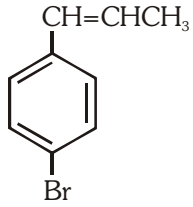
AIPMT – 2015 TEST PAPER WITH SOLUTIONS
(HELD ON SUNDAY 03th MAY, 2015)

1. The reaction of $C_6H_5CH = CHCH_3$ with HBr produces:-

(1) $C_6H_5CH_2\underset{\underset{Br}{|}}{C}HCH_3$ (2) $C_6H_5CH_2CH_2CH_2Br$

(3)  (4) $C_6H_5\underset{\underset{Br}{|}}{C}HCH_2CH_3$

Ans. (4)

Sol. $C_6H_5-CH=CH-CH_3 + HBr \rightarrow C_6H_5-\overset{\oplus}{C}H-CH_2-CH_3 \xrightarrow{Br^{\ominus}} C_6H_5-\underset{\underset{Br}{|}}{C}H-CH_2-CH_3$

2. In Duma's method for estimation of nitrogen, 0.25 g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is :-

(1) 18.20 (2) 16.76 (3) 15.76 (4) 17.36

Ans. (2)

Sol. Volume of nitrogen collected at 300 K and 725 mm pressure is 40 mL actual pressure
= 725 – 25 = 700 mm

Volume of nitrogen at STP

$$= \frac{273 \times 700 \times 40}{300 \times 760} = 33.52mL$$

22,400 mL of N_2 at STP weight = 28 g

33.5 mL of nitrogen weight = $\frac{28 \times 33.52}{22400}$ g

Percentage of nitrogen

$$= \frac{28 \times 33.52 \times 100}{22400 \times 0.25} = 16.76\%$$

3. The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are respectively, 1.1×10^{-12}, 1.8×10^{-10}, 5.0×10^{-13}, 8.3×10^{-17}. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, NaI and Na_2CrO_4 ?

(1) AgCl (2) AgBr (3) Ag_2CrO_4 (4) AgI

Ans. (3)

Sol. $Ag_2CrO_4 \rightarrow K_{sp} = [Ag^+]^2[CrO_4^{-2}]$

$$\Rightarrow [Ag^+] = \sqrt{\frac{K_{sp}}{[CrO_4^{-2}]}} = \sqrt{\frac{1.1 \times 10^{-12}}{[CrO_4^{-2}]}} = max^m$$

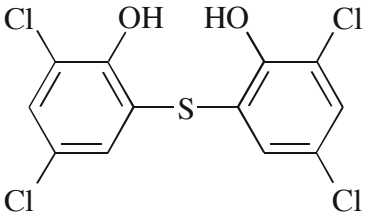
so answer is Ag_2CrO_4

4. Bithional is generally added to the soaps as an additive to function as a/an :-

(1) Dryer (2) Buffering agent
(3) Antiseptic (4) Softner

Ans. (3)

Sol. Bithionol (the compound is also called bithional) is added to soaps to impart antiseptic properties



Bithionol

5. "Metals are usually not found as nitrates in their ores".

Out of the following two (a and b) reasons which is/are true for the above observation ?

(a) Metal nitrates are highly unstable.

(b) Metal nitrates are highly soluble in water.

(1) a and b are false

(2) a is false but b is true

(3) a is true but b is false

(4) a and b are true

Ans. (2)

Sol. Metal nitrates are stable like $NaNO_3$ and KNO_3 and highly soluble in water.

6. The correct bond order in the following species is:-

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

(3) $O_2^- < O_2^+ < O_2^{2+}$ (4) $O_2^{2+} < O_2^+ < O_2^-$

Ans. (3)

Sol. According to molecular orbital theory (MOT)

	O_2^-	O_2^+	O_2^{+2}
No. of e^-	17	15	14
Bond order	1.5	2.5	3.0

7. The species Ar, K^+ and Ca^{2+} contain the same number of electrons. In which order do their radii increase ?

(1) $Ca^{2+} < Ar < K^+$ (2) $Ca^{2+} < K^+ < Ar$

(3) $K^+ < Ar < Ca^{2+}$ (4) $Ar < K^+ < Ca^{2+}$

Ans. (2)

Sol. In isoelectronic species

Atomic radius $\propto \frac{1}{Z_{eff}}$

hence increasing order of radius is $Ca^{+2} < K^+ < Ar$

8. The activation energy of a reaction can be determined from the slope of which of the following graphs ?

(1) $\frac{\ln K}{T}$ vs.T (2) ln K vs. $\frac{1}{T}$

(3) $\frac{T}{\ln K}$ vs. $\frac{1}{T}$ (4) ln K vs. T

Ans. (2)

Sol. Arrhenius equation

$$K = A.e^{-Ea/RT} \Rightarrow \ell nK = \ell nA - \frac{Ea}{RT}$$

so, activation energy of reaction can be determined from the slope of ℓnK vs $\frac{1}{T}$

9. Which of the following pairs of ions are isoelectronic and isostructural ?

(1) ClO_3^-, CO_3^{2-} (2) SO_3^{2-}, NO_3^-

(3) ClO_3^-, SO_3^{2-} (4) CO_3^{2-}, SO_3^{2-}

Ans. (3)

Sol.

	ClO_3^-	SO_3^{-2}
No. of e^-	42	42
hybridisation	sp^3	sp^3

both are having one lone pair on central atom hence they are pyramidal.

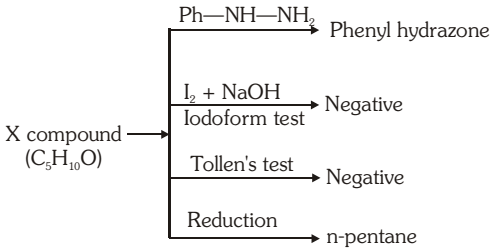
10. An organic compound 'X' having molecular formula $C_5H_{10}O$ yields phenyl hydrazone and gives negative response to the Iodoform test and Tollen's test. It produces n-pentane on reduction. 'X' could be :-

(1) 2-pentanone (2) 3-pentanone

(3) n-amyl alcohol (4) pentanal

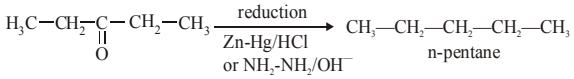
Ans. (2)

Sol.



According to questions $CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$

does not give iodoform as well as Tollen's test



11. Which of the following options represents the correct bond order ?

(1) $O_2^- < O_2 < O_2^+$

(2) $O_2^- > O_2 < O_2^+$

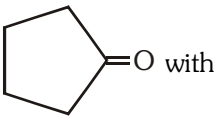
(3) $O_2^- < O_2 > O_2^+$

(4) $O_2^- > O_2 > O_2^+$

Ans. (1)

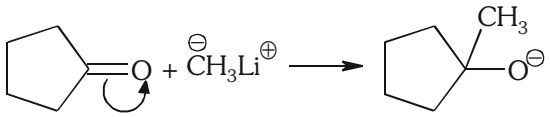
Sol. According to molecular orbital theory (MOT)

	O_2^-	O_2	O_2^+
No. of e^-	17	16	15
Bond order	1.5	2	2.5

12. Treatment of cyclopentanone  with methyl lithium gives which of the following species?

(1) Cyclopentanonyl cation
(2) Cyclopentanonyl radical
(3) Cyclopentanonyl biradical
(4) Cyclopentanonyl anion

Ans. (4)

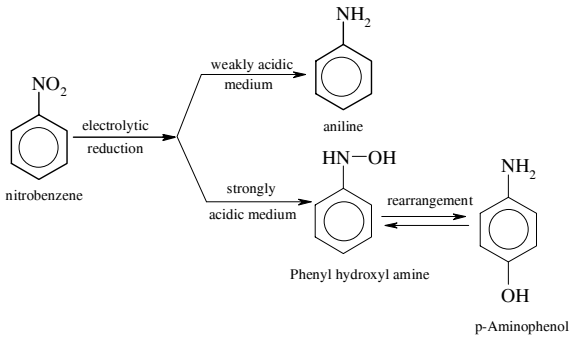
Sol. 

cyclopentanonyl anion

13. The electrolytic reduction of nitrobenzene in strongly acidic medium produces :-

(1) Azoxybenzene (2) Azobenzene
(3) Aniline (4) p-Aminophenol

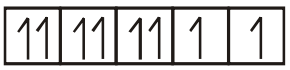
Ans. (4)

Sol. 

14. Magnetic moment 2.84 B.M. is given by :-
(At. nos, Ni = 28, Ti = 22, Cr = 24, Co = 27)

(1) Ti^{3+} (2) Cr^{2+} (3) Co^{2+} (4) Ni^{2+}

Ans. (4)

Sol. $Ni^{+2} = 3d^8$ 

number of unpaired electrons (n) =2

$\because \ \mu = \sqrt{n(n+2)}$

hence μ = 2.8 B.M., paramagnetic

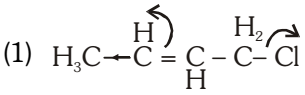
15. A given metal crystallizes out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom?

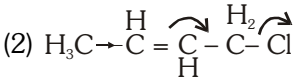
(1) 127 pm (2) 80 pm
(3) 108 pm (4) 40 pm

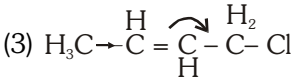
Ans. (1)

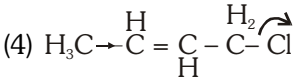
Sol. FCC : $r = \frac{a}{2\sqrt{2}} = \frac{361}{2\times 1.4141} = 127\text{pm}$

16. Which of the following is the most **correct** electron displacement for a nucleophilic reaction to take place?

(1) 

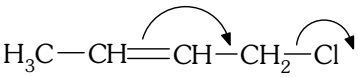
(2) 

(3) 

(4) 

Ans. (2)

Sol. After leaving Cl^-, due to resonance, π bond is also transferred



17. Which one of the following electrolytes has the same value of van't Hoff's factor (i) as that of the $Al_2(SO_4)_3$ (if all are 100% ionised) ?

(1) $K_3[Fe(CN)_6]$ (2) $Al(NO_3)_3$
(3) $K_4[Fe(CN)_6]$ (4) K_2SO_4

Ans. (3)

Sol. van't Hoff factor of

$Al_2(SO_4)_3 \rightarrow 2Al^{+3} + 3SO_4^{-2}$

so n = 5

$K_4[Fe(CN)_6] \rightarrow 4K^+ + [Fe(CN)_6]^{-4}$

so n =5 $\Rightarrow$ i = n =5

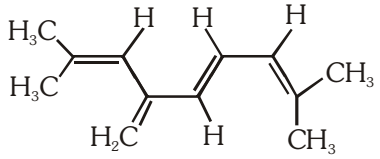
18. Nitrogen dioxide and sulphur dioxide have some properties in common. Which property is shown by one of these compounds, but not by the other ?

