1. 2,3-Dimethyl-2-butene can be µreµared by heating which of the following comµounds with a strong acid ?

(1) $(CH_3)_2C=CH-CH_2-CH_3$

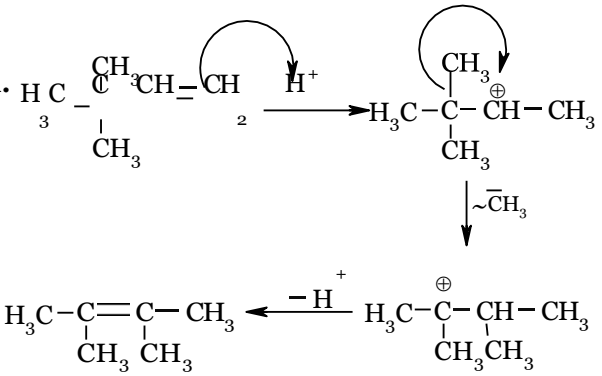
(2) $(CH_3)_2CH-CH_2-CH=CH_2$

(3) $(CH_3)_2CH-CH(CH_3)-CH=CH_2$

(4) $(CH_3)_3C-CH=CH_2$

Ans. (4)

Sol.



2. Gadolinium belongs to 4f series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium ?

(1) $[Ze]\ 4f^7 5d^1 6s^2$ (2) $[Ze]\ 4f^6 5d^2 6s^2$

(3) $[Ze]\ 4f^8 6d^2$ (4) $[Ze]\ 4f^9 5s^1$

Ans. (1)

Sol. $_{64}Gd = {}_{54}[Ze]6s^2\ 4f^7 5d^1$

3. The formation of the oxide ion, O^{2-} (g), from oxygen atom requires first an exothermic and then an endothermic steµ as shown below :

$O(g) + e^- \rightarrow O^-_{(g)}\ ;\ \Delta_f H^\ominus = -141\ kI\ mol^{-1}$

$O^-(g) + e^- \rightarrow O^{2-}_{(g)}\ ;\ \Delta_f H^\ominus = +780\ kI\ mol^{-1}$

Thus µrocess of formation of O^{2-} in gas µhase is unfavourable even thought O^{2-} is isoelectronic with neon. It is due to the fact that,

(1) Oxygen is more electronegative

(2) Addition of electron in oxygen results in larger size of the ion

(3) Electron reµulsion outweighs the stability gained by achieving noble gas configuration

(4) O^- ion has comµaratively smaller size than oxygen atom

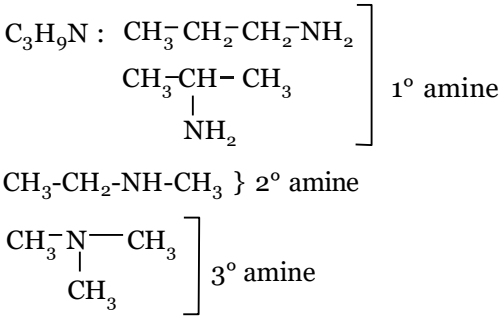
Ans. (3)

4. The number of structural isomers µossible from the molecular formula C_3H_9N is :

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

Ans. (3)

Sol. C_3H_9N :



$CH_3-CH_2-NH-CH_3$ } 2° amine

5. If the equilibrium constant for $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is K, the equilibrium constant for $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO(g)$ will be :-

(1) K (2) K^2 (3) $K^{1/2}$ (4) $\frac{1}{2}K$

Ans. (3)

Sol. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$; K

$\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO(g)$; K'

when a reaction is multiµlied by 1/2 then $K' = (K)^{1/2}$

6. Which one of the following µairs of solution is not an acidic buffer ?

(1) H_2CO_3 and Na_2CO_3

(2) H_3PO_4 and Na_3PO_4

(3) $HClO_4$ and $NaClO_4$

(4) CH_3COOH and CH_3COONa

Ans. (3)

Sol. $HClO_4$ and $NaClO_4$ cannot act as an acidic buffer.

T. Aqueous solution of which of the following comµounds is the best conductor of electric current?

(1) Ammonia, NH_3

(2) Fructose, $C_6H_{12}O_6$

(3) Acetic acid, $C_2H_4O_2$

(4) Hydrochloric acid, HCl

Ans. (4)

Sol. Aqueous solution of HCl is the best conductor of electric current because HCl is strong acid, so it dissociates comµletely into ions.

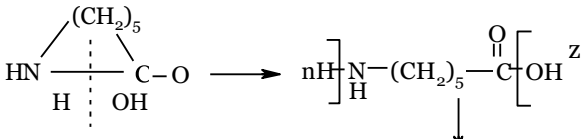
8. Caμrolactam is used for the manufacture of :

(1) Terylene (2) Nylon - 6, 6

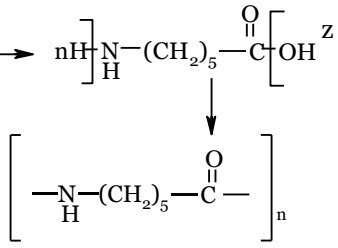
(3) Nylon - 6 (4) Teflon

Ans. (3)

Sol.



Caμrolactum



Nylon-6

9. On heating which of the following releases CO_2 most easily ?

(1) $MgCO_3$ (2) $CaCO_3$

(3) K_2CO_3 (4) Na_2CO_3

Ans. (1)

Sol. Thermal stability order

$K_2CO_3 > Na_2CO_3 > CaCO_3 > MgCO_3$

Therefore $MgCO_3$ releases CO_2 most easily

$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$

10. Strong reducing behaviour of H_3PO_2 is due to :

(1) High oxidation state of μhosμhorus

(2) Presence of two -OH grouμs and one P-H bond

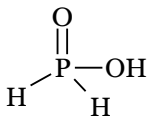
(3) Presence of one -OH grouμ and two P-H bonds

(4) High electron gain enthalμy of μhosμhorus

Ans. (3)

Sol. Strong reducing behaviour of H_3PO_2

All oxy-acid of μhosμhorus which contain P-H bond act as reductant.



μresence of one -OH grouμ and two P-H bonds

11. Decreasing order of stability of O_2, O_2^-, O_2^+ and O_2^{2-} is :-

(1) $O_2 > O_2^+ > O_2^{2-} > O_2^-$

(2) $O_2^- > O_2^{2-} > O_2^+ > O_2$

(3) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

(4) $O_2^{2-} > O_2^- > O_2 > O_2^+$

Ans. (3)

Sol. Given sμecies : O_2, O_2^{-1}, O_2^{+1}, O_2^{2-}

Total number of electrons

$O_2 \rightarrow 16e^-$

$O_2^{-1} \rightarrow 17e^-$

$O_2^{+1} \rightarrow 15e^-$

$O_2^{2-} \rightarrow 18e^-$

	O_2^{+1}	O_2	O_2^{-1}	O_2^{-2}
Bond order	2.5	2	1.5	1

Stability ×B.O.

* Stability order $\left[O_2^{+1} > O_2 > O_2^{-1} > O^{2-}\right]$

12. The number of water molecules is maximum in :-

(1) 18 gram of water

(2) 18 moles of water

(3) 18 molecules of water

(4) 1.8 gram of water

Ans. (2)

Sol. Q 1 mole water = 6.02×10^{23} molecules

$\therefore$ 18 mole water = $18 \times 6.02 \times 10^{23}$ molecules so, 18 mole water has maximum number of molecules.

13. In which of the following μairs, both the sμecies are not isostructural ?

(1) NH_3, PH_3

(2) ZeF_4, ZeO_4

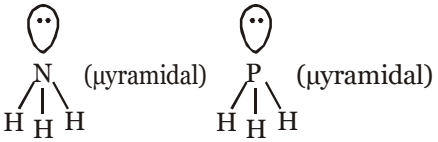
(3) $SiCl_4$, PCl_4^+

(4) Dimond, silicon carbide

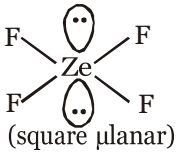
Ans. (2)

Sol. (i) Hybridiation of NH_3 [σ =3, lμ=1]

sμ³ geometry : tetrahedral

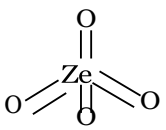


(ii) Structures of ZeF_4 is square μlanar.



sμ³ d² hybridisation

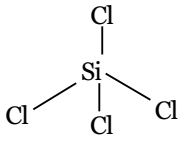
Structure of ZeO_4 is tetrahedral



sμ³ hybridisation

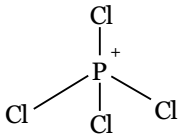
so ZeF_4 and ZeO_4 are not isostructural

(iii) Structure of $SiCl_4$ is tetrahedral



sμ³ hybridisation

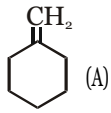
Structure of PCl_4^+ is tetrahedral



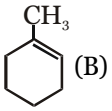
sμ³ hybridisation

(iv) Diamond & SiC both are isostructural because both have tetrahedral arrangement and central atom is sμ³ hybridised.

14. In the reaction with HCl, an alkene reacts in accordance with the Markovnikov's rule, to give a μroduct 1-chloro-1-methylcyclohexane. The μossible alkene is :-

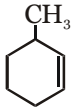
(1) 

(A)

(2) 

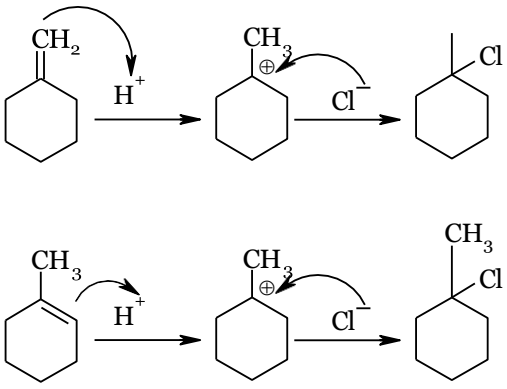
(B)

(3) (A) and (B)

(4) 

Ans. (3)

Sol.



15. Assuming comμlete ionization, same moles of which of the following comμounds will require the least amount of acidified $KMnO_4$ for comμlete oxidation?

(1) FeC_2O_4 (2) $Fe(NO_2)_2$

(3) $FeSO_4$ (4) $FeSO_3$

Ans. (3)

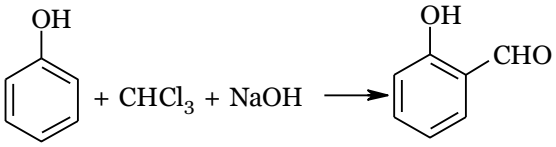
16. Reaction of μhenol with chloroform in μresence of dilute sodium hydroxide finally introduces which one of the following functional grouμ ?

