphase II (2) Metaphase I (3) Metaphase II (4) Anaphase I

Sol: Ans [4]

87. Which one of the following statements is worng ?

(1) Intine is made up of cellulose and pectin

(2) When pollen is shed at two-celled stage, double fertilization does not take place

(3) Vegetative cell is larger than generative cell

(4) Pollen grains in some plants remain viable for months

Sol: Ans [2]

88. The idea of mutations was brought forth by

(1) **Charles Darwin**, who abserved a side variety of organisms during sea voyage

(2) **Hugo do Vries**, who worked on evening primrose

(3) **Gregor Mendel**, who worked on *Pisum sativum*

(4) **Hardy Weinberg,** who worked on allele frequencies in a population

Sol: Ans [2]

89. Read the following four statements (A - D)

(A) In transcription, adenosine pairs with uracil

(B) Regulation of *lac* operon by repressor is referred to as positive regulation

(C) The human genome has approximately 50,000 genes

(D) Haemophilia is sex-linked recessive disease

How many of the above statements are right ?

(1) One (2) Two (3) Three (4) Four

Sol: Ans [2]

90. Which one of the following pairs of animals are similar to each other pertaining to the feature stated against them ?

(1) Sea horse and Flying fish - Cold blooded (Poikilothermal)

(2) *Pteropus* and *Ornithorhyncus* - Viviparity

(3) Garden lizard and Crocodile - Three chambered heart

(4) *Ascaris* and *Ancylostoma* - Metameric segmentation

Sol: Ans [1]

91. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C, respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is

(1) 1×10^{-2} C (2) 2×10^{-2} C (3) 3×10^{-2} C (4) 4×10^{-2} C

Sol: Ans [3]

Common potential $V = \dfrac{Q_1 + Q_2}{C_1 + C_2}$

Change on bigger sphere is $Q_2^1 = C_2 V$

$$Q_2^1 = \left(\frac{C_2}{C_1 + C_2}\right)(Q_1 + Q_2)$$

$$C_1 = 4\pi\varepsilon_o R_1$$

$$C_2 = 4\pi\varepsilon_o R_2$$

$$Q_2^1 = \left(\frac{R_2}{R_1 + R_2}\right)(Q_1 + Q_2) = \left(\frac{3}{3+1}\right)(5-1)\times 10^{-2} = \frac{3}{4}\times 4\times 10^{-2} = 3\times 10^{-2} C$$

92. A proton carrying 1 MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an α-particle to describe a circle of same radius in the same field?

(1) 4 MeV (2) 2 MeV (3) 1 MeV (4) 0.5 MeV

Sol: Ans [3]

$$R = \frac{\sqrt{2mE}}{qB}$$

For equal readius of proton and α-particle

$$\frac{\sqrt{2m_p E_p}}{q_p\, B} = \frac{\sqrt{2m_\alpha E_\alpha}}{q_\alpha\, B}$$

$$\Rightarrow \quad E_\alpha = \left(\frac{q_\alpha}{q_p}\right)^2 \times \left(\frac{m_p}{m_\alpha}\right) E_p \qquad \frac{m_p}{m_\alpha} = \frac{1}{4}; \quad \frac{q_\alpha}{q_p} = \frac{2}{1}$$

$$E_\alpha = \left(\frac{1}{4}\right)\times (2)^2 \times E_p$$

$$E_\alpha = E_p \qquad\qquad E_\alpha = 1 MeV$$

93. A circular platform is mounted on a frictionless vertical axle. Its radius R = 2 m and its moment of inertia about the axle is 200 kg m^2. It is initially at rest. A 50 kg man stands on the edge of the platform and begins to walk along the edge at the speed of 1 ms^{-1} relative to the ground. Time taken by the man to complete one revolution is

(1) $\dfrac{\pi}{2} s$ (2) π s (3) $\dfrac{3\pi}{2} s$ (4) 2π s

Sol: Ans [4]

Using conservation of angular momentum

$$I_p w_p = I_m W_m$$

$$200 \times w_p = 50(2)^2\, w_m$$

$$w_p = \frac{1}{2} \text{ rad/s}$$

$$w_{m/p} = w_m - w_p \quad = \left(\frac{1}{2}\right) - \left(-\frac{1}{2}\right) = 1 \text{ rad/s}$$

Time taken to complete one revolution is $T = \frac{2\pi}{w} = 2\pi\,\text{sec.}$

94. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to

(1) unity

(2) the speed of light in vacuum

(3) reciprocal of speed of light in vacuum

(4) the ratio of magnetic permeability to the electric susceptibility of vacuum

Sol: Ans [3]

Conceptual Question

95. A magnetic needle suspended parallel to a magnetic field requires √3 J of work to turn it through 60°. The torque needed to maintain the needle in this position will be

(1) $\frac{3}{2}J$ (2) 2√3 J (3) 3 J (4) √3 J

Sol: Ans [3]

Work done $U_f - U_i \quad = -MB\cos 60° - (-MB\cos 0°)$

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

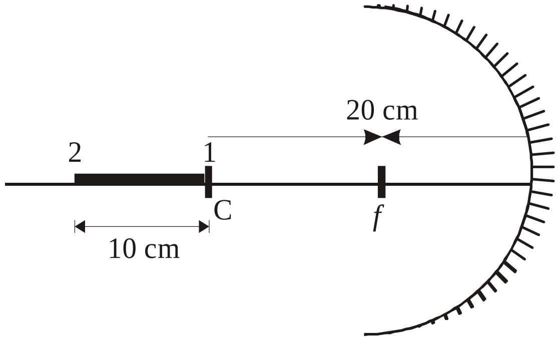
$$\sqrt{3} = \frac{MB}{2} \qquad \text{MB} = 2\sqrt{3}$$

$$\tau = MB\sin 60° \quad = 2\sqrt{3} \times \frac{\sqrt{3}}{2} = 3\text{J}$$

96. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away for the mirror. The length of the image is

(1) 5 cm (2) 10 cm (3) 15 cm (4) 2.5 cm

Sol: Ans [1]



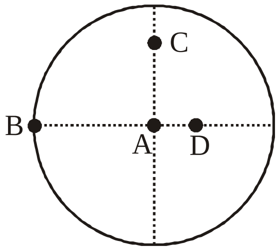
$v_1 = -20\,\text{cm}; \quad u_2 = -10\,\text{cm}$

$$\frac{1}{f} = \frac{1}{v_2} + \frac{1}{u_2}; \quad \frac{1}{-10} = \frac{1}{v_2} + \frac{1}{-30} \quad v_2 = -15 \text{ cm}$$

Similarly $v_1 = -20$ cm

Length of image is $V_2 - V_1 = 5\,\text{cm}$

97. The moment of inertia of uniform circular disc is maximum about an axis perpendicular to the disc and passing through



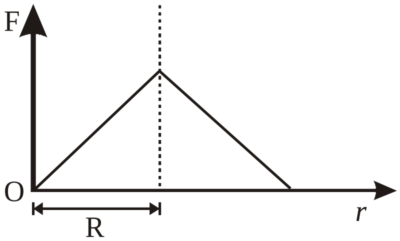
(1) A (2) B (3) C (4) D

Sol: Ans [2]

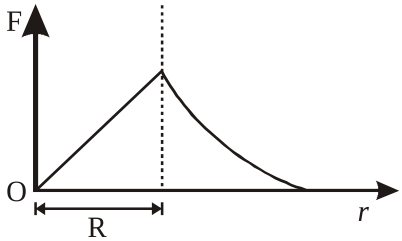
Conceptual Question

98. Which one of the following plots represents the variation of gravitational field on a particle with distance r due to a thin spherical shell of radius R? (r is measured from the centre of the spherical shell)

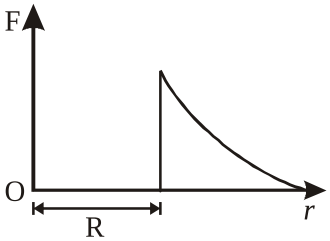
(1)



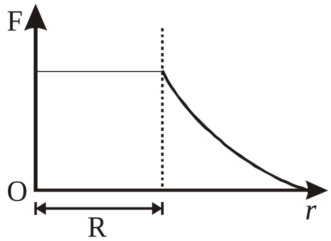
(2)



(3)



(4)

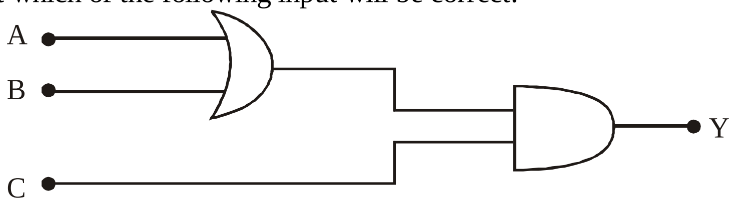


Sol: Ans [3]