(1) is a reducing agent
(2) is soluble in water
(3) is used as a food-preservative
(4) forms 'acid-rain'

Ans. (3)

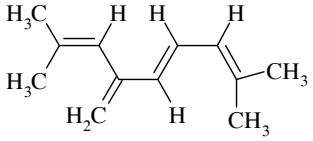
Sol. NO_2 is not used as food preservative.

19. The total number of π-bond electrons in the following structure is :-



(1) 8 (2) 12 (3) 16 (4) 4

Ans. (1)

Sol. 

Total π bonds = 4

Total π electrons = 8

20. Solubility of the alkaline earth's metal sulphates in water decreases in the sequence :-

(1) Ca > Sr > Ba > Mg (2) Sr > Ca > Mg > Ba

(3) Ba > Mg > Sr > Ca (4) Mg > Ca > Sr > Ba

Ans. (4)

Sol. Due to very small size of Mg^{+2}, Mg^{+2} shows maximum hydration energy.

$MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

Hydration energy ↓ Solubility ↓

21. Maximum bond angle at nitrogen is present in which of the following ?

(1) NO_2^- (2) NO_2^+

(3) NO_3^- (4) NO_2

Ans. (2)

Sol. NO_2^+ : sp hybridisation (bond angle = 180°)

$NO_2^- < NO_3^- < NO_2 < NO_2^+$

bond angle ↑

22. If the value of an equilibrium constant for a particular reaction is 1.6×10^{12}, then at equilibrium the system will contain :-

(1) mostly reactants

(2) mostly products

(3) similar amounts of reactants products

(4) all reactants

Ans. (2)

Sol. The value of equilibrium constant for reaction

$K = 1.6 \times 10^{12}$

The value of K is very high so the system will contain mostly products at equilibrium.

23. The number of d-electrons in Fe^{2+} (Z = 26) is not equal to the number of electrons in which one of the following?

(1) p-electrons in Cl (Z = 17)

(2) d-electrons in Fe (Z = 26)

(3) p-electrons in Ne (Z = 10)

(4) s-electrons in Mg (Z = 12)

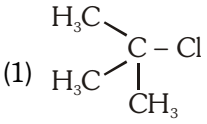
Ans. (1)

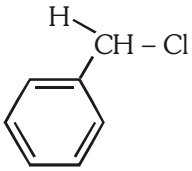
Sol. $Fe^{+2} = 3d^6$ (number of 'd' electrons = 6)

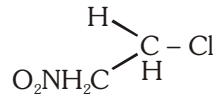
in Cl = $1s^2\ 2s^2\ 2p^6\ 2s^2\ 3p^5$

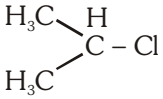
total p electrons = 11, which are not equal to number of 'd' electrons in Fe^{+2}

24. In which of the following compounds, then C - Cl bond ionisation shall give most stable carbonium ion?

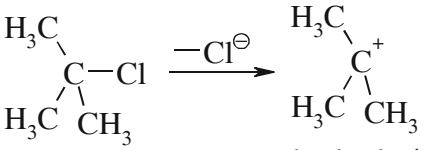
(1) 

(2) 

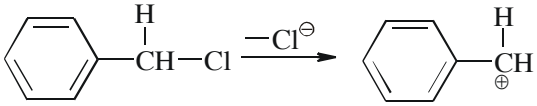
(3) 

(4) 

Ans. (2)

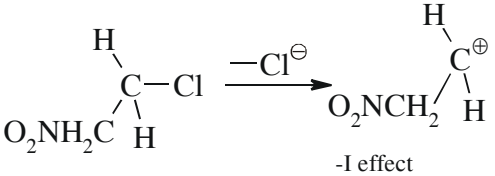
Sol. 

t-butyl carbonium ion

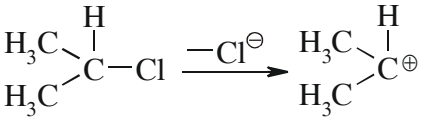


benzyl carbonium ion

[stable due to resonance]



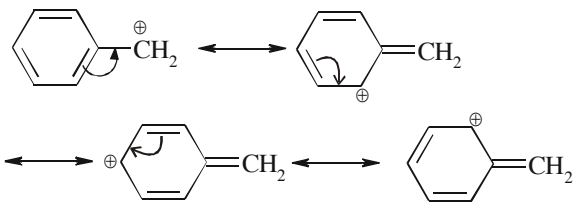
-I effect



Secondary carbonium ion

[isopropyl carbonium ion]

Most stable carbonium ion is benzyl carbocation due to resonance



25. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as :-

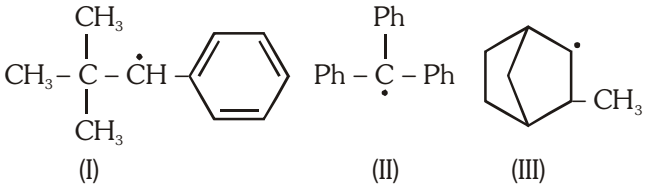
(1) Electrolytic cell (2) Dynamo

(3) Ni-Cd cell (4) Fuel Cell

Ans. (4)

Sol. A device that converts energy of combustion of fuels, directly into electrical energy is known as fuel cell.

26. Consider the following compounds



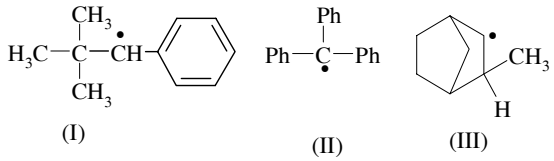
(I) (II) (III)

Hyperconjugation occurs In :-

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

Ans. (2)

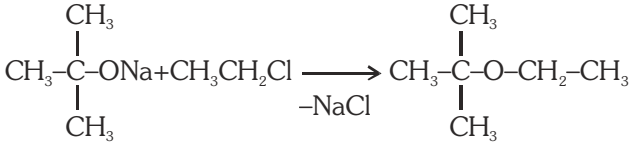
Sol.



(I) (II) (III)

Only (III) has H in conjugation with free radical

27. The reaction



is called :-

(1) Williamson continuous etherification process

(2) Etard reaction

(3) Gatterman - Koch reaction

(4) Williamson Synthesis

Ans. (4)

Sol. Given reaction is an important laboratory method for the preparation of symmetrical and unsymmetrical ethers. In this method, an alkyl halide is allowed to react with sodium alkoxide.

28. Cobalt (III) chloride forms several octahedral complexes with ammonia. Which of the following will not give test of chloride ions with silver nitrate at 25°C ?

(1) $CoCl_3 \cdot 4NH_3$ (2) $CoCl_3 \cdot 5NH_3$

(3) $CoCl_3 \cdot 6NH_3$ (4) $CoCl_3 \cdot 3NH_3$

Ans. (4)

Sol. $CoCl_3.3NH_3 \Rightarrow \left[Co(NH_3)_3Cl_3\right]$

$\left[Co(NH_3)_3Cl_3\right] \xrightarrow{AgNO_3}$ no ppt

29. A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture ?

(1) 4 : 1 (2) 16 : 1 (3) 2 : 1 (4) 1 : 4

Ans. (1)

Sol. $\frac{w_{H_2}}{w_{O_2}} = \frac{1}{4} \Rightarrow \frac{n_{H_2}}{n_{O_2}} = \frac{1/2}{4/32} = \frac{4}{1}$

30. Which of the following processes does not involve oxidation of iron ?

(1) Decolourization of blue $CuSO_4$ solutution by iron

(2) Formation of $Fe(CO)_5$ from Fe

(3) Liberation of H_2 from steam by iron at high temperature

(4) Rusting of iron sheets

Ans. (2)

Sol. $Fe^0 + 5CO \rightarrow \left[Fe^0(CO)_5\right]$

No change in the oxidation state of iron

31. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Nubmers in the parenthesis are atomic numbers).

(1) Zr (40) and Nb (41) (2) Zr (40) and Hf (72)

(3) Zr (40) and Ta (73) (4) Ti (22) and Zr (40)

Ans. (2)

Sol. Due to lanthanoid contraction
atomic radii of Zr and Hf is almost similar.

32. Which of the following statements is **correct** for a reversible process in a state of equilibrium ?

(1) $\Delta G = 2.30\ RT \log K$

(2) $\Delta G^\circ = -2.30\ RT \log K$

(3) $\Delta G^\circ = 2.30\ RT \log K$

(4) $\Delta G = -2.30\ RT \log K$

Ans. (2)

Sol. $\Delta G^0 = -2.30RT\log K$

because at equilibrium $\Delta G = 0$

33. The angular momentum of electron in 'd' orbital is equal to :-

(1) $\sqrt{2}\,\hbar$ (2) $2\sqrt{3}\,\hbar$ (3) $0\ \hbar$ (4) $\sqrt{6}\,\hbar$

Ans. (4)

Sol. Orbital angular momentum = $\sqrt{\ell(\ell+1)}.\hbar$

for d-orbital $\ell=2$

so orbital angular momentum = $\sqrt{2(2+1)}\hbar = \sqrt{6}\hbar$

34. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is **true** in this case ?

(1) Molecular mass of X is greater than the molecular mass of Y.

(2) Molecular mass of X is less than the molecular mass of Y.

(3) Y is undergoing dissociation in water while X undergoes no change.

(4) X is undergoing dissociation is water.

Ans. (4)

Sol. $(\Delta T_b)_x > (\Delta T_b)_y$

same solvent so, K_b is same

m is same (given)

$i_x \cdot k_b \cdot m > i_y \cdot k_b \cdot m \Rightarrow i_x > i_y$

so, x is undergoing dissociation in water.

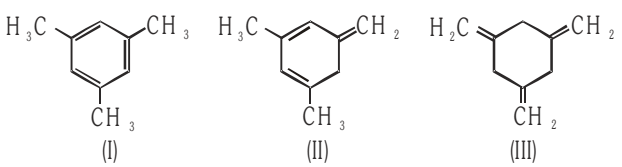
35. The function of "Sodium pump" is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a consituent of this pump :-

(1) Mg^{2+} (2) K^+ (3) Fe^{2+} (4) Ca^{2+}

Ans. (2)

Sol. K^+ ion is a constituent of sodium pump

36. Given :-



(I) (II) (III)

The enthalpy of the hydrogenation of these compounds will be in the order as :-

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

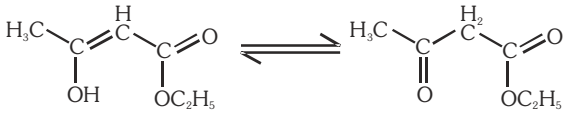
(3) II > I > III (4) I > II > III

Ans. (1)

Sol. $R{-}CH{=}CH{-}R + H_2$ (1 mole) $\longrightarrow$ $R{-}CH_2{-}CH_2{-}R + \Delta H$

enthalpy of hydrogenation $\propto \dfrac{1}{\text{stability of alkene}}$

37. The enolic form of ethyl acetoacetate as below has:-



(1) 16 sigma bonds and 1 pi - bond

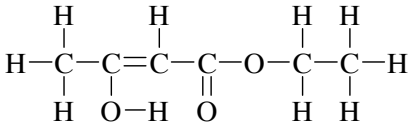
(2) 9 sigma bonds and 2 pi - bonds

(3) 9 sigma bonds and 1 pi - bond

(4) 18 sigma bonds and 2 pi - bonds

Ans. (4)

Sol.