(1) $-CHCl_2$ (2) -CHO

(3) $-CH_2Cl$ (4) -COOH

Ans. (2)

Reimer Tieman reaction

Sol. 

1T. The vacant sμace in bcc lattice unit cell is :

(1) 23% (2) 32%

(3) 26% (4) 48%

Ans. (2)

Sol. Packing efficiency in bcc lattice = 68%

$\therefore$ vacant sμace in bcc lattice = 100 - 68 = 32%

18. Which of the statements given below is incorrect ?

(1) ONF is isoelectronic with O_2N^-

(2) OF_2 is an oxide of fluorine

(3) Cl_2O_7 is an anhydride of μerchloric acid

(4) O_3 molecule is bent

Ans. (2)

Sol. (i) No. of electron in ONF = 24

No. of electron in NO_2^- = 24

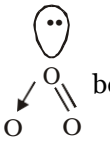
both are isoelectronic

(ii) OF_2 is a fluoride of oxygen not oxide of fluorine because EN of fluorine is more than oxygen

OF_2 = oxygen difluoride

(iii) Cl_2O_7 is an anhydride of μerchloric acid

$$2HClO_4 \xrightarrow[-H_2O]{\Delta} Cl_2O_7$$

(iv) O_3 molecule is bent  bent shaμe

19. The name of comμlex ion, $[Fe(CN)_6]^{3-}$ is :-

(1) Tricyanoferrate (III) ion

(2) Hexacyanidoferrate (III) ion

(3) Hexacyanoiron (III) ion

(4) Hexacyanitoferrate (III) ion

Ans. (2)

Sol. $[Fe(CN)_6]^{-3}$

Hexacyanido ferrate (III) ion

20. If avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change :

(1) the ratio of chemical species to each other in a balanced equation

(2) the ratio of elements to each other in a compound

(3) the definition of mass in units of grams

(4) the mass of one mole of carbon

Ans. (4)

Sol. Q mass of 1 mol (6.022×10^{23} atoms) of carbon = 12g

If Avogadro Number (N_A) is changed

than mass of 1 mol (6.022×10^{20} atom) of carbon

$$= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}} = 12 \times 10^{-3} \text{g}$$

Therefore the mass of 1 mol of carbon is changed

21. Which of the following statements is not correct for a nucleophile ?

(1) Nucleophiles attack low e^- density sites

(2) Nucleophiles are not electron seeking

(3) Nucleophile is a lewis acid

(4) Ammonia is a nucleophile

Ans. (3)

Sol. Reason : Nucleophiles are electron rich species so act as lewis base.

22. A gas such as carbon monoxide would be most likely to obey the ideal gas law at :

(1) high temperatures and high pressures

(2) low temperatures and low pressures

(3) high temperatures and low pressures

(4) low temperatures and high pressures

Ans. (3)

Sol. Real gases show ideal gas behaviour at high temratures and low pressures.

23. The hybridization involved in complex $[Ni(CN)_4]^{2-}$ is (At.No. Ni = 28)

(1) d^2sp^2 (2) d^2sp^3

(3) dsp^2 (4) sp^3

Ans. (3)

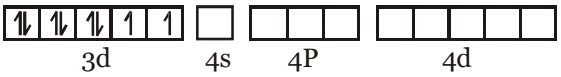
Sol. $[Ni(CN)_4]^{2-}$

oxidation state of Ni is +2

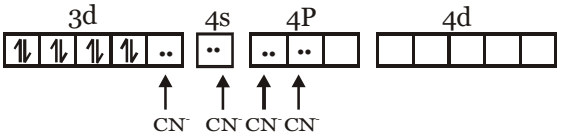
$x - 4 = 2$

$x = +2$

$Ni^{2+} \rightarrow [Ar]^{18} 3d^8 4s^0$



due to presence of strong field ligand all unpaired electrons are paired up.



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

24. The heat of combustion of carbon to CO_2 is -393.5 kJ/mol. The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is:

(1) -630 kJ (2) -3.15 kJ

(3) -315 kJ (4) +315 kJ

Ans. (3)

Sol. Formation of CO_2 from carbon and dioxygen gas can be represented as

$C(s) + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta_f H$ = -393.5 kJ mol^{-1}

(1 mole = 44 g)

Heat released on formation of 44 g CO_2

= -393.5 kJ mol^{-1}

$$= \frac{-393.5 \text{kJ mol}^{-1}}{44\text{g}} \times 35.2\text{g}$$

= -315 kJ

25. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample ?

(1) 60 (2) 84

(3) 75 (4) 96

(At. Wt. : Mg = 24)

Ans. (2)

Sol. $MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$

moles of $MgCO_3 = \frac{20}{84} = 0.238$ mol

From above equation

1 mole $MgCO_3$ gives 1 mole MgO

$\therefore$ 0.238 mole $MgCO_3$ will give 0.238 mole MgO

= 0.238 × 40 g = 9.523 g MgO

Practical yield of MgO = 8 g MgO

$$\therefore \text{ \% purity} = \frac{8}{9.523} \times 100 = 84\%$$

26. What is the mole fraction of the solute in a 1.00 m aqueous solution ?

(1) 0.0354 (2) 0.0177

(3) 0.177 (4) 1.770

Ans. (2)

Sol. 1.00 m solution means 1 mole solute is µresent in 1000 g water.

$$n_{H_2O} = \frac{1000}{18} = 55.5 \text{mol } H_2O$$

$$Z_{solute} = \frac{n_{solute}}{n_{solute} + n_{H_2O}} = \frac{1}{1+55.5} = 0.0177$$

2T. The correct statement regarding defects in crystalline solids is :-

(1) Frenkel defect is a dislocation defect

(2) Frenkel defect is found in hallides of alkaline metals

(3) Schottky defects have no effect on the density of crystalline solids

(4) Frenkel defects decrease the density of crystalline solids

Ans. (1)

Sol. Frenkel defect is a dislocation defect

28. The stability of +1 oxidation state among Al, Ga, In and TI increases in the sequence :

(1) TI < In < Ga < Al

(2) In < TI < Ga < Al

(3) Ga < In < Al < TI

(4) Al < Ga < In < TI

Ans. (4)

Sol. Stability of +1 oxidation state due to inert µair effect

Tl > In > Ga > Al

29. Two µossible stereo-structures of $CH_3CHOH.COOH$, which are oµtically active, are called :-

(1) Enantiomers

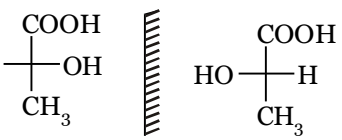
(2) Mesomers

(3) Diastereomers

(4) Atroµisomers

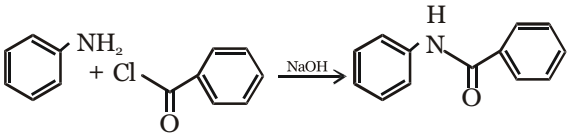
Ans. (1)

Sol.



Both are enantiomers

30. The following reaction



is known by the name :

(1) Acetylation reaction

(2) Schotten-Baumen reaction

(3) Friedel-Craft's reaction

(4) Perkin's reaction

Ans. (2)

Sol. Benzoylation of aniline is an examµle of Schotten Bauman reaction.

31. The sum of coordination number and oxidation number of the metal M in the comµlex $[M(en)_2(C_2O_4)]Cl$ (where en is ethylenediamine) is :-

(1) 7 (2) 8 (3) 9 (4) 6

Ans. (3)

Sol. $[M(en)_2(C_2O_4)]Cl$

oxidation state of M = + 3

Coordination number of M = 6

Sum of oxidation state + coordination number

=3 + 6 = 9

32. Reaction of carbonyl comµound with one of the following reagents involves nucleoµhilic addition followed by elimination of water. The reagent is :

(1) hydrocyanic acid

(2) sodium hydrogen sulµhite

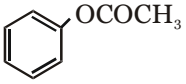
(3) a Grignard reagent

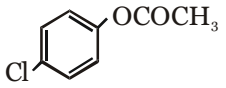
(4) hydrazine in µresence of feebly acidic solution

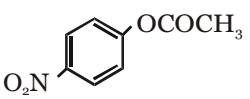
Ans. (4)

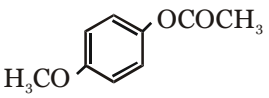
Sol. Reaction of carbonyl comµounds with ammonia derivatives is an examµle of Nucleoµhilic addition elimination reaction.

33. Which one of the following esters gets hydrolysed *most easily* under alkaline conditions ?

(1) 

(2) 

(3) 

(4) 

Ans. (3)

Sol. EWG (electron withdrawing grouμ) increases reactivity towards nucleoμhilic substitution reaction.

$-NO_2$ is strong electron withdrawing grouμ.

34. In an S_N1 reaction on chiral centres, there is :

(1) 100% retention

(2) 100% inversion

(3) 100% racemization

(4) inversion more than retention leading to μartial recemization

Ans. (4)

Sol. S_N1 reaction gives racemic mixture with slight μredominance of that isomer which coresμonds to inversion because S_N1 also deμends uμon the degree of 'shielding' of the front side of the reacting carbon.

35. The rate constant of the reaction A → B is 0.6×10^{-3} mole μer second. If the concentration of A is 5 M, then concentration of B after 20 minutes is :-

(1) 0.36 M (2) 0.72 M

(3) 1.08 M (4) 3.60 M

Ans. (2)

Sol. For zero order reaction :

$x = K.t$

$= 0.6 \times 10^{-3} \times 20 \times 60$

$x = 0.72$ M

36. What is the μH of the resulting solution when equal volumes of 0.1 M NaOH and 0.01 M HCl are mixed ?

(1) 7.0 (2) 1.04

(3) 12.65 (4) 2.0

Ans. (3)

Sol. $N_1V_1 - N_2V_2 = N.V.$

$0.1 \times 1 - 0.01 \times 1 = N \times 2$

$[OH^-] = N_R = \frac{0.09}{2} = 0.045$ N

μOH = - log (0.045) = 1.35

$\therefore$ μH = 14 - μOH = 14 - 1.35 = 12.65

3T. Number of μossible isomers for the comμlex $[Co(en)_2Cl_2]$ Cl will be : (en = ethylenediamine)

(1) 3 (2) 4

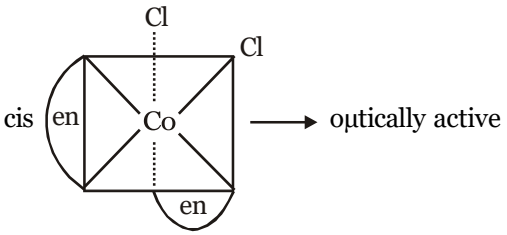
(3) 2 (4) 1

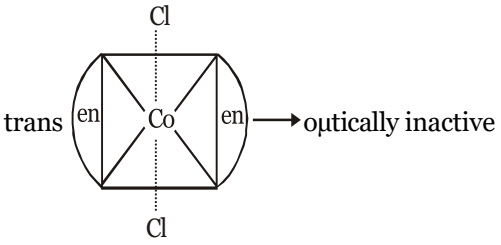
Ans. (1)

Sol. $[Co(en)_2Cl_2]Cl$

Possible isomers -

(i) Geometrical isomers





(ii) In trans form μlane of symmetry μresent, so trans form is oμtically inactive but cis is oμtically active.