Conceptual Question

99. To get an output Y = 1 in given circuit which of the following input will be correct:

	A	B	C
(1)	0	1	0
(2)	1	0	0
(3)	1	0	1
(4)	1	1	0



Sol: Ans [3]

Conceptual Question

100. The equation of a simple harmonic wave is given by

$$y = 3\sin\frac{\pi}{2}(50t - x)$$

where x and y are in metres and t is in seconds. The ratio of maximum particle velocity to the wave velocity is

(1) $\frac{2}{3}\pi$ (2) 2π (3) $\frac{3}{2}\pi$ (4) 3π

Sol: Ans [3]

$$V_{max} = A\omega;\ V_w = \frac{\omega}{k}$$

$$\frac{V_{max}}{V_\omega} = Ak;\quad y = 3\sin\frac{\pi}{2}(50t - x)$$

A = 3; $k = \pi/2$

$$\frac{V_{max}}{V_\omega} = \frac{3}{2}\pi$$

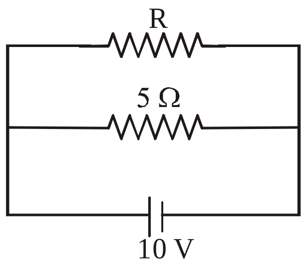
101. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is d and area of each plate is A, the energy stored in the capacitor is

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

Sol: Ans [4]

$$\text{Energy} = \frac{1}{2}CV^2 = \frac{1}{2}\times\varepsilon_o\frac{A}{d}\times(E\times d)^2 = \frac{1}{2}\varepsilon_o E^2 Ad$$

102. The power dissipated in the circuit shown in the figure is 30 Watts. The value of R is



(1) 30 Ω (2) 20 Ω (3) 15 Ω (4) 10 Ω

Sol: Ans [4]

Total power dissipated is $\frac{(10)^2}{5} + \frac{(10)^2}{k} = 30$ watt

R = 10 Ω

103. If v_e is escape velocity and v_o is orbital velocity of a satellite for orbit close tot he earth's surface, then these are related by

(1) $v_e = \sqrt{2}v_o$ (2) $v_o = \sqrt{2}v_e$ (3) $v_o = v_e$ (4) $v_e = \sqrt{2v_o}$

Sol: Ans [1]

Conceptual Question

104. A stone is dropped from a height h. It hits the ground with a certain momentum P. If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by

(1) 100% (2) 68% (3) 41% (4) 200%

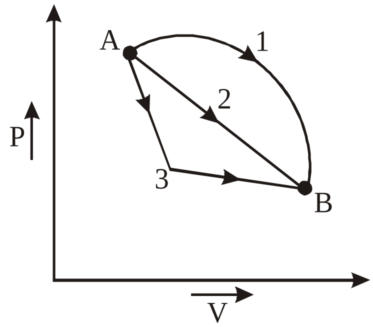
Sol: Ans [3]

Momentum $\alpha\sqrt{height}$

$$\frac{P_1}{P_2} = \sqrt{\frac{h_1}{h_2}} \quad \Rightarrow \quad \frac{P}{P'} = \sqrt{\frac{h}{2h}} \qquad P' = P\sqrt{2}$$

$\Rightarrow$ Change in momentum is 41%

105. An ideal gas goes from state A to state B via three different processes as indicated in the P-V diagram If Q_1, Q_2, Q_3 indicate the heat absorbed by the gas along the three processes and ΔU_1, ΔU_2, ΔU_3 indicate the change in internal energy along the three processes respectively, then



(1) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$ (2) $Q_1 > Q_2 > Q_3$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

(3) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$ (4) $Q_1 = Q_2 = Q_3$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$

Sol: Ans [2]

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

ΔU is same $\quad Q_1 > Q_2 > Q_3$

106. Two radiations of photons energies 1 eV and 25 eV, successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is

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

Sol: Ans [3]

$$\frac{1}{2}mV_{\max}^2 = h\nu - W$$

$$\Rightarrow \quad \frac{(V_1)_{\max}}{(V_2)_{\min}} = \frac{\sqrt{h\nu_1 - W}}{\sqrt{h\nu_2 - W}} = \frac{\sqrt{1-0.5}}{\sqrt{25-0.5}} = \sqrt{\frac{0.5}{2}} = \frac{1}{2}$$