18 σ + 2π

38. Biodegradable polymer which can be produced from glycine and aminocaproic acid is :-

(1) PHBV

(2) Buna - N

(3) Nylon 6, 6

(4) Nylon 2- nylon 6

Ans. (4)

Sol. Nylon 2-Nylon-6 is an alternating polyamide copolymer of glycine (NH_2–CH_2–COOH) and amino caproic acid [NH_2–$(CH_2)_5$COOH] and is biodegradable.

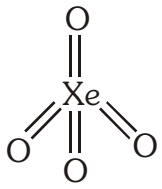
39. Which of the following species contains equal number of σ- and π- bonds :-

(1) XeO_4 (2) $(CN)_2$

(3) $CH_2(CN)_2$ (4) HCO_3^-

Ans. (1)

Sol.



number of σ bonds = 4
number of π bonds = 4

40. Which of these statements about $[Co(CN)_6]^{3-}$ is true:-

(1) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a low-spin configuration.

(2) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a high spin configuration.

(3) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will be in a high-spin configurtion.

(4) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will be in a low-spin configuration.

Ans. (4)

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

$Co^{+3} = 3d^6\ 4s^0\ 4p^0$

$\because$ in presence of strong field ligand, pairing of electrons occurs so in this complex no unpaired electron is present and it is low spin complex.

41. Which one is **not** equal to zero for an ideal solution:-

(1) ΔS_{mix} (2) ΔV_{mix}

(3) $\Delta P = P_{observed} - P_{Raoult}$ (4) ΔH_{mix}

Ans. (1)

Sol. For an ideal solution $\Delta S_{mix} > 0$

42. Which property of colloidal solution is independent of charge on the colloidal particles :-

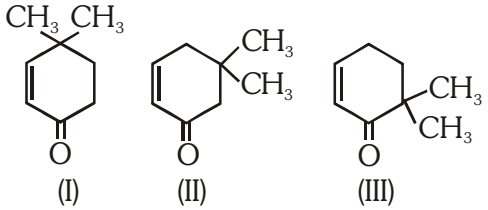
(1) Electrophoresis (2) Electro-osmosis

(3) Tyndall effect (4) Coagulation

Ans. (3)

Sol. Tyndall effect is an optical property, so it is independent of charge.

43. Given :-



(I) (II) (III)

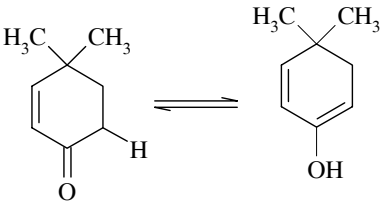
Which of the given compounds can exhibit tautomerism?

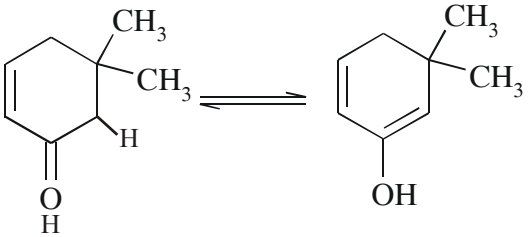
(1) I and III (2) II and III

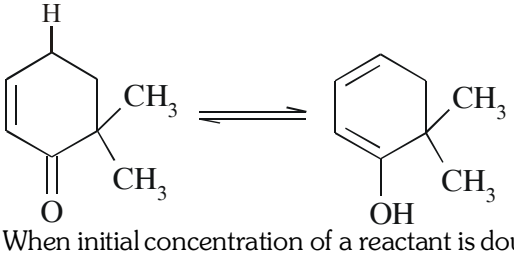
(3) I, II and III (4) I and II

Ans. (3)

Sol.







44. When initial concentration of a reactant is doubled in a reaction, its half-life period is not affected. The order of the reaction is :-

(1) First

(2) Second

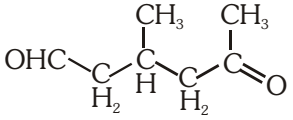
(3) More than zero but less than first

(4) Zero

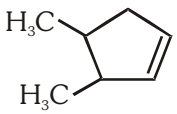
Ans. (1)

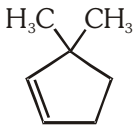
Sol. $t_{1/2} = \dfrac{0.693}{K}$ for first order $t_{1/2}$ is independent of concentration

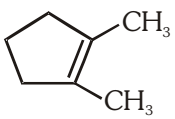
45. A single compound of the structure :-

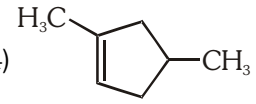


is obtainable from ozonolysis of which of the following cyclic compounds ?

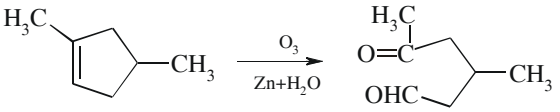
(1) 

(2) 

(3) 

(4) 

Ans. (4)

Sol. 

46. Which of the following endoparasites of humans does show viviparity ?
(1) *Enterobius vermicularis*
(2) *Trichinella spiralis*
(3) *Ascaris lumbricoides*
(4) *Ancylostoma duodenale*

Ans. (2)

47. Cryopreservation of gametes of threatened species in viable and fertile condition can be referred to as:-
(1) Advanced ex-situ conservation of biodiversity
(2) In situ conservation by sacred groves
(3) In situ cryo-conservation of biodiversity
(4) In situ conservation of biodiversity

Ans. (1)

48. Which one one of the following matches is **correct** ?

(1)	*Alternaria*	Sexual reproduction absent	Deuteromycetes
(2)	*Mucor*	Reproduction by Conjugation	Ascomycetes
(3)	*Agaricus*	Parasitic fungus	Basidiomycetes
(4)	*Phytophthora*	Aseptate mycelium	Basidiomycetes

Ans. (1)

49. Minerals known to be required in large amounts for plant growth include :-
(1) calcium, magnesium, manganese, copper
(2) potassium, phosphorus, selenium, boron
(3) magnesium, sulphur, iron, zinc
(4) phosphorus, potassium, sulphur, calcium

Ans. (4)

50. Which of the following enhances or induces fusion of protoplasts ?
(1) Polyethylene glycol and sodium nitrate
(2) IAA and kinetin
(3) IAA and gibberellins
(4) Sodium chloride and potassium chloride

Ans. (1)

51. Which of these is **not** an important component of initiation of parturition in humans ?
(1) Synthesis of prostaglandins
(2) Release of oxytocin
(3) Release of prolactin
(4) Increase in estrogen and progesterone ratio

Ans. (3)

52. In which of the following gametophyte is **not** independent free living ?
(1) *Marchantia* (2) *Pteris*
(3) *Pinus* (4) *Funaria*

Ans. (3)

53. Which of the following is **not** a sexually transmitted disease ?
(1) Acquired Immuno Deficiency Syndrome (AIDS)
(2) Trichomoniasis
(3) Encephalitis
(4) Syphilis

Ans. (3)

54. Leaves become modified into spines in :-
(1) Pea (2) Onion
(3) Silk Cotton (4) *Opuntia*

Ans. (4)

55. Which one gives the most valid and recent explanation for stomatal movements ?
(1) Potassium influx and efflux
(2) Starch hydrolysis
(3) Guard cell photosynthesis
(4) Transpiration

Ans. (1)

56. Which of the following had the smallest brain capacity ?
(1) *Homo sapiens*
(2) *Homo neanderthalensis*
(3) *Homo habilis*
(4) *Homo erectus*

Ans. (3)

57. High value of BOD (Biochemical Oxygen Demand) indicates that :-
(1) Water is highly polluted
(2) Water is less polluted
(3) Consumption of organic matter in the water is higher by the microbes
(4) Water is pure

Ans. (1)

58. Sliding filament theory can be best explained as :-
(1) Actin and Myosin filaments shorten and slide pass each other
(2) Actin and Myosin filaments do not shorten but rather slide pass each other
(3) When myofilaments slide pass each other, Myosin filaments shorten while Actin filaments do not shorten
(4) When myofilaments slide pass each other Actin filaments shorten while Myosin filament do not shorten

Ans. (2)

59. A gymnast is able to balance his body upside down even in the total darkness because of :-
(1) Vestibular apparatus (2) Tectorial membrane
(3) Organ of corti (4) Cochlea

Ans. (1)

60. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offsprings ?
(1) A,B and AB only (2) A,B,AB and O
(3) O only (4) A and B only

Ans. (2)

61. Typical growth curve in plants is :-
(1) Linear (2) Stair-steps shaped
(3) Parabolic (4) Sigmoid

Ans. (4)

62. The UN Conference of Parties on climate change in the year 2011 was held in :-
(1) South Africa (2) Peru
(3) Qatar (4) Poland

Ans. (1)

63. A technique of micropropagation is :-
(1) Somatic embryogenesis
(2) Protoplast fusion
(3) Embryo rescue
(4) Somatic hybridization

Ans. (1)

64. How many pairs of contrasting characters in pea plants were studied by Mendel in his experiments ?
(1) Six (2) Eight (3) Seven (4) Five

Ans. (3)

65. $\oplus \, ♀ \, K_{(5)} \overset{\frown}{C}_{(5)} A_5 \, G_{(2)}$ is the floral formula of :-
(1) *Sesbania* (2) *Petunia*
(3) *Brassica* (4) *Allium*

Ans. (2)

66. The crops engineered for glyphosate are resistant/ tolerant to :-
(1) Bacteria (2) Insects
(3) Herbicides (4) Fungi

Ans. (3)

67. Which of the following statements is **not correct**?
(1) Goblet cells are present in the mucosa of intestine and secrete mucus
(2) Oxyntic cells are present in the mucosa of stomach and secrete HCl.
(3) Acini are present in the pancreas and secrete carboxypeptidase
(4) Brunner's glands are present in the submucosa of stomach and secrete pepsinogen

Ans. (4)

68. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are :-
(1) G 17%, A 16.5%, T 32.5%
(2) G 17%, A 33%, T 33%
(3) G 8.5%, A 50%, T 24.5%
(4) G 34%, A 24.5%, T 24.5%

Ans. (2)

69. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to :-
(1) Acidic pH of the insect gut
(2) Action of gut micro-organisms
(3) Presence of conversion factors in insect gut
(4) Alkaline pH of the insect gut

Ans. (4)

70. Cytochromes are found in :-
(1) Outer wall of mitochondria
(2) Cristae of mitochondria
(3) Lysosomes
(4) Matrix of mitochondria