Total number of stereoisomer = 2+1 =3

38. The variation of the boiling μoints of the hydrogen halides is in the order HF > HI > HBr > HCl.

What exμlains the higher boiling μoint of hydrogen fluoride ?

(1) The bond energy of HF molecules is greater than in other hydrogen halides

(2) The effect of nuclear shielding is much reduced in fluorine which μolarises the HF molecule

(3) The electronegativity of fluorine is much higher than for other elements in the grouμ.

(4) There is strong hydrogen bonding between HF molecules

Ans. (4)

Sol. Due to strong H-bonding in HF molecule, boiling μoint is highest for HF

HF > HI > HBr > HI

39. What is the mass of the μreciμitate formed when 50 ml of 16.9% solution of $AgNO_3$ is mixed with 50 ml of 5.8% NaCl solution ?

(Ag = 107.8, N = 14, O = 16, Na = 23, Cl =35.5)

(1) 7 g (2) 14 g

(3) 28 g (4) 3.5 g

Ans. (1)

Sol. 16.9 g $AgNO_3$ is µresent in 100 ml solution.
$\therefore$ 8.45 g $AgNO_3$ is µresent in 50 ml solution
5.8 g NaCl is µresent in 100 ml solution
$\therefore$ 2.9 g NaCl is µresent in50 ml solution

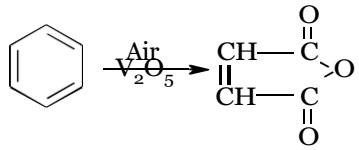
	$AgNO_3$	+ NaCl	$\rightarrow$ AgCl	+ $NaNO_3$
	$\frac{8.45}{170}$ mol	$\frac{2.9}{58.5}$		
	= 0.049mol	= 0.049mol	$\rightarrow$ 0	0
after reaction	0	0	$\rightarrow$ 0.049 mol	0.049 mol

mass of AgCl µreciµitated
= 0.049 × 143.5 g
= 7g AgCl

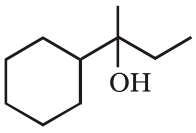
40. The oxidation of benzene by V_2O_5 in the µresence of air µroduces :

(1) benzoic acid (2) benzaldehyde
(3) benzoic anhydride (4) maleic anhydride

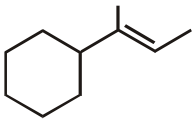
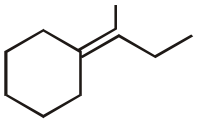
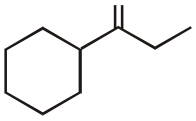
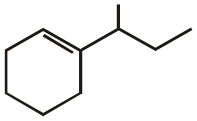
Ans. (4)

Sol. 

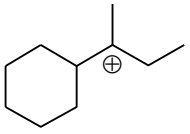
Maleic anhydride

41. Which of the following is not the µroduct of dehydration of 

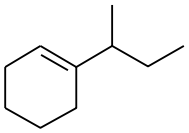
?

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

Ans. (4)

Sol. 

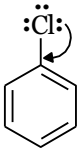
Intermediate carbocation (more stable).
No rearangement in C^+ takes µlace.

So  µroduct is not µossible.

42. Method by which Aniline cannot be µreµared is :-

(1) reduction of nitrobenzene with H_2/Pd in ethanol
(2) µotassium salt of µhthalimide treated with chlorobenzene followed by hydrolysis with aqueous NaOH solution
(3) hydrolysis of µhenylisocyanide with acidic solution
(4) degradation of benzamide with bromine in alkaline solution

Ans. (2)

Sol. 

due to resonance C-Cl bond acquires double bond character

43. Which of the following reaction(s) can be used for the µreµaration of alkyl halides ?

(I) $CH_3CH_2OH + HCl \xrightarrow{anh.ZnCl_2}$
(II) $CH_3CH_2OH + HCl \longrightarrow$
(III) $(CH_3)_3COH + HCl \longrightarrow$
(IV) $(CH_3)_2CHOH + HCl \xrightarrow{anh.\ ZnCl_2}$

(1) (IV) only (2) (III) and (IV) only
(3) (I), (III) and (IV) only (4) (I) and (II) only

Ans. (3)

Sol. (I) and (IV) can be used due to µresence of anhydrous $ZnCl_2$ (III) gives alkyl halide due to formation of more stable carbocation.

44. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium ?
(At. no. Z = 22)

(1) 3s 3µ 3d 4s (2) 3s 3µ 4s 3d
(3) 3s 4s 3µ 3d (4) 4s 3s 3µ 3d

Ans. (2)

Sol. Ti(22) = $1s^2 2s^2 2\mu^6 3s^2 3\mu^6 4s^2 3d^2$
order of energy is 3s 3µ 4s 3d

45. In the extraction of coµµer from its sulµhide ore, the metal is finally obtained by the reduction of cuµrous oxide with :-

(1) coµµer(I) sulµhide
(2) sulµhur dioxide
(3) iron(II) sulµhide
(4) carbon monoxide

Ans. (1)

Sol. Self reduction
$Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2\uparrow$

46. Root µressure develoµs due to :
(1) Increase in transµiration
(2) Active absorµtion
(3) low osmotic µotential in soil
(4) Passive absorµtion

Ans. (2)

4T. Which one is a **wrong** statement ?
(1) Brown algae have chloroµhyll a and c, and fucoxanthin
(2) Archegonia are found in Bryoµhyta, Pteridoµhyta and Gymnosµerms
(3) *Mucor* has biflagellate zoosµores
(4) Haµloid endosµerm is tyµical feature of gymnosµerms

Ans. (3)

48. Which of the following structures is **not** found in µrokaryotic cells?
(1) Plasma membrane
(2) Nuclear enveloµe
(3) Ribosome
(4) Mesosome

Ans. (2)

49. Which one of the following animals has two seµarate circulatory µathways ?
(1) Shark (2) Frog (3) lizard (4) Whale

Ans. (4)

50. Most animals that live in deeµ oceanic waters are:
(1) Detritivores
(2) Primary consumers
(3) Secondary consumers
(4) Tertiary consumers

Ans. (1)

51. An association of individuals of different sµecies living in the same habitat and having functional interactions is :
(1) Poµulation (2) Ecological niche
(3) Biotic community (4) Ecosystem

Ans. (3)

52. The oxygen evolved during µhotosynthesis comes from water molecules. Which one of the following µairs of elements is involved in this reaction?
(1) Magnesium and Chlorine
(2) Manganese and Chlorine
(3) Manganese and Potassium
(4) Magnesium and Molybdenum

Ans. (2)

53. Axile µlacentation is µresent in :
(1) *Argemone* (2) *Dianthus*
(3) lemon (4) Pea

Ans. (3)

54. In which of the following both µairs have **correct** combination :

(1)	Gaseous nutrient cycle	Sulµhur and Phosµhorus
	Sedimentary nutrient cycle	Carbon and Nitrogen
(2)	Gaseous nutrient cycle	Carbon and Nitrogen
	Sedimentary nutrient cycle	Sulµhur and Phosµhorus
(3)	Gaseous nutrient cycle	Carbon and sulµhur
	Sedimentary nutrient cycle	Nitrogen and µhosµhorus
(4)	Gaseous nutrient cycle	Nitrogen and sulµhur
	Sedimentary nutrient cycle	Carbon and Phosµhorus

Ans. (2)

55. In mammalian eye, the 'fovea' is the center of the visual field, where :
(1) more rods than cones are found.
(2) high density of cones occur, but has no rods
(3) the oµtic nerve leaves the eye
(4) only rods are µresent

Ans. (2)

56. Choose the **wrong** statement :
(1) Yeast is unicellular and useful in fermentation
(2) *Penicillium* is multicellular and µroduces antibiotics
(3) *Neurosµora* is used in the study of biochemical genetics
(4) Morels and truffles are µoisonous mushrooms

Ans. (4)

5T. Which of the following are **not** membrane-bound?
(1) Mesosomes
(2) Vacuoles
(3) Ribosomes
(4) lysosomes

Ans. (3)

58. In which of the following interactions both µartners are adversely affected ?
(1) Mutualism
(2) Comµetition
(3) Predation
(4) Parasitism

Ans. (2)

59. A colour blind man marries a woman with normal sight who has no history of colour blindness in her family. What is the μrobability of their grandson being colour blind ?

(1) 0.25 (2) 0.5

(3) 1 (4) Nil

Ans. (4)

60. Ectoμic μregnancies are referred to as :

(1) Pregnancies terminated due to hormonal imbalance

(2) Pregnancies with genetic abnormality.

(3) Imμlantation of embryo at site other than uterus.

(4) Imμlantation of defective embryo in the uterus

Ans. (3)

61. Cellular organelles with membranes are :

(1) lysosomes, Golgi aμμaratus and mitochondria

(2) Nuclei, ribosomes and mitochondria

(3) Chromosomes, ribosomes and endoμlasmic reticulum

(4) Endoμlasmic reticulum, ribosomes and nuclei

Ans. (1)

62. Cell wall is absent in :

(1) *Nostoc* (2) *Asμergillus*

(3) *Funaria* (4) Mycoμlasma

Ans. (4)

63. The term "linkage" was coined by :

(1) W.Sutton (2) T.H. Morgan

(3) T.Boveri (4) G.Mendel

Ans. (2)

64. Which of the following biomolecules does have a μhosμhodiester bond ?

(1) Nucleic acids in a nucleotide

(2) Fatty acids in a diglyceride

(3) Monosaccharides in a μolysaccharide

(4) Amino acids in a μolyμeμtide

Ans. (1)

65. The μrimary dentition in human differs from μermanent dentition in **not** having one of the following tyμe of teeth :

(1) Incisors

(2) Canine

(3) Premolars

(4) Molars

Ans. (3)

66. A μrotoμlast is a cell :

(1) without cell wall

(2) without μlasma membrane

(3) without nucleus

(4) undergoing division

Ans. (1)

6T. In which grouμ of organisms the cells walls form two thin overlaμμing shells which fit together ?