107. For the angle of minimum deviation of a prism to be equal to its refracting angle, the prism must be made of a material whose refractive index

(1) is greater than 2 (2) lies between √2 and 1

(3) lies between 2 and √2 (4) is less than 1

Sol: Ans [3]

$$\frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \mu \qquad \delta_m = A$$

$$\Rightarrow \quad \mu = 2\cos\left(\frac{A}{2}\right)$$

For $\delta_m = A$

Hence, μ lies between 2 and √2

108. If the momentum of an electron is changed by P, then the de Broglie wavelength associated with it changes by 0.5%. The initial momentum of electron will be

(1) 100 P (2) 200 P (3) 400 P (4) $\frac{P}{200}$

Sol: Ans [2]

$P = \frac{h}{\lambda}$ $\frac{\Delta P}{P} = \frac{\Delta h}{\lambda}$ $\Delta P = P \frac{\Delta\lambda}{\lambda} = \frac{0.5}{100}$ $P' = 200P$

109. Three masses the placed on the x-axis 300 g at origin, 500 g at x = 40 cm and 400 g at x = 70 cm. The distance of the centre of mass from the origin is

(1) 30 cm (2) 40 cm (3) 45 cm (4) 50 cm

Sol: Ans [2]

$$\chi_{cm} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}$$

$m_1 = 300g;$ $x_1 = 0;$ $m_2 = 500g;$ $x_2 = 40cm;$ $m_3 = 400g;$ $x_3 = 70cm$

$\chi_{cm} = 40cm$

110. A car of mass m is moving on a level circular track of radius R. If μ_s represents the static friction between the road and tyres of the car, the maximum speed of the car in circular motion is given by

(1) $\sqrt{\mu_s Rg}$ (2) $\sqrt{\mu_s mRg}$ (3) $\sqrt{Rg/\mu_s}$ (4) $\sqrt{mRg/\mu_s}$

Sol: Ans [1]

Conceptual Question

111. A slab of stone of area 0.36 m^2 and thickness 0.1 m is exposed on the lower surface to steam at 100°C. A block of ice at 0°C rests on the upper surface of the slab. In one hour 4.8 kg of ice is melted. The thermal conductivity of slab is (Given latent heat of fusion of ice = 3.36×10^5 J kg^{-1})

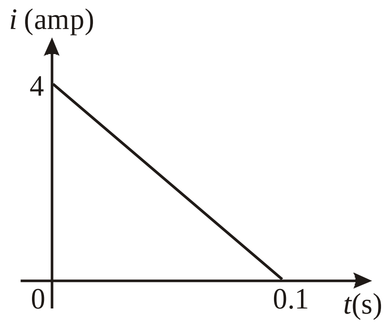
(1) 1.02 J / m / s / °C (2) 1.24 J / m / s / °C (3) 1.29 J / m / s /°C (4) 2.05 J / m / s /°C

Sol: Ans [2]

$$Q = \frac{KA(\Delta T)t}{L} = mL$$

$$K = \frac{56}{45} = 1.24$$

112. In a coil of resistance of 10 Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is



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

Sol: Ans [3]

$$\left|\frac{d\phi}{dt}\right| = e$$

$$d\phi = (iR)\,dt$$

$$\Delta\phi = \int d\phi = R\int idt$$

$$\Delta\phi = R \times (area\ under\ \ i = t\, graph)$$

$$\Delta\phi = 10 \times \frac{1}{2} \times 4 \times 0.1$$

$$\Delta\phi = 2\text{weber}$$

113. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude Po. The instantaneous velocity of this car is proportional to

(1) $t/\sqrt{m}$ (2) $t^2 P_o$ (3) $t^{1/2}$ (4) $t^{-1/2}$

Sol: Ans [3]

$$m\left(\frac{dV}{dt}\right)V = P_o$$

$$V\,dV = \left(\frac{P_o}{m}\right)dt$$

On integrating

$$\frac{V^2}{2} = \frac{P_o}{m}t$$

$$V \propto \sqrt{t}$$

114. A train moving at a speed of 220 ms^{-1} towards a stationary object, emits a sound of frequency 1000 Hz. Some of the sound reaching the object gets reflected black to the train as echo. The frequency of the echo as detected by the driver of the train is: (speed of sound in air is 330 ms^{-1})

(1) 3000 Hz (2) 3500 Hz (3) 4000 Hz (4) 5000 Hz

Sol: Ans [4]

$$f' = f\,\frac{(V+V_o)}{(V-V_s)} = \frac{1000(330+220)}{(330-220)} = 1000 \times \frac{550}{110} = 5000\,\text{Hz}$$