Ans. (2)

71. Read the following five statements (A to E) and select the option with **all correct** statements :-
(A) Mosses and Lichens are the first organisms to colonise a bare rock.
(B) *Selaginella* is a homosporous pteridophyte
(C) Coralloid roots in *Cycas* have VAM
(D) Main plant body in bryophytes is gametophytic, whereas in pteridophytes it is sporophytic
(E) In gymnosperms, male and female gametophytes are present within sporangia located on sporophyte
(1) (B), (C) and (D) (2) (A), (D) and (E)
(3) (B), (C) and (E) (4) (A), (C) and (D)

Ans. (2)

72. Which one of the following is **correct** ?
(1) Serum = Blood + Fibrinogen
(2) Lymph = Plasma + RBC + WBC
(3) Blood = Plasma + RBC + WBC
(4) Plasma = Blood – Lymphocytes
Ans. (3)

73. The movement of a gene from one linkage group to another is called :-
(1) Duplication (2) Translocation
(3) Crossing over (4) Inversion
Ans. (2)

74. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services ?
(1) Indian Council of Agricultural Research
(2) Genetic Engineering Approval Committee
(3) Research Committee on Genetic Manipulation
(4) Bio-safety committee
Ans. (2)

75. Rachel Carson's famous book "Silent Spring" is related to :-
(1) Noise pollution
(2) Population explosion
(3) Ecosystem management
(4) Pesticide pollution
Ans. (4)

76. Gastric juice of infants contains :-
(1) nuclease, pepsinogen, lipase
(2) pepsinogen, lipase, rennin
(3) amylase, rennin, pepsinogen
(4) maltase, pepsinogen, rennin
Ans. (2)

77. Which of the following is **not** one of the prime health risks associated with greater UV radiation through the atmosphere due to depletion of stratospheric ozone ?
(1) Reduced Immune System
(2) Damage to eyes
(3) Increased liver cancer
(4) Increased skin cancer
Ans. (3)

78. Capacitation refers to changes in the :-
(1) Ovum before fertilization
(2) Ovum after fertilization
(3) Sperm after fertilization
(4) Sperm before fertilization
Ans. (4)

79. Most animals are tree dwellers in a:-
(1) Thorn woodland
(2) Temperate deciduous forest
(3) Tropical rain forest
(4) Coniferous forest
Ans. (3)

80. True nucleus is absent in :-
(1) *Mucor* (2) *Vaucheria*
(3) *Volvox* (4) *Anabaena*
Ans. (4)

81. Glenoid cavity articulates :-
(1) Scapula with acromion
(2) Clavicle with scapula
(3) Humerus with scapula
(4) Clavicle with acromion
Ans. (3)

82. Transmission tissue is characteristic feature of :-
(1) Solid style (2) Dry stigma
(3) Wet stigma (4) Hollow style
Ans. (1)

83. DNA is **not** present in :-
(1) Ribosomes (2) Nucleus
(3) Mitochondria (4) Chloroplast
Ans. (1)

84. Gene regulation governing lactose operon of *E.coli* that involves the lac I gene product is :
(1) Negative and inducible because repressor protein prevents transcription
(2) Negative and repressible because repressor protein prevents transcription
(3) Feedback inhibition because excess of β-galactosidase can switch off trascription
(4) Positive and inducible because it can be induced by lactose
Ans. (1)

85. Which of the following does **not** favour the formation of large quantities of dilute urine ?
(1) Caffeine (2) Renin
(3) Atrial-natriuretic factor (4) Alcohol
Ans. (2)

86. What causes a green plant exposed to the light on only one side, to bend toward the source of light as it grows ?
(1) Green plants seek light because they are phototropic
(2) Light stimulates plant cells on the lighted side to grow faster
(3) Auxin accumulates on the shaded side, stimulating greater cell elongation there.
(4) Green plants need light to perform photosynthesis
Ans. (3)

87. Nuclear envelope is a derivative of :-
(1) Membrane of Golgi complex
(2) Microtubules
(3) Rough endoplasmic reticulum
(4) Smooth endoplasmic reticulum

Ans. (3)

88. Select the **correct** option :-

	I		II
(a)	Synapsis aligns homologous chromosomes	(i)	Anaphase-II
(b)	Synthesis of RNA and protein	(ii)	Zygotene
(c)	Action of enzyme recombinase	(iii)	G_2-phase
(d)	Centromeres do not separate but chromatids move towards opposite poles	(iv)	Anaphase-I
		(v)	Pachytene

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

Ans. (1)

89. Keel is the characteristic feature of flower of :-
(1) *Indigofera* (2) *Aloe* (3) Tomato (4) Tulip

Ans. (1)

90. Perigynous flowers are found in :-
(1) Cucumber (2) China rose
(3) Rose (4) Guava

Ans. (3)

91. A chemical signal that has both endocrine and neural roles is ?
(1) Calcitonin (2) Epinephrine
(3) Cortisol (4) Melatonin

Ans. (2)

92. In which of the following both pairs have **correct** combination :-
(1) *In situ* conservation : Cryopreservation
Ex situ conservation : Wildlife Sanctuary
(2) *In situ* conservation : Seed Bank
Ex situ conservation : National Park
(3) *In situ* conservation : Tissue culture
Ex situ conservation : Sacred groves
(4) *In situ* conservation : National Park
Ex situ conservation : Botanical Garden

Ans. (4)

93. HIV that causes AIDS, first starts destroying:
(1) Leucocytes
(2) Helper T- Lymphocytes
(3) Thrombocytes
(4) B- Lymphocytes

Ans. (2)

94. Hysteresctomy is surgical removal of :
(1) Prostate gland
(2) Vas-deference
(3) Mammary glands
(4) Uterus

Ans. (4)

95. Removal of proximal convoluted tubule from the nephron will result in:
(1) More concentrated urine
(2) No change in quality and quantity of urine
(3) No urine formation
(4) More diluted urine

Ans. (4)

96. A major characteristic of the monocot root is the presence of :
(1) Scattered vascular bundles
(2) Vasculature without cambium
(3) Cambium sandwiched between phloem and xylem along the radius
(4) Open vascular bundles

Ans. (2)

97. Which of the following characteristics is mainly responsible for diversification of insects on land ?
(1) Bilateral symmetry (2) Exoskeleton
(3) Eyes (4) Segmentation

Ans. (2)

98. Which of the following cells during gametogenesis is normally dipoid?
(1) Spermatid
(2) Spermatogonia
(3) Secondary polar body
(4) Primary polar body

Ans. (2)

99. The structures that are formed by stacking of organized flattened membranous sacs in the chloroplasts are :
(1) Grana
(2) Stroma lamellae
(3) Stroma
(4) Cristae

Ans. (1)

100. The chromosomes in which centromere is situated close to one end are:
(1) Acrocentric
(2) Telocentric
(3) Sub-metacentric
(4) Metacentric
Ans. (1)

101. In a ring girdled plant:
(1) The root dies first
(2) The shoot and root die together
(3) Neither root nor shoot will die
(4) The shoot dies first
Ans. (1)

102. Vertical distribution of different species occupying different levels in a biotic community is known as:
(1) Stratification
(2) Zonation
(3) Pyramid
(4) Divergence
Ans. (1)

103. Multiple alleles are present :
(1) At different loci on the same chromosome
(2) At the same locus of the chromosome
(3) On non-sister chromatids
(4) On different chromosomes
Ans. (2)

104. The mass of living material at a trophic level at a particular time is called :
(1) Standing state
(2) Net primary productivity
(3) Standing crop
(4) Gross primary productivity
Ans. (3)

105. Which of the following animals is **not** viviparous?
(1) Elephant
(2) Platypus
(3) Whale
(4) Flying fox (Bat)
Ans. (2)

106. In an ecosystem the rate of production of organic matter during photosynthesis is termed as:
(1) Gross primary productivity
(2) Secondary productivity
(3) Net productivity
(4) Net primary productivity
Ans. (1)

107. Erythropoiesis starts in :
(1) Liver
(2) Spleen
(3) Red bone marrow
(4) Kidney
Ans. (3)

108. Which is the most common mechanism of genetic variation in the population of sexually reproducing organism?
(1) Chromosomal aberrations
(2) Genetic drift
(3) Recombination
(4) Transduction
Ans. (3)

109. Blood pressure in the mammalian aorta is maximum during :
(1) Diastole of the right ventricle
(2) Systole of the left ventricle
(3) Diastole of the right atrium
(4) Systole of the left atrium
Ans. (2)

110. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe?
(1) rising CO_2 concentration
(2) falling CO_2 concentration
(3) rising CO_2 and falling O_2 concentration
(4) falling O_2 concentration
Ans. (1)

111. Vascular bundles in monocotyledons are considered closed because:
(1) Cambium is absent
(2) There are no vessels with perforations
(3) Xylem is surrounded all around by phloem
(4) A bundle sheath surrounds each bundle
Ans. (1)

112. Male gemetes are flagellated in :
(1) *Anabaena*
(2) *Ectocarpus*
(3) *Spirogyra*
(4) *Polysiphonia*
Ans. (2)

113. Which one of the following may require pollinators, but is genetically similar to autogamy ?
(1) Xenogamy (2) Apogamy
(3) Cleistogamy (4) Geitonogamy

Ans. (4)

114. In ginger vegetative propagation occurs through:
(1) Offsets (2) Bulbils
(3) Runners (4) Rhizome

Ans. (4)

115. Which one of the following is **no**t an inclusion body found in prokaryotes ?
(1) Cyanophycean granule
(2) Glycogen granule
(3) Polysome
(4) Phosphate granule

Ans. (3)

116. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has :
(1) same number of chromosomes but twice the amount of DNA
(2) twice the number of chromosomes and four times the amount of DNA
(3) four times the number of chromosomes and twice the amount of DNA
(4) twice the number of chromosomes and twice the amount of DNA

Ans. (2)

117. Alleles are :
(1) true breeding homozygotes
(2) different molecular forms of a gene
(3) heterozygotes
(4) different phenotype

Ans. (2)

118. Select the **correct** matching in the following pairs:
(1) Smooth ER – Synthesis of lipids
(2) Rough ER– Synthesis of glycogen
(3) Rough ER – Oxidation of fatty acids
(4) Smooth ER – Oxidation of phospholipids

Ans. (1)

119. The terga, sterna and pleura of cockroach body are joined by :
(1) Muscular tissue (2) Arthrodial membrane
(3) Cartilage (4) Cementing glue

Ans. (2)

120. Which of the following represents the correct combination without any exception?

	Characteristics	Class
(1)	Mouth ventral, gills without operculum; skin with placoid scales; persistent notochord	Chondrichthyes
(2)	Sucking and circular mouth; jaws absent, integument without scales; paired appendages	Cyclostomata
(3)	Body covered with feathers; skin moist and glandular; fore-limbs form wings; lungs with air sacs	Aves
(4)	Mammary gland; hair on body; pinnae; two pairs of Limbs	Mammalia

Ans. (1)

121. Which one of the following statements in **incorrect**?
(1) In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme.
(2) The competitive inhibitor does not affect the rate of breakdown of the enzyme-substrate complex.
(3) The presence of the competitive inhibitor decreases the Km of the enzyme for the substrate.
(4) A competitive inhibitor reacts reversibly withthe enzyme to form an enzyme- inhibitor complex.