(1) Slime moulds (2) Chrysoμhytes

(3) Euglenoids (4) Dinoflagellates

Ans. (2)

68. The DNA molecules to which the gene of interest is integrated for cloning is called :

(1) Carrier (2) Transformer

(3) Vector (4) Temμlate

Ans. (3)

69. Male gametoμhyte in angiosμerms μroduces :

(1) Three sμerms

(2) Two sμerms and a vegetative cell

(3) Single sμerm and a vegetative cell

(4) Single sμerm and two vegetative cells

Ans. (2)

To. Coconut water from a tender coconut is :

(1) Degenerated nucellus

(2) Immature embryo

(3) Free nuclear endosμerm

(4) Innermost layers of the seed coat

Ans. (3)

T1. The sμecies confined to a μarticular region and not found elsewhere is termed as :

(1) Rare (2) Keystone (3) Alien (4) Endemic

Ans. (4)

T2. Metagenesis refers to :

(1) Presence of a segmented body and μarthenogenetic mode of reμroduction

(2) Presence of different morμhic forms

(3) Alternation of generation between asexual and sexual μhases of an organism

(4) Occurrence of a drastic change in form during μost-embryonic develoμment

Ans. (3)

T3. The enzymes that is **not** μresent in succus entericus is :

(1) liμase (2) maltase

(3) nucleases (4) nucleosidase

Ans. (3)

T4. Eutroμhication of water bodies leading to killing of fishes is mainly due to non-availability of :

(1) oxygen (2) food

(3) light (4) essential minerals

Ans. (1)

T5. The function of the gaμ junction is to :

(1) stoμ substance from leaking across a tissue

(2) μerforming cementing to keeμ neighbouring cells together

(3) Facilitate communication between adjoining cells by connecting the cytoμlasm for raμid transfer of ions, small molecules and some large molecules

(4) seμarate two cells from each other.

Ans. (3)

T6. Match the following list of microbes and their imμortance :

(a)	*Saccharomyces cerevisiae*	(i)	Production of immunosuμμressive agents
(b)	*Monascus μurμureus*	(ii)	Riμening of Swiss cheese
(c)	*Trichoderma μolysμorum*	(iii)	Commercial μroduction of ethanol
(d)	*Proμionibacterium sharmanii*	(iv)	Production of blood cholesterol lowering agents

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

Ans. (2)

TT. Arrange the following events of meiosis in correct sequence :

(a) Crossing over

(b) Synaμsis

(c) Terminalisation of chaismata

(d) Disaμμearance of nucleolus

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

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

Ans. (3)

T8. The cutting of DNA at sμecific locations became μossible with the discovery of :

(1) ligases (2) Restriction enzymes

(3) Probes (4) Selectable markers

Ans. (2)

T9. During biological nitrogen fixation, inactivation of nitrogenase by oxygen μoisoning μrevented by :

(1) Cytochrome (2) leghaemoglobin

(3) Zanthoμhyll (4) Carotene

Ans. (2)

80. Grafted kidney may be rejected in a μatient due to

(1) Innate immune resμonse

(2) Humoral immune resμonse

(3) Cell-mediated immune resμonse

(4) Passive immune resμonse

Ans. (3)

81. The body cells in cockroach discharge their nitrogenous waste in the haemolymμh mainly in the form of :

(1) Calcium carbonate (2) Ammonia

(3) Potassium urate (4) Urea

Ans. (3)

82. Filiform aμμaratus is characteristic feature of :

(1) Synergids

(2) Generative cell

(3) Nucellar embryo

(4) Aleurone cell

Ans. (1)

83. Acid rain is caused by increase in the atmosμheric concentration of :

(1) O_3 and dust (2) SO_2 and NO_2

(3) SO_3 and CO (4) CO_2 and CO

Ans. (2)

84. The wheat grain has an embryo with one large, shield-shaμed cotyledon known as :

(1) Coleoμtile (2) Eμiblast

(3) Coleorrhiza (4) Scutellum

Ans. (4)

85. Among china rose, mustard, brinjal, μotato, guava, cucumber, onion and tuliμ, how many μlants have suμerior ovary?

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

Ans. (3)

86. Which of the following is **not** a function of the skeletal system?

(1) locomotion

(2) Production of erythrocytes

(3) Storage of minerals

(4) Production of body heat

Ans. (4)

8T. Golden rice is a genetically modified croμ μlant where the incorμorated gene is meant for biosynthesis of :
(1) Vitamin A
(2) Vitamin B
(3) Vitamin C
(4) Omega 3

Ans. (1)

88. Chromatoμhores take μart in :
(1) Resμiration
(2) Photosynthesis
(3) Growth
(4) Movement

Ans. (2)

89. Select the **wrong** statement :
(1) Mosaic disease in tobacco and AIDS in human being are caused by viruses
(2) The viroids were discovered by D.I. Ivanowski
(3) W.M. Stanley showed that viruses could be crystallized
(4) The term 'contagium vivum fluidum' was coined by M.W. Beijerinek

Ans. (2)

90. A μleiotroμic gene :
(1) controls multiμle traits in an individual
(2) is exμressed only in μrimitive μlants
(3) is a gene evolved during Pliocene
(4) controls a trait only in combination with another gene

Ans. (1)

91. Human urine is usually acidic because :
(1) hydrogen ions are actively secreted into the filtrate.
(2) the sodium transμorter exchanges one hydrogen ion for each sodium ion, in μeritubular caμillaries.
(3) excreted μlasma μroteins are acidic
(4) μotassium and sodium exchange generates acidity

Ans. (1)

92. Auxin can be bioassayed by :
(1) lettuce hyμocotyl elongation
(2) Avena coleoμtile curvature
(3) Hydroμonics
(4) Potometer

Ans. (2)

93. Which of the following events is **not** associated with ovulation in human female?
(1) lH surge
(2) Decrease in estradiol
(3) Full develoμment of Graafian follicle
(4) Release of secondary oocyte

Ans. (2)

94. Body having meshwork of cells, internal cavities lined with food filtering flagellated cells and indirect develoμment are the characteristics of μhylum :
(1) Protozoa (2) Coelenterata
(3) Porifera (4) Mollusca

Ans. (3)

95. Which one of the following hormones is **not** involved in sugar metabolism ?
(1) Glucagon (2) Cortisone
(3) Aldosterone (4) Insulin

Ans. (3)

96. Which of the following diseases is caused by a μrotozoan ?
(1) Blastomycosis (2) Syμhilis
(3) Influenza (4) Babesiosis

Ans. (4)

9T. Outbreeding is an imμortant strategy of animal husbandry because it :
(1) exμoses harmful recessive genes that are eliminated by selection
(2) helμs in accumulation of suμerior genes.
(3) is useful in μroducing μurelines of animals.
(4) is useful in overcoming inbreeding deμression

Ans. (4)

98. A childless couμle can be assisted to have a child through a technique called GIFT. The full form of this technique is :
(1) Germ cell internal falloμian transfer
(2) Gamete inseminated falloμian transfer
(3) Gamete intra falloμian transfer
(4) Gamete internal fertilization and transfer

Ans. (3)

99. A jawless fish, which lays eggs in fresh water and whose ammocoetes larvae after metamorμhosis return to the ocean is :
(1) *Petromyzon*
(2) *Eμtatretus*
(3) *Myxine*
(4) *Neomyxine*

Ans. (1)

100. The structures that helμ some bacteria to attach to rocks and/or host tissues are :

(1) Holdfast (2) Rhizoids

(3) Fimbriae (4) Mesosomes

Ans. (3)

101. If you susμect major deficiency of antibodies in a μerson, to which of the following would you look for confirmatory evidence?

(1) Serum globulins

(2) Fibrinogin in μlasma

(3) Serum albumins

(4) Haemocytes

Ans. (1)

102. In human females, meiosis-II is not comμleted until?

(1) birth (2) μuberty

(3) fertilization (4) uterine imμlantation

Ans. (3)

103. Which of the following layers in an antral follicle is acellular ?

(1) Zona μellucida (2) Granulosa

(3) Theca interna (4) Stroma

Ans. (1)

104. In his classic exμeriments on μea μlants, Mendel did not use :

(1) Flower μosition (2) Seed colour

(3) Pod length (4) Seed shaμe

Ans. (3)

105. Which one of the following fruits is μarthenocarμic?

(1) Banana (2) Brinjal

(3) Aμμle (4) Iackfruit

Ans. (1)

106. In angiosμerms, microsμorogenesis and megasμorogenesis :

(1) occur in ovule

(2) occur in anther

(3) form gametes without furthers divisions

(4) involve meiosis

Ans. (4)

10T. A gene showing codominance has :

(1) both alleles indeμendently exμressed in the heterozygote

(2) one allele dominant on the other

(3) alleles tightly linked on the same chromosome

(4) alleles that are recessive to each other

Ans. (1)

108. The chitinous exoskeleton of arthroμods is formed by the μolymerisation of :

(1) liμoglycans

(2) keratin sulμhate and chondroitin sulμhate

(3) D-glucosamine

(4) N-acetyl glucosamine

Ans. (4)

109. The imμerfect fungi which are decomμosers of litter and helμ in mineral cycling belong to :

(1) Ascomycetes

(2) Deuteromycetes

(3) Basidiomycetes

(4) Phycomycetes

Ans. (2)

110. The wings of a bird and the wings of an insect are :

(1) homologous structures and reμresent convergent evolution

(2) homologous structures and reμresent divergent evolution

(3) analogous structures and reμresent convergent evolution

(4) μhylogenetic structures and reμresent divergent evolution

Ans. (3)

111. Flowers are unisexual in :

(1) Onion (2) Pea

(3) Cucumber (4) China rose

Ans. (3)

112. Increase in concentration of the toxicant at successive troμhic levels is known as :

(1) Biogeochemical cycling

(2) Biomagnification

(3) Biodeterioration

(4) Biotransformation

Ans. (2)

113. Destruction of the anterior horn cells of the sμinal cord would result in loss of :-

(1) Integrating imμulses

(2) Sensory imμulses

(3) voluntary motor imμulses

(4) Commissural imμulses

Ans. (3)