115. The input resistance of a silicon transistor is 100 Ω. Base current is changed by 40 mA, which results in a change in collector current by 2 mA. This transistor is used as a common emitter amplifier with a load resistance of 4 kΩ. The voltage gain of the amplifier is

(1) 1000 (2) 2000 (3) 3000 (4) 4000

Sol: Ans [2]

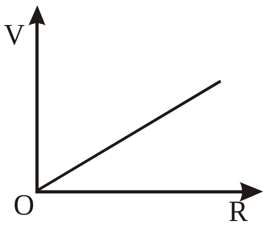
$$R_i = 100i$$

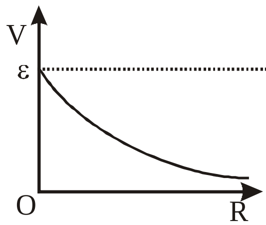
$$\Delta i_B = 40 \times 10^{-6}$$

$$\Delta i_C = 2\times10^{-3}$$

$$A_V = \frac{R_o\times\Delta i_C}{R_i\times\Delta i_B} = \frac{4\times10^3\times2\times10^{-3}}{100\times40\times10^{-6}\times10^{-3}} = 2\times10^3 = 2000$$

116. A cell having an emf ε and internal resistance *r* is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by

(1)


(2)


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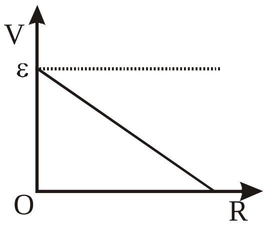
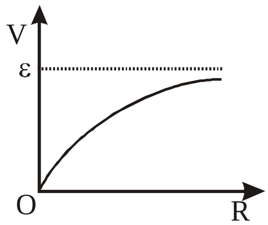
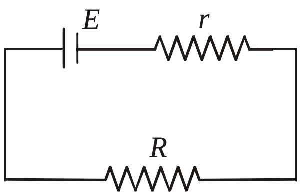


(4)


Sol: Ans [4]



V = IR $\Rightarrow V = \frac{ER}{R+r}$

117. The dimensions of $(\mu_o\varepsilon_o)^{-1/2}$ are

(1) $[L^{1/2}T^{1/2}]$ (2) $[L^{1/2}T^{-1/2}]$ (3) $[L^{-1}T]$ (4) $[LT^{-1}]$

Sol: Ans [4]

$$C = \frac{1}{\sqrt{\mu_o\varepsilon_o}}$$

$[LT^{-1}]$

118. The half life of a radioactive nucleus is 50 days. The time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it has decayed and the time t_1 when $\frac{1}{3}$ of it had decayed is:

(1) 15 days (2) 30 days (3) 50 days (4) 60 days

Sol: Ans [3]

$$\frac{2}{3}N_o = N_o e^{-\lambda t_1} \qquad \text{...(i)}$$

$$\frac{1}{3}N_o = N_o e^{-\lambda t_2} \qquad \text{...(ii)}$$

eqution (i) and (ii) $2 = e^{-\lambda t_1 + \lambda t_2}$

$$2 = e^{\lambda(t_2 - t_1)}$$

$\log 2 = \lambda(t_2 - t_1)$

$\frac{\log 2}{\lambda} = t_2 - t_1 = t_{1/2} = 50$ days.

119. The instantaneous values of alternating current and voltages in a circuit are given as

$$i = \frac{1}{\sqrt{2}}\sin(100\pi t) \text{ ampere}$$

$$e = \frac{1}{\sqrt{2}}\sin(100\pi t + \frac{\pi}{3}) \text{ volt}$$

The average power in Watts consumed in the circuit is

(1) $\frac{1}{8}$ (2) $\frac{1}{4}$ (3) $\frac{\sqrt{3}}{4}$ (4) $\frac{1}{2}$

Sol: Ans [1]

$$P = V_{rms}.I_{rms}.\cos\phi$$

$$= \frac{1}{2}V_o I_o.\cos\phi$$

$$= \frac{1}{2} \times \frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}}.\cos\frac{\pi}{3}$$

$$= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$$

120. The transition from the state $n = 3$ to $n = 1$ in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from

(1) $4 \to 3$ (2) $2 \to 1$ (3) $3 \to 2$ (4) $4 \to 2$

Sol: Ans [1]

Conceptual Question.