Ans. (3)

122. Which of the following regions of the brain is incorrectly paired with its function?
(1) Cerebellum- language comprehension
(2) Corpus callosum-communication between the left and right cerebral cortices
(3) Cerebrum- calculation and contemplation
(4) Medulla oblongata - homeostatic control

Ans. (1)

123. Which one of the following statements is not true?
(1) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people
(2) The flowers pollinated by flies and bats secrete foul odour to attract them
(3) Honey is made by bees by digesting - pollen collected from flowers
(4) Pollen grains are rich in nutrients, and they are used in the form of tablets and syrups

Ans. (3)

124. The active from of *Entamoeba histolytica feeds upon:*
(1) mucosa and submucosa of colon only
(2) food in intestine
(3) blood only
(4) erythrocytes; mucosa and submucosa of colon

Ans. (4)

125. Which of the following viruses is not transferred through semen of an infected male?
(1) Human immunodeficiency virus
(2) Chikungunya virus
(3) Ebola virus
(4) Hepatitis B virus

Ans. (2)

126. A population will not exist in Hardy - Weinberg equilibrium if :
(1) There are no mutations
(2) There is no migration
(3) The population is large
(4) Individuals mate selectively

Ans. (4)

127. The guts of cow and buffalo possess:
(1) *Chlorella* spp.
(2) Methanogens
(3) Cyanobacteria
(4) *Fucus* spp.

Ans. (2)

128. The hilum is a scar on the :
(1) Fruit, where it was attached to pedicel
(2) Fruit, where style was present
(3) Seed, where micropyle was present
(4) Seed, where funicle was attached

Ans. (4)

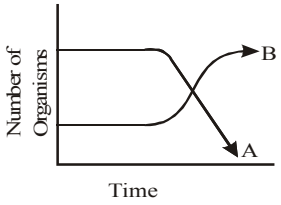
129. Secondary Succession takes place on/in :
(1) Degraded forest
(2) Newly created pond
(3) Newly cooled lava
(4) Bare rock

Ans. (1)

130. Which one of the following statements is **wrong**?
(1) Agar - agar is obtained from *Gelidium* and *Gracilaria*
(2) *Chlorella* and *Spirulina* are used as space food
(3) Mannitol is stored food in Rhodophyceae
(4) Algin and carragen are products of algae

Ans. (3)

131. The following graph depicts changes in two populations (A and B) of herbivores in a grassy field A possible reason for these changes is that:



(1) Population B competed more successfully for food than population A
(2) Population A produced more offspring than population B
(3) Population A consumed the members of population B
(4) Both plant populations in this habitat decreased

Ans. (1)

132. Match each disease with its **correct** type of vaccine:

(a) tuberculosis	(i) harmless virus
(b) whooping cough	(ii) inactivated toxin
(c) diphtheria	(iii) killed bacteria
(d) polio	(iv) harmless bacteria

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

Ans. (2)

133. Which of the following are the important floral rewards to the animal pollinators?
(1) Nectar and pollen grains
(2) Floral fragrance and calcium crystals
(3) Protein pellicle and stigmatic exudates
(4) Colour and large size flower

Ans. (1)

134. An abnormal human baby with 'XXX' sex chromosomes was born due to :
(1) formation of abnormal ova in the mother
(2) fusion of two ova and one sperm
(3) fusion of two sperms and one ovum
(4) formation of abnormal sperms in the father

Ans. (1)

135. Transpiration and root pressure cause water to rise in plants by :
(1) Pulling and pushing it, respectively
(2) Pushing it upward
(3) Pushing and pulling it, respectively
(4) Pushing it upward

Ans. (1)

136. An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude :

(1) Zero (2) $\frac{\mu_0 n^2 e}{r}$ (3) $\frac{\mu_0 ne}{2r}$ (4) $\frac{\mu_0 ne}{2\pi r}$

Ans. (3)

Sol. Magnetic field due to a circular loop

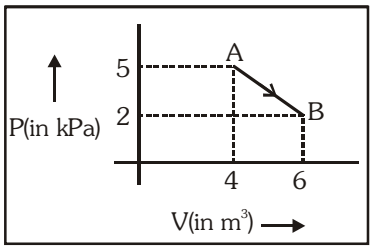
$B = \frac{\mu_0 NI}{2r}$ Where $N \rightarrow$ no. of loops

$I = \frac{q}{T} = \frac{e}{1/n} = ne$

$B = \frac{\mu_0 ne}{2r}$ (Here $N = 1$ as e^- makes only one loop)

hence option (3)

137. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure,



The change in internal energy of the gas during the transition is :

(1) –20 kJ (2) 20 J (3) –12 kJ (4) 20 kJ

Ans. (1)

Sol. $\Delta U = n C_V \Delta T$ & $T = \frac{PV}{nR}$

so $\Delta T = T_2 - T_1 = \frac{P_2V_2 - P_1V_1}{nR}$

so $\Delta U = \frac{nR}{\gamma - 1}\left(\frac{P_2V_2 - P_1V_1}{nR}\right) = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$

$\Rightarrow \Delta U = \frac{-8 \times 10^3}{2/5} = -20$ kJ

Hence option (1)

138. When two dispalcements represented by $y_1 = a\sin(\omega t)$ and $y_2 = b\cos(\omega t)$ are superimposed the motion is :

(1) simple harmonic with amplitude $\frac{a}{b}$

(2) simple harmonic with amplitude $\sqrt{a^2 + b^2}$

(3) simple harmonic with amplitude $\frac{(a+b)}{2}$

(4) not a simple harmonic

Ans. (2)

Sol. $y_1 = a \sin \omega t$

& $y_2 = b \cos \omega t = b \sin (\omega t + \frac{\pi}{2})$

since the frequencies for both SHM are same, resultant motion will be SHM. Now

Amplitude $A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$

here $A_1 = a$, $A_2 = b$ & $\phi = \frac{\pi}{2}$

so $A = \sqrt{a^2 + b^2}$

Hence option (2)

139. A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to

$v(x) = \beta x^{-2n}$

where β and n are constants and x is the position of the particle. The acceleraion of the particle as a function of x, is given by :

(1) $-2n\beta^2 x^{-4n-1}$ (2) $-2\beta^2 x^{-2n+1}$

(3) $-2n\beta^2 e^{-4n+1}$ (4) $-2n\beta^2 x^{-2n-1}$

Ans. (1)

Sol. $v = \beta x^{-2n}$

so $\frac{dv}{dx} = -2n\beta x^{-2n-1}$

Now $a = v\frac{dv}{dx} = (\beta x^{-2n})(-2n\beta x^{-2n-1})$

$\Rightarrow a = -2n\beta^2 x^{-4n-1}$

Hence option (1)

140. If radius of the $^{27}_{13}Al$ nucleus is taken to be R_{Al} then the radius of $^{125}_{53}Te$ nucleus is nearly :

(1) $\frac{5}{3}R_{Al}$ (2) $\frac{3}{5}R_{Al}$

(3) $\left(\frac{13}{53}\right)^{1/3}R_{Al}$ (4) $\left(\frac{53}{13}\right)^{1/3}R_{Al}$

Ans. (1)

Sol. $R \propto A^{1/3}$

$$\frac{R_{Al}}{R_{Te}} = \left(\frac{27}{125}\right)^{1/3} \Rightarrow R_{Te} = \frac{5}{3} R_{Al}$$

hence option (1)

141. In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maxima of single slit pattern ?

(1) 0.1 mm (2) 0.5 mm

(3) 0.02 mm (4) 0.2 mm

Ans. (4)

Sol. Angular width of central maxima in double slit experiment $= \frac{\beta}{D} = \frac{\frac{\lambda D}{d}}{D} = \frac{\lambda}{d}$

Angular width of central maxima in single slit experiment $= \frac{2\lambda}{d'}$

According to the question

$$\frac{10\lambda}{d} = \frac{2\lambda}{d'}$$

$\Rightarrow d' = 0.2\ d = 0.2$ mm

hence option (4)

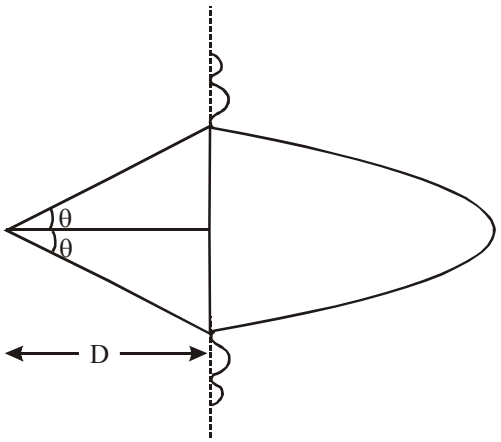
142. For a parallel beam of monochromatic light of wavelength 'λ', diffraction is produced by a single slit whose width 'a' is of the order of the wavelength of the light. If 'D' is the distance of the screen from the slit, the width of the central maxima will be :

(1) $\frac{D\lambda}{a}$ (2) $\frac{Da}{\lambda}$ (3) $\frac{2Da}{\lambda}$ (4) $\frac{2D\lambda}{a}$

Ans. (4)

Sol. Linear width of central maxima = D (2θ) = 2Dθ

$= 2D\frac{\lambda}{a}$



Hence Option (4)

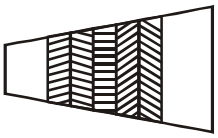
143. Across a metallic conductor of non-uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is :

(1) current (2) drift velocity

(3) electric field (4) current density

Ans. (1)

Sol. Metallic conductor can be considered as the combination of various conductors connected in series combination. And in series combination the current always remains constant.