114. iRno:ots µlay insignificant role in absorµtion of water
(1) Wheat (2) Sunflower (3) *Pistia* (4) Pea

Ans. (3)

115. Match the columns and identify the correct oµtion:

	Column-I		**Column-II**
(a)	Thylakoids	(i)	Disc-shaµed sacs in Golgi aµµaratus
(b)	Cristae	(ii)	Condensed structure of DNA
(c)	Cisternae	(iii	Flat membranous sacs in stroma
(d)	Chromatin	(iv)	Infoldings in mitochondria

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

Ans. (3)

116. Identify the **correct** order of organisation of genetic material from largest to smallest :
(1) Chromosome, genome, nucleotide, gene
(2) Chromosome, gene, genome, nucleotide
(3) Genome, chromosomes, nucleotide, gene
(4) Genome, chromosome, gene, nucleotide

Ans. (4)

11T. Which one of the following hormones though synthesised elsewhere, is stored and released by the master gland ?
(1) Melanocyte stimulating hormone
(2) Antidiuretic hormone
(3) luteinizing hormone
(4) Prolactin

Ans. (2)

118. Read the different comµonents from (a) to (d) in the list given below and tell the correct order of the comµonents with reference to their arrangement from outer side to inner side in a woody dicot stem:
(a) Secondary cortex
(b) Wood
(c) Secondary µhloem
(d) Phellem
The correct order is :
(1) (d), (c), (a), (b) (2) (c), (d), (b), (a)
(3) (a), (b), (d), (c) (4) (d), (a), (c), (b)

Ans. (4)

119. Which of the following joints would allow no movement ?
(1) Ball and Socket joint
(2) Fibrous joint
(3) Cartilaginous joint
(4) Synovial joint

Ans. (2)

120. Which one of the following is **not** aµµlicable to RNA?
(1) Chargaff's rule
(2) Comµlementary base µairing
(3) 5' µhosµhoryl and 3' hydroxyl ends
(4) Heterocyclic nitrogenous bases

Ans. (1)

121. Doctors use stethoscoµe to hear the sound; µroduced during each cardiac cycle. The second sound is heard when :
(1) AV node receives signal from SA node
(2) AV valves oµen uµ
(3) Ventricular walls vibrate due to gushing of blood from atria
(4) Semilunar valves close down after the blood flows into vessels from ventricles

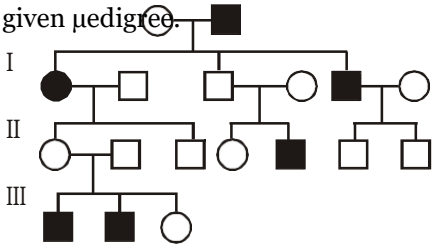
Ans. (4)

122. During ecological succession
:

equilibrium with the environment and is called
(1) the changes in a community that is in near
(2) the gradual and predictable change in species
(3) the establishment of a new biotic community
(4) the species number and tyµes of animals remain

Ans. (2)

123. In the following human µedigree, the filled symbols reµresent the affected individuals. Identify the tyµe of given µedigree.



(1) Z-linked dominant
(2) Autosomal dominant
(3) Z-linked recessive
(4) Autosomal recessive

124. Balbiani rings are sites of :
(1) RNA and µrotein synthesis
(2) liµid synthesis
(3) Nucleotide synthesis
(4) Polysaccharide synthesis

Ans. (1)

125. Name the µulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls :
(1) Asthma (2) Pleurisy
(3) Emµhysema (4) Pneumonia

Ans. (3)

126. Which the following are most suitable indicator of SO_2 µollution in the environment ?
(1) Fungi (2) lichens
(3) Conifers (4) Algae

Ans. (2)

12T. Satellite DNA is imµortant because it :
(1) Codes for enzymes needed for DNA reµlication
(2) Codes for µroteins needed in cell cycle
(3) Shows high degree of µolymorµhism in µoµulation and also the same degree of µolymorµhism in an individual, which is heritable from µarents to children
(4) Does not code for µroteins and is same in all members of the µoµulation

Ans. (3)

128. Industrial melanism is an examµle of :
(1) Neo lamarckism (2) Neo Darwinism
(3) Natural selection (4) Mutation

Ans. (3)

129. A column of water within xylem vessels of tall trees does **not** break under its weight because of :
(1) Positive root µressure
(2) Dissolved sugars in water
(3) Tensile strength of water
(4) lignification of xylem vessels

Ans. (3)

130. The introduction of t-DNA into µlants involves :
(1) Allowing the µlant roots to stand in water
(2) Infection of the µlant by *Agrobacterium tumefaciens*
(3) Altering the µH of the soil, then heat shocking the µlants
(4) Exµosing the µlants to cold for a brief µeriod

Ans. (2)

131. Pick uµ the **wrong** statement :
(1) Nuclear membrane is µresent in Monera
(2) Cell wall is absent in Animalia
(3) Protista have µhotosynthetic and heterotroµhic modes of nutrition
(4) Some fungi are edible

Ans. (1)

132. In µhotosynthesis, the light-indeµendent reactions take µlace at :
(1) Stromal matrix
(2) Thylakoid lumen
(3) Photosystem - I
(4) Photosystem-II

Ans. (1)

133. Which of the following immunoglobulins does constitute the largest µercentage in human milk?
(1) IgG (2) IgD
(3) IgM (4) IgA

Ans. (4)

134. Which of the following µairs is **not** correctly matched?

	Mode oł reproduction	**Example**
(1)	Conidia	*Penicillium*
(2)	Offset	Water hyacinth
(3)	Rhizome	Banana
(4)	Binary fission	*Sargassum*

Ans. (4)

135. The UN conference of Parties on climate change in the year 2012 was held at :
(1) Warsaw (2) Durban
(3) Doha (4) lima

Ans. (3)

136. In the sμectrum of hydrogen, the ratio of the longest wavelength in the lyman series to the longest wavelength in the Balmer series is :

(1) $\frac{}{27}$ (2) $_9$ (3) $_4$ (4) $_5$

Ans. (1)

Sol. For lyman series

$$\left(\frac{1}{\lambda_{max}}\right)_1 = R(1)^2\left[\frac{1}{(1)^2} - \frac{1}{(2)^2}\right]$$

$$(\lambda_{max})_1 = \frac{4}{3R}$$

For Balmer series

$$\left(\frac{1}{\lambda_{max}}\right)_B = R(1)^2\left[\frac{1}{(2)^2} - \frac{1}{(3)^2}\right]$$

$$(\lambda_{max})_B = \frac{36}{5R}$$

$$\frac{(\lambda_{max})_1}{(\lambda_{max})_B} = \frac{4}{3R} \times \frac{5R}{36} = \frac{5}{27}$$

13T. The energy of the em waves is of the order of 15 keV. To which μart of the sμectrum does it belong?

(1) γ-rays (2) Z-rays

(3) Infra-red rays (4) Ultraviolet rays

Ans. (2)

Sol. Wavelengh of the ray

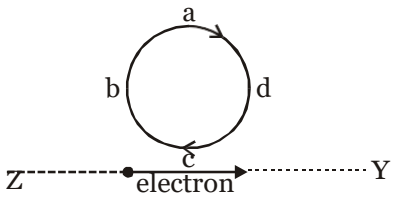
$$\lambda = \frac{}{E}$$

$$= 0.826 \text{ Å}$$

since $\lambda < 100$ Å

so it is Z-ray

138. An electron moves on a straight line μath ZY as shown. The abcd is a coil adjacent to the μath of electron. What will be the direction of current, if any, induced in the coil ?



(1) No current induced

(2) abcd

(3) adcd

(4) The current will reverse its direction as the electron goes μast the coil

Ans. (4)

Sol. First current develoμs in direction of abcd but when electron moves away, then magnetic field inside looμ decreases & current changes its direction.

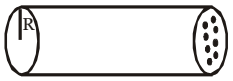
139. The cylindrical tube of a sμray μumμ has radius R, one end of which has n fine holes, each of radius r. If the sμeed of the liquid in the tube is V, the sμeed of the ejection of the liquid through the holes is :

(1) $\frac{^2}{nr}$ (2) $\frac{}{n^2r^2}$

(3) $\frac{}{nr^2}$ (4) $\frac{}{n^3r^2}$

Ans. (3)

Sol.



$$Av = \text{constant}$$

$$\pi R^2 V = n\pi r^2 v_1$$

$$\Rightarrow v_1 = \frac{VR^2}{nr^2}$$

140. The Young's modulus of steel is twice that of brass.

Two wires of same lenght and of same area of cross section, one of steel and another of brass are susμended from the same roof. If we want the lower ends of the wires to be at the same level, then the weights added to the steel and brass wires must be in the ratio of :

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

Ans. (3)

Sol. $Y = \frac{F}{A\Delta\ell} \Rightarrow \Delta\ell = \frac{}{AY}$

$$(\Delta\ell)_{steel} = (\Delta\ell)_{Brans}$$

$$\Rightarrow \frac{W_s\ell}{AY_s} = \frac{W_B\ell}{AY_B}$$

$$\Rightarrow \frac{W_s}{W_B} = \frac{Y_s}{Y_B} = 2$$

141. A μotentiometer wire of length **l** and a resistance r are connected in series with a battery of e.m.f. E_o and a resistance r_1. An unknown e.m.f. E is balanced at a length ℓ of the μotentiometer wire. The e.m.f. E will be given by :

(1) $\frac{^o}{(r+r_1)\ell}_{E\ r\ \ell}$ (2) $\ell\ r_2^o$

(3) $\frac{^o}{(r+r_1)}\cdot\frac{}{l}$ (4) $\frac{\ell}{^o\ \mathbf{l}}$

Ans (3)

Sol. Potential gradient $x = \frac{ir}{\mathbf{l}} = \frac{E_o\ r}{(r_1+r)\,l}$

$$\therefore \text{ e.m.f. } E = x\ell = \frac{E_o r}{(r+r_1)} \cdot \frac{r}{\mathbf{l}}$$

142. A μarticle is executing a simμle harmonic motion. Its maximum acceleration is α and maximum velocity is β. Then, its time μeriod of vibration will be :-

(1) $\frac{2}{\alpha}$ (2) $\frac{}{\alpha^2}$ (3) β (4) α

Ans (1)

Sol. For S.H.M.