Hence option (1)

144. On observing light from three different stars P, Q and R, it was found that intensity of violet color is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity or red colour is maximum in the spectrum of Q. If T_P, T_Q and T_R are the respective absolute temperatures of P, Q and R, then it can be concluded from the above observation that :

(1) $T_P > T_R > T_Q$ (2) $T_P < T_R < T_Q$

(3) $T_P < T_Q < T_R$ (4) $T_P > T_Q > T_R$

Ans. (1)

Sol. From Wein's displacement law

$$\lambda_m \propto \frac{1}{T}$$

Now from sequence 'VIBGYOR'

$(\lambda_m)_P < (\lambda_m)_R < (\lambda_m)_Q$

So $T_P > T_R > T_Q$

Hence option (1)

145. A potentiometer wire has length 4 m and resistance 8Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2V, so as to get a potential gradient 1 mV per cm on the wire is :

(1) 40 Ω (2) 44 Ω (3) 48 Ω (4) 32 Ω

Ans. (4)

Sol. Potential gradient = $\frac{1mV}{cm} = 10^{-3}$ V/cm = 10^{-1}V/m

Let the resistance to be connected is R then

$$I = \frac{2}{8+R}$$

Potential drop across the potentiometer wire

$$= \frac{8\times 2}{8+R} = \frac{16}{8+R}$$

Potential gradient = $\left(\frac{16}{8+R}\right)\times\frac{1}{4}$ V/m

$$= \frac{4}{8+R} = 0.1$$

$\Rightarrow$ R = 32Ω

Hence option (4)

146. Consider 3rd orbit of He^+ (Helium), using non-relativistic approach, the speed of electron in this orbit will be [given K = 9×10^9 constant, Z = 2 and h (Planck's Constant) = 6.6×10^{-34} J s]

(1) 1.46×10^6 m/s

(2) 0.73×10^6 m/s

(3) 3.0×10^8 m/s

(4) 2.92×10^6 m/s

Ans. (1)

Sol. For H-like atoms

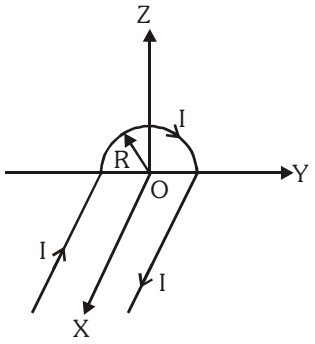
$$v = \frac{Z}{n}\times 2.188\times10^6 \text{ m/s}$$

here Z = 2, n = 3

v = 1.46×10^6 m/s

Hence option (1)

147. A wire carrying current I has the shape as shown in adjoining figure. Linear parts of the wire are very long and parallel to X-axis while semicircular portion of radius R is lying in Y-Z plane. Magnetic field at point O is :



(1) $\vec{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} - 2\hat{k})$

(2) $\vec{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} + 2\hat{k})$

(3) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} - 2\hat{k})$

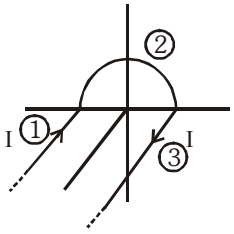
(4) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}(\pi\hat{i} + 2\hat{k})$

Ans. (2)

Sol. 'B' due to segment '1'

$$B_1 = \frac{\mu_0 I}{4\pi R}\ [\sin 90° + \sin\theta]\ (-\hat{k})$$

$$B_1 = \frac{\mu_0 I}{4\pi R}\ (-\hat{k}) = B_3$$



B due to segment '2'

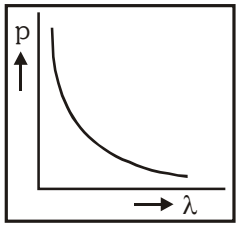
$$B_2 = \frac{\mu_0 I}{4R}\ (-\hat{i})$$

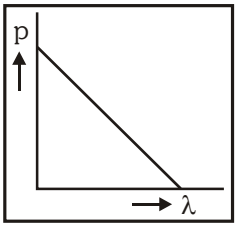
so 'B' at center $\vec{B}_c = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

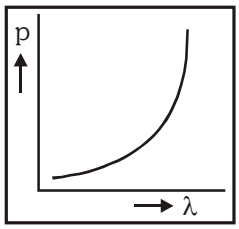
$$\Rightarrow \vec{B}_C = \frac{-\mu_0 I}{4R}\left(\hat{i} + \frac{2\hat{k}}{\pi}\right) = \frac{-\mu_0 I}{4\pi R}\ (\pi\hat{i} + 2\hat{k})$$

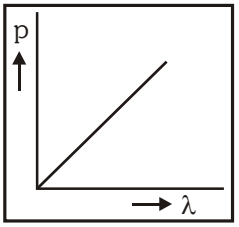
Hence option (2)

148. Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength ?

(1) 

(2) 

(3) 

(4) 

Ans. (1)

Sol. $P = \frac{hc}{\lambda} \Rightarrow P \propto \frac{1}{\lambda}$ (Rectangular hyperbola)

hence option (1)

149. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is **incorrect** ?

(1) The energy stored in the capacitor decreases K times.

(2) The change in energy stored is $\frac{1}{2}CV^2\left(\frac{1}{K}-1\right)$.

(3) The charge on the capacitor is not conserved.

(4) The potential difference between the plates decreases K times.

Ans. (3)

Sol. Once the capacitor is charged, its charge will be constant Q = CV

When dielectric slab is inserted

$C'_{New} = KC$

$E = \frac{Q^2}{2C} \Rightarrow E_{New} = \frac{1}{K} E_{initial}$

$V = \frac{Q}{C}$ so $V_{new} = \frac{1}{K} V$

Hence option (3)

150. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is :-

(1) 100 cm (2) 120 cm

(3) 140 cm (4) 80 cm

Ans. (2)

Sol. Fundamental frequency of closed organ pipe $= \frac{v}{4\ell_c}$

2nd overtone frequency of open organ pipe $= \frac{3v}{2\ell_0}$

Now $\frac{v}{4\ell_c} = \frac{3v}{2\ell_0} \Rightarrow \ell_0 = 6\ell_c = 6(20\text{ cm}) = 120\text{ cm}$

Hence option (2)

151. The refracting angle of a prism is A, and refractive index of the material of the prism is cot(A/2). The angle of minimum deviation is :-

(1) 180° – 2A (2) 90° – A

(3) 180° + 2A (4) 180° – 3A

Ans. (1)

Sol. $\mu = \frac{\sin\left(\frac{\delta_m + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$\because \mu = \cot(A/2)$

$\therefore \cot(A/2) = \frac{\sin\left(\frac{\delta_m + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

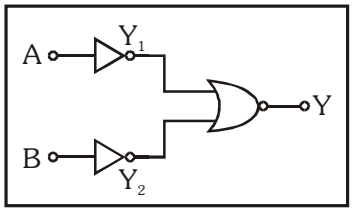
$\Rightarrow \cos(A/2) = \sin\left(\frac{\delta_m + A}{2}\right)$

$\Rightarrow 90° - A/2 = \frac{\delta_m + A}{2}$

$\Rightarrow \delta_m = 180° - 2A$

hence option (1)

152. Which logic gate is represented by the following combination of logic gates ?



(1) NAND (2) AND

(3) NOR (4) OR

Ans. (2)

Sol. $y_1 = \bar{A}$, $y_2 = \bar{B}$,

$y = \overline{y_1 + y_2} = \overline{\bar{A} + \bar{B}}$ (using De-morgan's theorem)

$y = A \cdot B$

Hence this logic gate represents AND gate.

Hence option (2)

153. A Carnot engine, having an efficiency of $\eta = \frac{1}{10}$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is :-

(1) 99 J (2) 90 J

(3) 1 J (4) 100 J

Ans. (2)

Sol. For Engine & refrigerators operating between two same temperatures

$$\eta = \frac{1}{1+\beta} \quad \Rightarrow \frac{1}{10} = \frac{1}{1+\beta} \Rightarrow \beta = 9$$

$\beta = \frac{Q_2}{W}$ (From the principle of refrigerator)

$9 = \frac{Q_2}{10} \quad \Rightarrow Q_2 = 90$ Joule

Hence option (2)

154. A certain metallic surface is illuminated with monochromatic light of wavelength, λ. The stopping potential for photo-electric current for this light is $3V_0$. if the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for this surface for photoelectric effect is :-

(1) 4 λ (2) $\frac{\lambda}{4}$ (3) $\frac{\lambda}{6}$ (4) 6 λ

Ans. (1)

Sol. $eV_S = E - \phi \Rightarrow V_S = \frac{hc}{\lambda e} - \frac{hc}{\lambda_0 e}$

here

$$3V_0 = \frac{hc}{\lambda e} - \frac{hc}{\lambda_0 e} \quad ...(1)$$

and $V_0 = \frac{hc}{2\lambda e} - \frac{hc}{\lambda_0 e}$ ...(2)

equation (1) – 3 × equation (2)

$$\Rightarrow 0 = -\frac{hc}{2\lambda e} + \frac{2hc}{\lambda_0 e}$$

$\Rightarrow \lambda_0 = 4\lambda$

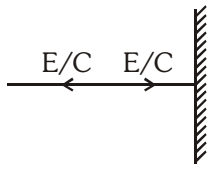
Hence option (1)

155. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = Velocity of light) :-

(1) $\frac{2E}{C}$ (2) $\frac{2E}{C^2}$ (3) $\frac{E}{C^2}$ (4) $\frac{E}{C}$

Ans. (1)

Sol.



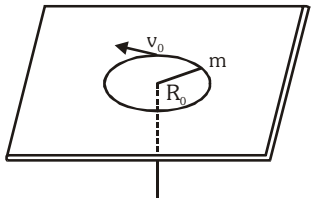
Momentum of light $p = \frac{E}{C}$

So momentum transferred to the surface

$= p_f - p_i = \frac{2E}{C}$

Hence option (1)

156. A mass m moves in a circle on a smooth horizontal plane with velocity v_0 at a radius R_0. The mass is attached to a string which passes through a smooth hole in the plane as shown.



The tension in the string is increased gradually and finally m moves in a circle of radius $\frac{R_0}{2}$. The final value of the kinetic energy is :-

(1) $\frac{1}{4}mv_0^2$ (2) $2mv_0^2$

(3) $\frac{1}{2}mv_0^2$ (4) mv_0^2

Ans. (2)

Sol. Angular momentum remains Constant because of the torque of tension is zero.

$\Rightarrow$ Li = L_f

$\Rightarrow mv_0R = mv\frac{R}{2}$

$\Rightarrow v = 2v_0$

$KE_f = \frac{1}{2}m(2v_0)^2 = 2mv_0^2$

hence option (2)

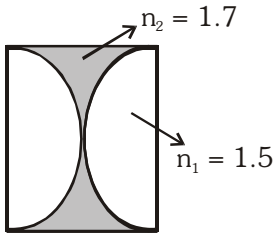
157. Two identical thin plano-convex glass lenses (refractive index 1.5) each having radius of curvature of 20 cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is :-

(1) –25 cm (2) –50 cm

(3) 50 cm (4) –20 cm

Ans. (2)

Sol.



From lens maker's formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

we have $\frac{1}{f_1} = (1.5-1)\left(\frac{1}{20}\right) = \frac{1}{40}$

$$\frac{1}{f_2} = (1.5-1)\left(\frac{1}{20}\right) = \frac{1}{40}$$

& $\frac{1}{f_3} = (1.7-1)\left(\frac{2}{20}\right) = \frac{7}{100}$

Now $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

$\Rightarrow \frac{1}{f} = \frac{1}{40} + \frac{1}{40} - \frac{7}{100}$

$\Rightarrow$ f = – 50 cm

Hence option (2)

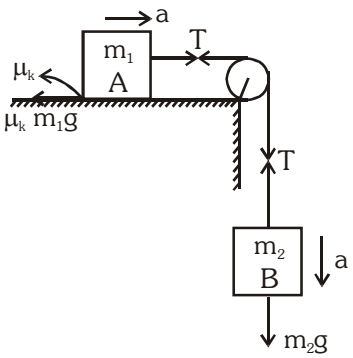
158. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of kinetic friction between the block and the table is μ_k. When the block A is sliding on the table, the tension in the string is :-

(1) $\frac{(m_2 - \mu_k m_1)g}{(m_1 + m_2)}$ (2) $\frac{m_1 m_2 (1 + \mu_k)g}{(m_1 + m_2)}$

(3) $\frac{m_1 m_2 (1 - \mu_k)g}{(m_1 + m_2)}$ (4) $\frac{(m_2 + \mu_k m_1)g}{(m_1 + m_2)}$

Ans. (2)

Sol.



For the motion of both blocks

$m_2 g - T = m_2 a$

$T - \mu_k m_1 g = m_1 a$

$\Rightarrow a = \frac{(m_2 - \mu_k m_1)g}{m_1 + m_2}$

For the block of mass 'm_2'

$$m_2 g - T = m_2\left[\frac{m_2 - \mu_k m_1}{m_1 + m_2}\right]g$$

$$T = m_2 g - \left[\frac{m_2 - \mu_k m_1}{m_1 + m_2}\right]m_2 g = m_2 g\left[\frac{m_1 + \mu_k m_1}{m_1 + m_2}\right]$$

$\Rightarrow T = \frac{m_1 m_2 (1 + \mu_k)g}{m_1 + m_2}$

Hence option (2)

159. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are V_1 and V_2, respectively. Its time period is :-

(1) $2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$ (2) $2\pi\sqrt{\frac{V_1^2 + V_2^2}{x_1^2 + x_2^2}}$

(3) $2\pi\sqrt{\frac{V_1^2 - V_2^2}{x_1^2 - x_2^2}}$ (4) $2\pi\sqrt{\frac{x_1^2 + x_2^2}{V_1^2 + V_2^2}}$

Ans. (1)

Sol. For particle undergoing SHM

$V = \omega\sqrt{A^2 - x^2}$

so $V_1 = \omega\sqrt{A^2 - x_1^2}$ & $V_2 = \omega\sqrt{A^2 - x_2^2}$

solving these two equations we get

$$\omega = \sqrt{\frac{V_1^2 - V_2^2}{x_2^2 - x_1^2}} = \frac{2\pi}{T}$$

$$\Rightarrow T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$$

Hence option (1)

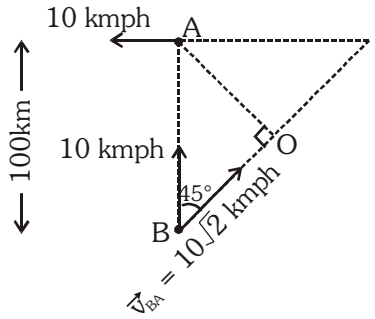
160. A ship A is moving Westwards with a speed of 10 km h^{-1} and a ship B 100 km South of A, is moving Northwards with a speed of 10 km h^{-1}. The time after which the distance between them becomes shortest, is :-

(1) 5 h (2) $5\sqrt{2}$ h

(3) $10\sqrt{2}$ h (4) 0 h

Ans. (1)

Sol.



$|\vec{v}_{BA}| = \sqrt{10^2 + 10^2} = 10\sqrt{2}$ kmph

distance OB = 100 cos45°= $50\sqrt{2}$ km

Time taken to reach the shortest distance between

A & B = $\frac{50\sqrt{2}}{|\vec{v}_{BA}|} = \frac{50\sqrt{2}}{10\sqrt{2}}$

t_{sn} = 5 hrs.

Hence option (1)

161. A rod of weight W is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre of mass of the rod is at distance x from A. The normal reaction on A is :-

(1) $\frac{Wd}{x}$ (2) $\frac{W(d-x)}{x}$

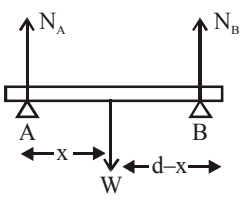
(3) $\frac{W(d-x)}{d}$ (4) $\frac{Wx}{d}$

Ans. (3)

Sol. By torque balancing about B

$N_A(d) = W(d-x)$

$\Rightarrow N_A = \frac{W(d-x)}{d}$



Hence option (3)

162. The approximate depth of an ocean is 2700 m. The compressibility of water is 45.4×10^{-11} Pa^{-1} and density of water is 10^3 kg/m^3.What fractional compression of water will be obtained at the bottom of the ocean ?

(1) 1.0×10^{-2} (2) 1.2×10^{-2}

(3) 1.4×10^{-2} (4) 0.8×10^{-2}

Ans. (2)

Sol. As we know

$$B = \frac{P}{\frac{\Delta V}{V}}$$

so $\frac{\Delta V}{V} = \frac{P}{B}$

Now P = ρgh & compressibility 'K' = $\frac{1}{B}$

so $\frac{\Delta V}{V} = \rho gh$ (K)

$= 10^3 \times 9.8 \times 2700 \times 45.4 \times 10^{-11}$

$= 1.201 \times 10^{-2}$

Hence option (2)

163. Two particles of masses m_1, m_2 move with initial velociteis u_1 and u_2. On collision, one of the particles get excited to higher level, after abosrbing energy ε. If final velocities of particles be v_1 and v_2 then we must have :

(1) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$

(2) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

(3) $\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$

(4) $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$

Ans. (2)

Sol. Energy will always be conserved so

K. $E._{initial}$ = K.$E._{final}$ + Excitation energy

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \varepsilon$$

Hence option (2) .

164. Kepler's third law states that square of period of revolution (T) of a planet around the sun, is proportional to third power of average distance r between sun and planet

i.e. $T^2 = Kr^3$

here K is constant.

If the masses of sun and planet are M and m respectively then as per Newton's law of gravitation force of attraction between them is

$F = \frac{GMm}{r^2}$, here G is gravitational constant.

The relation between G and K is described as :

(1) $GMK = 4\pi^2$ (2) $K = G$

(3) $K = \frac{1}{G}$ (4) $GK = 4\pi^2$

Ans. (1)

Sol. $T = \frac{2\pi r}{v} = \frac{2\pi r}{\sqrt{GM}}\sqrt{r}$

$\left(\text{as } v = \sqrt{\frac{GM}{r}}\right)$

$T = \frac{2\pi}{\sqrt{GM}}\, r^{3/2}$

$T^2 = \frac{4\pi^2}{GM} \cdot r^3$

Comparing

$K = \frac{4\pi^2}{GM}$

Hence option (1)

165. A block of mass 10 kg, moving in x direction with a constant speed of 10 ms^{-1}, is subjected to a retarding force F = 0.1 x J/m during its travel from x = 20 m to 30 m. Its final KE will be :

(1) 450 J (2) 275 J

(3) 250 J (4) 475 J

Ans. (4)

Sol. $W = -\int F dx$

$W = -\int_{20}^{30} 0.1x\,dx$

$W = -0.1\left[\frac{x^2}{2}\right]_{20}^{30}$

$W = -0.1\left[\frac{900-400}{2}\right] = -25$

From work energy theorem $W = K_f - K_i$

$\Rightarrow -25 = K_f - \frac{1}{2}\,10(10)^2$

$\Rightarrow K_f = 475$

Hence option (4)

166. A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is 250 m^2. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be : ($\rho_{air} = 1.2$ kg/m^3)

(1) 4.8×10^5 N, upwards

(2) 2.4×10^5 N, upwards

(3) 2.4×10^5 N, downwards

(4) 4.8×10^5 N, downwards

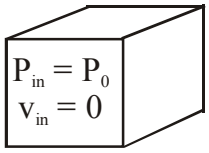
Ans. (2)

Sol. By Bernaulli's equation

$P + \frac{1}{2}\rho v^2 = P_0 + 0$

$p_0 - p = \frac{1}{2}\rho v^2$

$F = \frac{1}{2}\rho v^2 A$



$F = 2.4 \times 10^5$ upward

Hence Option (2)

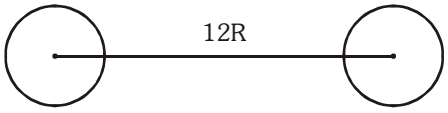
167. Two spherical bodies of mass M and 5 M and radii R and 2 R are released in free space with initial separation between their centres equal to 12 R. If they attract each other due to gravitational force only, then the distance covered by the smaller body before collision is :

(1) 4.5 R (2) 7.5 R

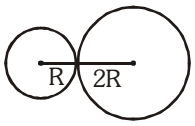
(3) 1.5 R (4) 2.5 R

Ans. (2)

Sol.



Initial distance between their centers = 12 R



At time of collision the distance between their centers = 3R

So total distance travelled by both=12R–3R = 9R

Since the bodies move under mutual forces, center of mass will remain stationary so

$m_1x_1 = m_2x_2$

$mx = 5m(9R - x)$

$x = 45R - 5x$

$6x = 45R$

$$x = \frac{45}{6}R$$

$$\boxed{x = 7.5R}$$

Hence option (2)

168. A resitance 'R' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z', the power drawn will be:

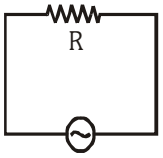
(1) $P\sqrt{\frac{R}{Z}}$ (2) $P\left(\frac{R}{Z}\right)$

(3) P (4) $P\left(\frac{R}{Z}\right)^2$

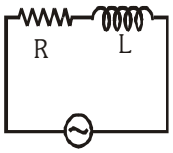
Ans. (4)

Sol.