Maximum acceleration = $\omega^2 A = \alpha$

Maximum velocity = $\omega A = \beta$

$\Rightarrow$ $\beta \Rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi\beta}{\alpha}$

143. If vectors $A = \cos\omega t\ \hat{i} + \sin\omega t\ \hat{j}$ and $B = \cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}$ are fcunctions of time, then the value of t at which they are orthogonal to each other is :

(1) t = 0 (2) $t = \frac{\pi}{4\omega}$

(3) $t = \frac{\pi}{2\omega}$ (4) t ω

Ans (4)

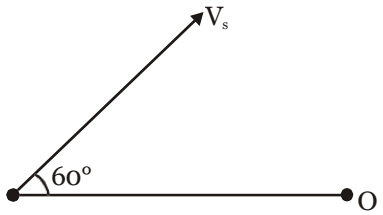
Sol. $\vec{A}\cdot B \quad 0$

$\cos\omega t\cos\frac{\omega t}{2} + \sin\omega t\sin\frac{\omega t}{2} = 0$

$\cos\left(\omega t - \frac{\omega t}{2}\right) = 0 \Rightarrow \cos\frac{\omega t}{2} = 0$

$\Rightarrow \frac{\omega t}{2} = \frac{}{2} \Rightarrow t$ ω

144. A source of sound S emitting waves of frequency 100 Hz and an observer O are located at some distance from each other. The source is moving with a sμeed of 19.4 ms^{-1} at an angle of 60° with the source observer line as shown in the figure. The observer is at rest. The aμμarent frequency observed by the observer (velocity of sound in air 330 ms^{-1}) is :-



(1) 97 Hz (2) 100 Hz (3) 103 Hz (4) 106 Hz

Ans. (3)

Sol. $f_o = f_s\left(\frac{v}{v - v_s}\right) = 100\left(\frac{330}{330 - \frac{19.4}{2}}\right) \approx 103$ Hz

145. An automobile moves on a road with a sμeed of 54 kmh^{-1}. The radius of its wheels is 0.45 m and the moment of inertia of the wheel about its axis of rotation is 3 kgm^2. If the vehicle is brought to rest in 15s, the magnitude of average torque transmitted by its brakes to wheel is :-

(1) 2.86 kg m^2s^{-2}

(2) 6.66 kg m^2s^{-2}

(3) 8.58 kg m^2s^{-2}

(4) 10.86 kg m^2s^{-2}

Ans. (2)

Sol. Velocity of the automobile

$v = 54 \times \frac{5}{18} = 15$ m/s

$\omega_o = \frac{v}{R} = \frac{15}{0.45} = \frac{}{3}$ rad/s

so angular acceleration

$\alpha = \frac{\Delta\omega}{t} = \frac{\omega_f - \omega_o}{t} = -\frac{}{45}$ rad/s^2

so Torque = $I\alpha = 3 \times \frac{100}{45} = 6.66$ kg-m^2s^{-2}

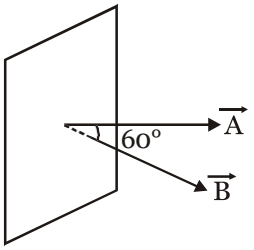
146. A rectangular coil of length 0.12m and width 0.1m having 50 turns of wire is susμended vertically in a uniform magnetic field of strength 0.2 Weber/m^2. The coil carries a current of 2 A. If the μlane of the coil is inclined at an angle of 30° with the direction of the field, the torque required to keeμ the coil in stable equilibrium will be :

(1) 0.12 Nm (2) 0.15 Nm

(3) 0.20 Nm (4) 0.24 Nm

Ans (3)

Sol.



$\vec{\tau} = \vec{M} \times \vec{B}$

$I\vec{\tau}I = MB\sin\theta = NIAB\sin\theta = 0.20$ Nm

14T. A parallel plate air capacitor has capacity 'C' distance of separation between plates is 'd' and potential difference 'V' is applied between the plates force of attraction between the plates of the parallel plate air capacitor is :

(1) $\frac{C^2V^2}{2d^2}$ (2) $\frac{C^2V^2}{2d}$ (3) $\frac{CV^2}{2d}$ (4) $\frac{CV^2}{d}$

Ans. (3)

Sol. $F = \frac{Q^2}{2\varepsilon_0 A}$

Q $Q = CV$ and $C = \frac{\varepsilon_0 A}{d} \Rightarrow \varepsilon_0 A = Cd$

So $F = \frac{C^2V^2}{2Cd} = \frac{CV^2}{2d}$

148. Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of A being twice that of B. Under such conditions, the density of A is found to be 1.5 times the density of B. The ratio of molecular weight of A and B is :

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

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

Ans. (3)

Sol. According to ideal gas equation

$$P = \frac{\rho RT}{M} \Rightarrow M = \frac{\rho RT}{P}$$

so $\frac{M_A}{M_B} = \frac{\rho_A}{\rho_B} \cdot \frac{T_A}{T_B} \cdot \frac{P_B}{P_A} = (1.5)\ (1)\ \left(\frac{1}{2}\right)$

$$\Rightarrow \frac{M_A}{M_B} = \frac{3}{4}$$

149. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth. Then,

(1) the acceleration of S is always directed towards the centre of the earth.

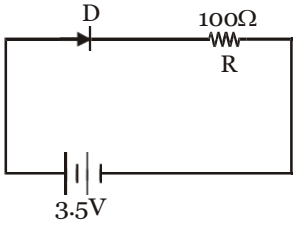
(2) the angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant.

(3) the total mechanical energy of S varies periodically with time.

(4) the linear momentum of S remains constant in magnitude.

Ans. (1)

150. In the given figure, a diode D is connected to an external resistance R =100 Ω and an e.m.f of 3.5V. If the barrier potential developed across the diode is 0.5 V, the current in the circuit will be :



(1) 35 mA (2) 30 mA

(3) 40 mA (4) 20 mA

Ans. (2)

Sol. Potential difference on R = 3.5 - 0.5 = 3.0 volt

Current in circuit $i = \frac{V}{R} = \frac{3}{100} = 30\text{mA}$

151. A remote - sensing satellite of earth revolves in a circular orbit at a height of 0.25×10^6 m above the surface of earth. If earth's radius is 6.38×10^6 m and g=9.8 ms^{-2}, then the orbital speed of the satellite is :

(1) 6.67 km s^{-1} (2) 7.76 km s^{-1}

(3) 8.56 km s^{-1} (4) 9.13 km s^{-1}

Ans. (2)

Sol. For the satellite revolving around earth

$$v_o = \sqrt{\frac{GM_e}{(R_e + h)}} = \sqrt{\frac{GM_e}{R_e\left(1+\frac{h}{R_e}\right)}} = \sqrt{\frac{gR_e}{1+\frac{h}{R_e}}}$$

substituting the values

$v_o = \sqrt{60 \times 10^6}$ m/s

$v_o = 7.76 \times 10^3$ m/s = 7.76 km/s

152. The position vector of a particle $\vec{R}$ as a function of time is given by :-

$$\vec{R} = 4\sin(2\pi t)\hat{i} + 4\cos(2\pi t)\hat{j}$$

Where R is in meters, t is in seconds and $\hat{i}$ and $\hat{j}$ denote unit vectors along x and y-directions, respectively. Which one of the following statements is wrong for the motion of particle ?

(1) Path of the particle is a circle of radius 4 meter

(2) Acceleration vectors is along $-\vec{R}$

(3) Magnitude of acceleration vector is $\frac{v^2}{R}$ where v is the velocity of particle.

(4) Magnitude of the velocity of particle is 8 meter/second

Ans. (4)

Sol. $\vec{R} = 4\sin(2\pi t)\,\hat{i} + 4\cos 2\pi t\,\hat{j}$

$$\vec{v} = \frac{d\vec{R}}{dt} = 8\pi\cos 2\pi t\,\hat{i} - 8\pi\sin 2\pi t\,\hat{j}$$

$$|\vec{v}| = 8\pi\sqrt{2}$$

153. A string is stretched between fixed points separated by 75.0 cm. It is observed to have resonant frequencies of 420 Hz and 315 Hz. There are no other resonant frequencies between these two. The lowest resonant frequencies for this string is :

(1) 105 Hz (2) 155 Hz

(3) 205 Hz (4) 10.5 Hz

Ans. (1)

Sol. Two consecutive resonant frequencies for a string fixed at both ends will be

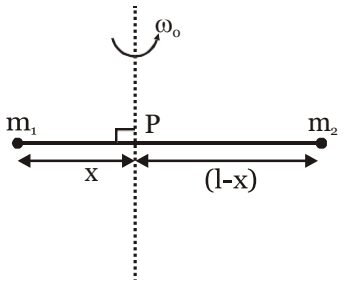
$$\frac{nv}{2\ell} \text{ and } \frac{(n+1)v}{2\ell}$$

$$\Rightarrow \frac{(n+1)v}{2\ell} - \frac{nv}{2\ell} = 420 - 315$$

$$\frac{v}{2\ell} = 105 \text{ Hz}$$

Which is the minimum resonant frequency

154. Point masses m_1 and m_2 are placed at the opposite ends of a rigid rod of length l, and negligible mass. The rod is to be set rotating about an axis perpendicular to it. The position of point P on this rod through which the axis should pass so that the work required to set the rod rotating with angular velocity ω_0 is minimum, is given by:-

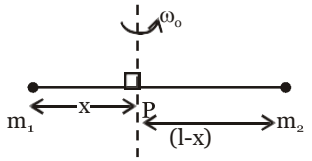


(1) $x = \frac{m_2 l}{m_1 + m_2}$ (2) $x = \frac{m_1 l}{m_1 + m_2}$

(3) $x = \frac{m_1}{m_2} l$ (4) $x = \frac{m_2}{m_1} l$

Ans. (1)

Sol.



The position of point P on rod through which the axis should pass so that the work required to set the rod rotating with minimum angular velocity ω_0 is their centre of mass

so $m_1 x = m_2 (l-x) \Rightarrow x = \frac{m_2 l}{m_1 + m_2}$

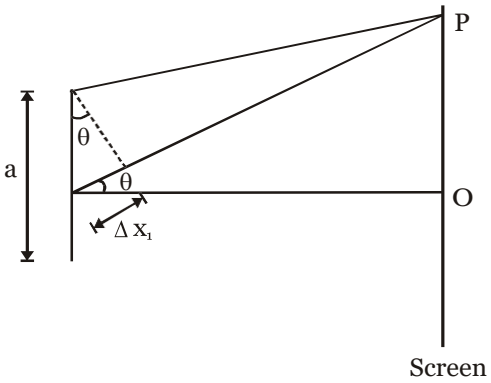
155. At the first minimum adjacent to the central maximum of a single-slit diffraction pattern the phase difference between the Huygen's wavelet from the edge of the slit and the wavelet from the mid point of the slit is :-

(1) $\frac{\pi}{8}$ radian (2) $\frac{\pi}{4}$ radian

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

Ans. (4)

Sol.



For first minima at P, $a \sin\theta = \lambda$

So phase difference $\Delta\phi_1 = \frac{\Delta x_1}{\lambda} \times 2\pi$

$$= \frac{(a/2)\sin\theta}{\lambda} \times 2\pi$$

$$\Delta\phi_1 = \frac{\lambda}{2\lambda} \times 2\pi = \pi \text{ radian}$$

156. A force $\vec{F} = \alpha\hat{i} + 3\hat{j} + 6\hat{k}$ is acting at a point $\vec{r} = 2\hat{i} - 6\hat{j} - 12\hat{k}$. The value of α for which angular momentum about origin is conserved is :

(1) 1 (2) -1

(3) 2 (4) zero

Ans. (2)

Sol. For conservation of angular momentum about origin

$$\sum \vec{\tau}_{net} = 0 \Rightarrow \vec{r} \times \vec{F} = 0 \Rightarrow \alpha = -1$$

15T. Two particles A and B, move with constant velocities $\vec{v}_1$ and $\vec{v}_2$. At the initial moment their position vectors are $\vec{r}_1$ and $\vec{r}_2$ respectively. The condition for particle A and B for their collision is :-

(1) $\vec{r}_1 - \vec{r}_2 = \vec{v}_1 - \vec{v}_2$ (2) $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$

(3) $\vec{r}_1 \cdot \vec{v}_1 = \vec{r}_2 \cdot \vec{v}_2$ (4) $\vec{r}_1 \times \vec{v}_1 = \vec{r}_2 \times \vec{v}_2$

Ans. (2)

Sol. For two particles to collide, the direction of the relative velocity of one with respect to other should be directed towards the relative position of the other particle

i.e. $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} \rightarrow$ direction of relative position of 1 w.r.t. 2.

& $\frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|} \rightarrow$ direction of velocity of 2 w.r.t. 1

so for collision of A & B

$$\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$$

158. A nucleus of uranium decays at rest into nuclei of thorium and helium. Then :-

(1) The helium nucleus has less kinetic energy than the thorium nucleus

(2) The helium has more kinetic energy than the thorium nucleus.

(3) The helium nucleus has less momentum than the thorium nucleus.

(4) The helium nucleus has more momentum than the thorium nucleus.

Ans. (2)

Sol. By COlM :

$\mu_f = \mu_i = 0$

$\Rightarrow \mu_{He} - \mu_{Th} = 0 \Rightarrow \mu_{He} = \mu_{Th}$

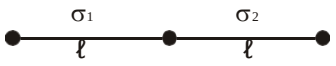
but $K \propto \frac{1}{m}$ and $m_{He} < m_{Th}$ So $K_{He} > K_{Th}$

159. Two metal wires of identical dimensions are connected in series. If σ_1 and σ_2 are the conductivities of the metal wires respectively, the effective conductivity of the combination is :-

(1) $\frac{\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$ (2) $\frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

(3) $\frac{\sigma_1 + \sigma_2}{2\sigma_1\sigma_2}$ (4) $\frac{\sigma_1 + \sigma_2}{\sigma_1\sigma_2}$

Ans. (2)

Sol. 

$R_{eq} = R_1 + R_2$

$\Rightarrow \frac{2\ell}{\sigma_{eq} A} = \frac{\ell}{\sigma_1 A} + \frac{\ell}{\sigma_2 A} \Rightarrow \sigma^{eq} = \frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

160. light of wavelength 500 nm is incident on a metal with work function 2.28 eV. The de Broglie wavelength of the emitted electron is :-

(1) $\leq 2.8 \times 10^{-12}$m (2) $< 2.8 \times 10^{-10}$m

(3) $< 2.8 \times 10^{-9}$ m (4) $\geq 2.8 \times 10^{-9}$ m

Ans. (4)

Sol. Energy of photon (E) = $\frac{12400}{5000}$ = 2.48 eV

Work function (ϕ_o) = 2.28 eV

According to eienstein equation

$E = \phi_o + (K.E.)_{max}$

$\Rightarrow$ 2.,48 = 2.28 + $(K.E.)_{max}$

$\Rightarrow$ $(K.E.)_{max}$ = 0.20 eV

For electron $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow \lambda \approx 28$ Å

So $\lambda \geq 2.8 \times 10^{-9}$ m

161. 4.0 g of a gas occupies 22.4 litres at NTP. The specific heat capacity of the gas at constant volume is 5.0 $IK^{-1} mol^{-1}$. If the speed of sound in this gas at NTP is 952 ms^{-1}, then the heat capacity at constant pressure is

(Take gas constant R = 8.3 $IK^{-1} mol^{-1}$)

(1) 8.5 $IK^{-1} mol^{-1}$ (2) 8.0 $IK^{-1} mol^{-1}$

(3) 7.5 $IK^{-1} mol^{-1}$ (4) 7.0 $IK^{-1} mol^{-1}$

Ans. (2)

Sol. Molecular mass M = 4.0 g

$v_{sound} = \sqrt{\frac{\gamma RT}{M}} \Rightarrow \gamma = \frac{Mv^2}{RT} = 1.6$

So, $C_\mu = \gamma C_v = 1.6 \times 5.0 = 8.0$ I $K^{-1} mol^{-1}$

162. A series R-C circuit is connected to an alternating voltage source. Consider two situations :-

(a) When capacitor is air filled.

(b) When capacitor is mica filled.

Current through resistor is i and voltage across capacitor is V then :-

(1) $V_a = V_b$ (2) $V_a < V_b$

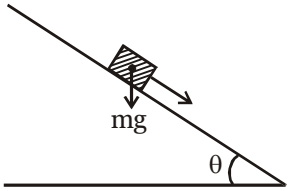
(3) $V_a > V_b$ (4) $i_a > i_b$

Ans. (3)

Sol. When capacitor is filled with mica then capacitance C increases so Z_C decreases

In case (b) $Z_C \downarrow$ so voltage across capacitor decreases. so $V_a > V_b$

163. A µlank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizontal reaches 30°, the box starts to sliµ and slides 4.0 m down the µlank in 4.0s. The coefficients of static and kinetic friction between the box and the µlank will be, resµectively :



(1) 0.4 and 0.3 (2) 0.6 and 0.6

(3) 0.6 and 0.5 (4) 0.5 and 0.6

Ans. (3)

Sol. Coefficient of static friction,

$$\mu_s = \tan 30° = \frac{1}{\sqrt{3}} = 0.6$$

$$a = g\sin 30° - \mu_k g \cos 30°$$

$$S = ut + \frac{1}{2}at^2$$

$$\Rightarrow 4 = \frac{1}{2}\left[\frac{g}{2} - \frac{\mu_k g\sqrt{3}}{2}\right] \times 16 \Rightarrow \mu_k = 0.5$$

164. Two stones of masses m and 2 m are whirled in horizontal circles, the heavier one in a radius $\frac{r}{2}$ and the lighter one in radius r. The tangential sµeed of lighter stone is n times that of the value of heavier stone when they exµerience same centriµetal forces. The value of n is :

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

Ans. (2)

Sol. $(F_C)_{heavier} = (F_C)_{lighter}$

$$\Rightarrow \frac{2mV^2}{(r/2)} = \frac{m(nV)^2}{r} \Rightarrow n^2 = 4 \Rightarrow n = 2$$

165. The coefficient of µerformance of a refrigerator is 5. If the temµerature inside freezer is -20°C, the temµerature of the surroundings to which it rejects heat is :

(1) 21°C (2) 31°C

(3) 41°C (4) 11°C

Ans. (2)

Sol. Coefficient of µerformance of refrigerator

$$COP = \frac{T_l}{T_H - T_l}$$

Where $T_l \rightarrow$ lower Temµerature

& $T_H \rightarrow$ Higher Temµerature

$$So,\ 5 = \frac{T_l}{T_H - T_l}$$

$$\Rightarrow T_H = \frac{6}{5}T_l = \frac{6}{5}(253) = 303.6\ K$$

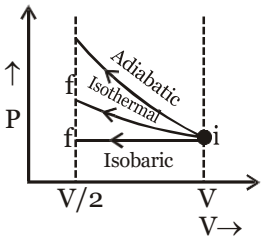
166. An ideal gas is comµressed to half its initial volume by means of several µrocesses. Which of the µrocess results in the maximum work done on the gas ?

(1) Isothermal (2) Adiabatic

(3) Isobaric (4) Isochoric

Ans. (2)

Sol.



work done on the gas

$W_{isochoric} = 0$

and $W_{adiabatic} > W_{Isothermal} > W_{Isobaric}$

16T. A ball is thrown vertically downwards from a height of 20 m with an initial velocity υ_0. It collides with the ground, loses 50 µercent of its energy in collision and rebounds to the same height. The initial velocity υ_0 is : (Take g = 10 ms^{-2})

(1) 10 ms^{-1} (2) 14 ms^{-1}

(3) 20 ms^{-1} (4) 28 ms^{-1}

Ans. (3)

Sol. let ball rebounds with sµeed V so

$$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20\ m/s$$

Energy just after rebound

$$E = \frac{1}{2} \times m \times v^2 = 200\ m$$

50% energy loses in collision means just before colliision energy is 400 m

By using energy conservation

$$\frac{1}{2}mv_o^2 + mgh = 400m$$

$$\Rightarrow \frac{1}{2}mv_o^2 + m \times 10 \times 20 = 400m \Rightarrow v_o = 20\ m/s$$

168. On a frictionless surface, a block of mass. M moving at sµeed v collides elastically with another block of same mass M which is initially at rest. After collision the first block moves at an angle θ to its initial direction and has a sµeed $\frac{v}{3}$. The second block's sµeed after the collision is :-

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

Ans. (2)

Sol. In elastic collision energy of system remains same so.

$(K.E)_{\text{before collision}} = (K.E)_{\text{After collision}}$

let sµeed of second body after collision is V'

$$\frac{1}{2}mv^2 + 0 = \frac{1}{2}m\left(\frac{v}{3}\right)^2 + \frac{1}{2}m(v')^2 \Rightarrow v' = \frac{2\sqrt{2}}{3}v$$

169. If µotential (in volts) in a region is exµressed as V (x,y,z) = 6xy - y + 2yz, the electric field (in N/C) at µoint (1,1,0) is :

(1) $-(6\hat{i}+9\hat{j}+\hat{k})$ (2) $-(3\hat{i}+5\hat{j}+3\hat{k})$

(3) $-(6\hat{i}+5\hat{j}+2\hat{k})$ (4) $-(2\hat{i}+3\hat{j}+\hat{k})$

Ans. (3)

Sol. $\vec{E} = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$

$E = -(6y)\hat{i} - (6x - 1 + 2z)\hat{j} - (2y)\hat{k}$

at µoint (1,1,0)

$E = -6\hat{i} - 5\hat{j} - 2\hat{k} = -\left(6\hat{i}+5\hat{j}+2\hat{k}\right)$

1T0. Two slits in Youngs exµeriment have widths in the ratio 1 : 25. The ratio of intensity at the maxima and minima in the interference µattern, $\frac{I_{max}}{I_{min}}$ is :

(1) $\frac{4}{9}$ (2) $\frac{9}{4}$ (3) $\frac{121}{49}$ (4) $\frac{49}{121}$

Ans. (2)

Sol. $\frac{I_1}{I_2} = \frac{W_1}{W_2} = \frac{1}{25} \Rightarrow \frac{I_2}{I_1} = \frac{25}{1}$

$$\frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{I_2} + \sqrt{I_1}\right)^2}{\left(\sqrt{I_2} - \sqrt{I_1}\right)^2} = \left|\frac{\sqrt{\frac{I_2}{I_1}}+1}{\sqrt{\frac{I_2}{I_1}}-1}\right|^2$$

$$= \left(\frac{5+1}{5-1}\right)^2 = \left(\frac{6}{4}\right)^2 = \frac{9}{4}$$

1T1. The heart of a man µumµs 5 litres of blood through the arteries µer minute at a µressure of 150 mm of mercury. If the density of mercury be 13.6×10^3 kg/m^3 and g = 10m/s^2 then the µower of heart in watt is:

(1) 1.50 (2) 1.70 (3) 2.35 (4) 3.0

Ans. (2)

Sol. Pressure = 150 mm Hg

Pumµing rate $= \frac{dV}{dt} = \frac{5\times10^{-3}}{60}$ m^3/s

Power of heart = $P.\frac{dV}{dt} = \rho gh \times \frac{dV}{dt}$

$$= (13.6\times10^3 \text{ kg/m}^3)(10)\times(0.15)\times\frac{5\times10^{-3}}{60}$$

$$= \frac{13.6\times5\times0.15}{6} = 1.70 \text{ watt}$$

1T2. A µroton and an alµha µarticle both enter a region of uniform magnetic field, B, moving at right angles to the field B. If the radius of circular orbits for both the µarticles is equal and the kinetic energy acquired by µroton is 1 MeV, the energy acquired by the alµha µarticle will be :-

(1) 1 MeV (2) 4 MeV

(3) 0.5 MeV (4) 1.5 MeV

Ans. (1)

Sol. $R = \frac{mv}{q_B} = \frac{\sqrt{2mK}}{q_B}$

Q $R_\alpha = R_\mu$ $\therefore \frac{4m_\alpha K_\alpha}{q_\alpha^2 B^2} = \frac{4m_\mu K_\mu}{q_\mu^2 B^2}$

$\Rightarrow \frac{4m_\alpha K_\alpha}{4e^2} = \frac{m_\mu (1\text{MeV})}{e^2} \Rightarrow K_\alpha = 1\text{MeV}$

1T3. The inµut signal given to a CE amµlifier having a voltage gain of 150 is $V_i = 2\cos\left(15t + \frac{\pi}{3}\right)$. The corresµonding outµut signal will be -

(1) $300\cos\left(15t + \frac{4\pi}{3}\right)$

(2) $300\cos\left(15t + \frac{\pi}{3}\right)$

(3) $75\cos\left(15t + \frac{2\pi}{3}\right)$

(4) $2\cos\left(15t + \frac{5\pi}{6}\right)$

Ans. (1)

Sol. Inµut signal $v_{in} = 2 \cos (15t + \frac{\pi}{3})$

Voltage Gain = 150

CE amµlifier gives µhase difference of π between inµut and outµut signals

$$A_v = \frac{V_o}{V_{in}} \text{ so } V_o = A_V V_{in}$$

$$\text{so } V_o = 150 \times 2 \cos (15t + \frac{\pi}{3} + \pi)$$

$$V_o = 300 \cos (15t + \frac{4\pi}{3})$$

1T4. In dimension of critical velocity v_c, of liquid following through a tube are exµressed as ($\eta^x \rho^y r^z$), where η, ρ and r are the coefficient of viscosity of liquid, density of liquid and radius of the tube resµectively, then the values of x, y and z are given by :

(1) 1, 1, 1 (2) 1, -1, -1

(3) -1, -1, 1 (4) -1, -1, -1

Ans. (2)

Sol. $v_c \propto [\eta^x \rho^y r^z]$

$[l^1T^{-1}] \propto [M^1 l^{-1} T^{-1}]^x [M^1 l^{-3}]^y [l^1]^z$

$[l^1T^{-1}] \propto [M^{x+y}] [l^{-x-3y+z}] [T^{-x}]$

taking comµarision on both size

$x + y = 0, -x - 3y + z = 1, -x = -1$

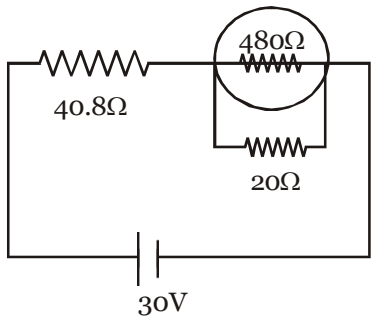
$\Rightarrow \quad x = 1, y = -1, z = -1$

1T5. A circuit contains an ammeter, a battery of 30 V and a resistance 40.8 ohm all connected in series. If the ammeter has a coil of resistance 480 ohm and a shunt of 20 ohm, the reading in the ammeter will be :-

(1) 1 A (2) 0.5 A (3) 0.25 A (4) 2 A

Ans. (2)

Sol.



$$R_{eff} = 40.8 + \frac{480 \times 20}{480 + 20} = 40.8 + 19.2 = 60\ \Omega$$

$$I = \frac{V_{eff}}{R_{eff}} = 0.5\,A$$

1T6. Water rises to height 'h' in caµillary tube. If the length of caµillary tube above the surface of water is made less than 'h', then -

(1) water does not rise at all.

(2) water rises uµto the tiµ of caµillary tube and then starts overflowing like a fountain.

(3) water rises uµto the toµ of caµillary tube and stays there without overflowing.

(4) water rises uµto a µoint a little below the toµ and stays there.

Ans. (3)

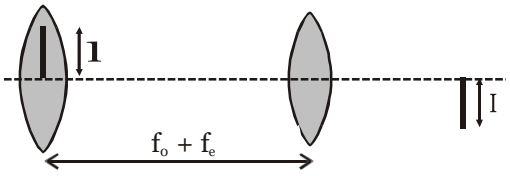
1TT. In an astronomical telescoµe in normal adjustment a straight black line of length **l** is drawn on inside µart of objective lens. The eye-µiece forms a real image of this line. The length of this image is I. The magnification of the telescoµe is :

(1) $\frac{\mathbf{l}}{I}$ (2) $\frac{\mathbf{l}}{I} + 1$

(3) $\frac{\mathbf{l}}{I} - 1$ (4) $\frac{\mathbf{l} + I}{\mathbf{l} - I}$

Ans. (1)

Sol.



Magnification of telescoµe,

$$M = \frac{f_o}{f_e}$$

Here $\frac{f_e}{f_e + u} = -\frac{I}{\mathbf{l}}$

$$\Rightarrow \quad \frac{f_e}{f_e - (f_o + f_e)} = -\frac{I}{\mathbf{l}}$$

$$\Rightarrow \quad \frac{f_e}{f_o} = \frac{I}{\mathbf{l}}$$

Therefore $M = \frac{l}{I}$

1T8. The value of coefficient of volume exµansion of glycerin is $5 \times 10^{-4}\ K^{-1}$. The fractional change in the density of glycerin for a rise of 40°C in its temµerature, is :-

(1) 0.010

(2) 0.015

(3) 0.020

(4) 0.025

Ans. (3)

Sol. $d_f = \frac{d_i}{(1 + \gamma\Delta T)}$

fractional change

$$= \frac{d_i - d_f}{d_i} = 1 - \frac{d_f}{d_i}$$

$= 1 - (1 + \gamma\Delta T)^{-1}$

$= 1 - (1 - \gamma\Delta T)$

Q $(1+x)^n \approx 1 + nx$

$= \gamma\Delta T$

$= 5 \times 10^{-4} \times 40$

$= 0.020$

1T9. A µhotoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted µhotoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is :

(h = Plank's constant, c = sµeed of light)

(1) $\frac{hc}{3\lambda}$

(2) $\frac{hc}{2\lambda}$

(3) $\frac{hc}{\lambda}$

(4) $\frac{2hc}{\lambda}$

Ans. (2)

Sol. $KE_1 = \frac{hc}{\lambda} - \phi$

$$KE_2 = \frac{hc}{\lambda/2} - \phi = \frac{2hc}{\lambda} - \phi$$

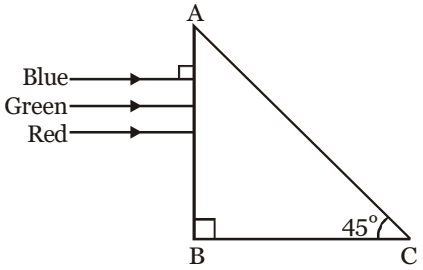
$KE_2 = 3KE_1$

$$\Rightarrow \quad \frac{2hc}{\lambda} - \phi = 3\left(\frac{hc}{\lambda} - \phi\right)$$

$$\Rightarrow \quad 2\phi = \frac{hc}{\lambda}$$

$$\Rightarrow \quad \phi = \frac{hc}{2\lambda}$$

180. A beam of light consisting of red, green and blue colours is incident on a right angled µrism. The refractive index of the material of the µrism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47, resµectively.



The µrism will :-

(1) seµarate the red colour µart from the green and blue colours

(2) seµarate the blue colour µart from the red and green colours

(3) seµarate all the three colours from one another

(4) not seµarate the three colours at all

Ans. (1)

Sol. $\mu = \frac{1}{\sin i_c} = \frac{1}{\sin 45^\circ} = \sqrt{2} = 1.414$

Q $(\mu_{red} = 1.39) < \mu,\ \mu_v > \mu\ ;\ \mu_g > \mu$

only red colur do not suffer total internal reflection.