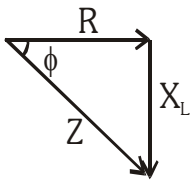
Pure resistor circuit



Resistor & Inductor circuit



(Phasor diagram)



AC source Impedance = Z

$$P = \frac{V^2}{R} \qquad P' = V.\left[\frac{V}{Z}\right].\cos\phi$$

$\Rightarrow V^2 = PR$ $\qquad P' = \frac{V^2}{Z}.\frac{R}{Z}$

(From phasor diagram)

$$P' = \frac{(PR)R}{Z^2}$$

$$P' = \left(\frac{R}{Z}\right)^2 P$$

Hence option (4)

169. The ratio of the specific heats $\frac{C_P}{C_V} = \gamma$ in terms of degrees of freedom (n) is given by :

(1) $\left(1+\frac{n}{3}\right)$ (2) $\left(1+\frac{2}{n}\right)$

(3) $\left(1+\frac{n}{2}\right)$ (4) $\left(1+\frac{1}{n}\right)$

Ans. (2)

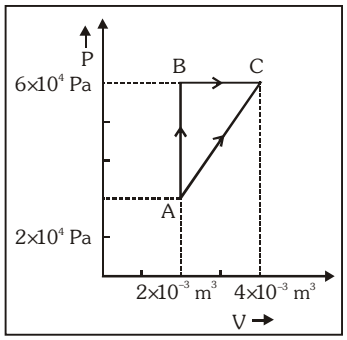
Sol. $\gamma = 1 + \frac{2}{n}$

Here degree of freedom $\rightarrow$ n

$\therefore \quad \gamma = 1 + \frac{2}{n}$

Hence option (2)

170. Figure below shows two paths that may be taken by a gas to go from a state A to a state C.



In process AB, 400 J of heat is added to the system and in process BC, 100 J of heat is added to the system. The heat absorbed by the system in the process AC will be :

(1) 500 J (2) 460 J

(3) 300 J (4) 380 J

Ans. (2)

Sol. In cyclic process ABCA,

$\Delta U_{cyclic} = 0$

$Q_{cyclic} = W_{cyclic}$

$Q_{AB} + Q_{BC} + Q_{CA}$ = closed loop area.

$$400 + 100 + Q_{CA} = \frac{1}{2} \times (2 \times 10^{-3}) \times 4 \times 10^4$$

$400 + 100 - Q_{AC} = 40$

$Q_{AC} = 460$ J

Hence option (2)

171. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be :

(1) $[EV^{-1}T^{-2}]$ (2) $[EV^{-2}T^{-2}]$

(3) $[E^{-2}V^{-1}T^{-3}]$ (4) $[EV^{-2}T^{-1}]$

Ans. (2)

Sol. Applying dimensional analysis

$S \propto E^aV^bT^c$

$M^1L^0T^{-2} = k\,[M^1L^2T^{-2}]^a[L^1T^{-1}]^b[T^1]^c$

$M^1L^0T^{-2} = k\,[M^aL^{2a}T^{-2a}]\,L^bT^{-b}T^c$

Comparision

$$a = 1 \left| \begin{matrix} 2a + b = 0 \\ b = -2 \end{matrix} \right| \begin{matrix} -2 = -2a - b + c \\ -2 = -2(1) + 2 + c \end{matrix}$$

$c = -2$

So the dimensional formula for surface tension will be $[E^1V^{-2}T^{-2}]$

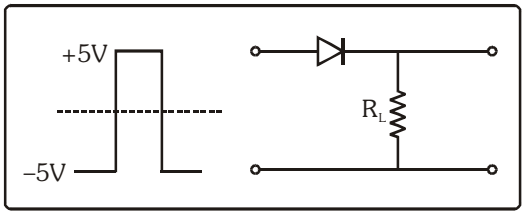
Alternate solution :

$$\text{Surface Tension} = \frac{\text{Surface energy}}{\text{Area}}$$

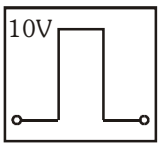
$$[\text{Surface tension}] = \frac{[E]}{[V \cdot T]^2} = [E\,V^{-2}\,T^{-2}]$$

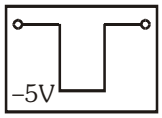
Hence option (2)

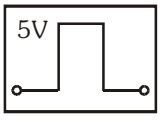
172. If in a p-n junction, a square input signal of 10 V is applied as shown,

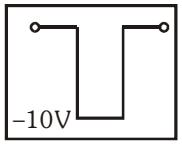


then the output across R_L will be :

(1) 

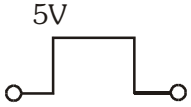
(2) 

(3) 

(4) 

Ans. (3)

Sol. This is the circuit where P-N junction is acting as a Half-wave rectifier so the output will be



Hence option (3)

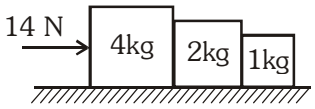
173. Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is :

(1) 6 N (2) 8 N (3) 18 N (4) 2 N

Ans. (1)

Sol. Acceleration of system $= \frac{F_{net}}{M_{total}}$

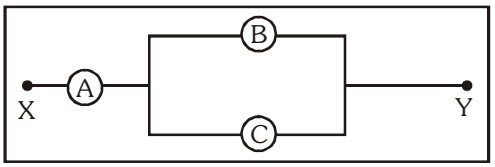
$$= \frac{14}{4+2+1} = 2\ m/s^2$$



The contact force between 4 kg & 2 kg block will move 2 kg & 1 kg block with the same acceleration so $F_{contact} = (2 + 1)a = 3(2) = 6N$

Hence option (1)

174. A, B and C are voltmeters of resistance R, 1.5 R and 3R respectively as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C respectively. Then :



(1) $V_A \neq V_B = V_C$ (2) $V_A = V_B \neq V_C$

(3) $V_A \neq V_B \neq V_C$ (4) $V_A = V_B = V_C$

Ans. (4)

Sol. Effective resistance of B & C $= \frac{(1.5R)(3R)}{1.5R + 3R} = R$

In series sequence $V \propto R$

so voltage across 'A' = voltage across B & C

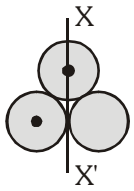
Now B & C are parallel so $V_B = V_C$

$\Rightarrow V_A = V_B = V_C$

Hence option (4)

175. Three identical spherical shells, each of mass m and radius r are placed as shown in figure. Consider an axis XX' which is touching to two shells and passing through diameter of third shell.

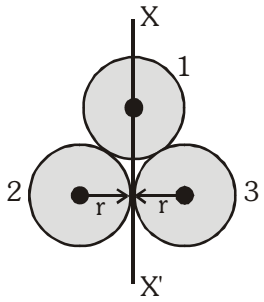
Moment of inertia of the system consisting of these three spherical shells about XX' axis is :-



(1) $3\ mr^2$ (2) $\frac{16}{5}mr^2$ (3) $4\ mr^2$ (4) $\frac{11}{5}mr^2$

Ans. (3)

Sol.



$I_{xx'} = I_1 + I_2 + I_3$

$$\frac{2}{3}mr^2 + \left(\frac{2}{3}mr^2 + mr^2\right) + \left(\frac{2}{3}mr^2 + mr^2\right)$$

(Using parallel axis theorem)

$\Rightarrow I_{xx'} = 2mr^2 + 2mr^2 = 4mr^2$

Hence option (3)

176. The electric field in a certain region is acting radially outward and is given by E = Ar. A charge contained in a shepere of radius 'a' centred at the origin of the field, will be given by :

(1) $A\ \varepsilon_0\ a^2$ (2) $4\ \pi\varepsilon_0\ Aa^3$

(3) $\varepsilon_0\ Aa^3$ (4) $4\ \pi\varepsilon_0\ Aa^2$

Ans. (2)

Sol. Flux linked with sphere = $\vec{E}.d\vec{s}$

since electric field is radial. It is always perpendicular to the surface.

so $\phi = Ar.(4\pi r^2)$

$\phi = A(a)(4\pi r^2)$ (as r = a)

$\phi = A4\pi a^3$

Now according to gauss law

$$\phi = \frac{q_{in}}{\epsilon_0} \quad \Rightarrow \quad q_{in} = \phi.\epsilon_0$$

so $q_{in} = A4\pi a^3\ \epsilon_0$

Hence option (2)

177. The two ends of a metal rod are matainted at temperatures 100°C and 110°C. The rate of heat flow in the rod is found to be 4.0 J/s. If the ends are maintained at temperatures 200°C and 210°C, the rate of heat flow will be :

(1) 16.8 J/s (2) 8.0 J/s

(3) 4.0 J/s (4) 44.0 J/s

Ans. (3)

Sol. Rate of heat flow $\propto$ temperature difference between two ends

$$\Rightarrow \frac{dQ}{dt} \propto (T_2 - T_1)$$

Here temperature differnece in both case is same (i.e. 10°C)

So, rate of heat flow will also be same

$$\text{So, } \frac{dQ}{dt} = 4\ J/s$$

Hence option (3)

178. Two similar springs P and Q have spring constants K_P and K_Q, such that $K_P > K_Q$. The are stretched, first by the same amount (case a,) then by the same force (case b). The work done by the springs W_P and W_Q are related as, in case (a) and case (b), respectively :

(1) $W_P = W_Q$; $W_P = W_Q$

(2) $W_P > W_Q$; $W_Q > W_P$

(3) $W_P < W_Q$; $W_Q < W_P$

(4) $W_P = W_Q$; $W_P > W_Q$

Ans. (2)

Sol. Given $K_P > K_Q$

Case (a) : $x_1 = x_2 = x$

$$\frac{W_P}{W_Q} = \frac{\frac{1}{2}K_P x^2}{\frac{1}{2}K_Q x^2} = \frac{K_P}{K_Q} \Rightarrow W_P > W_Q$$

Case (b) : $F_1 = F_2 = F$

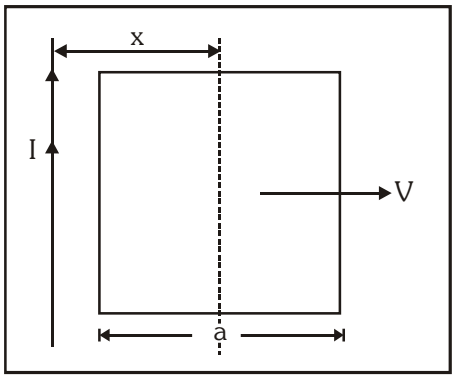
For constant force

$$W = \frac{F^2}{2K} \Rightarrow W \propto \frac{1}{K}$$

$$\text{So } \frac{W_P}{W_Q} = \frac{K_Q}{K_P} \Rightarrow W_Q > W_P$$

Hence option (2)

179. A conducting square frame of side 'a' and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity 'V'. The emf induced in the frame will be proportional to :

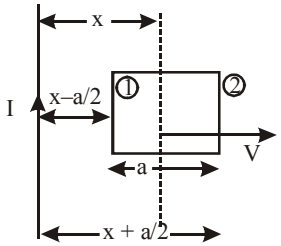


(1) $\frac{1}{(2x-a)^2}$ (2) $\frac{1}{(2x+a)^2}$

(3) $\frac{1}{(2x-a)(2x+a)}$ (4) $\frac{1}{x^2}$

Ans. (3)

Sol.



emf Induced in side (1)

$\varepsilon_1 = B_1 V\ell$

emf Induced is side (2)

$\varepsilon_2 = B_2 V\ell$

emf in the frame = $B_1 V\ell - B_2 V\ell$

$\varepsilon = V\ell\,[B_1 - B_2]$

$\Rightarrow \varepsilon \propto B_1 - B_2$ Since $B \propto \frac{1}{r}$

So $\varepsilon \propto \left[\frac{1}{x-\frac{a}{2}} - \frac{1}{x+\frac{a}{2}}\right]$

$\Rightarrow \varepsilon \propto \left[\frac{1}{(2x-a)} - \frac{1}{(2x+a)}\right]$

Hence Option (3)

180. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time t is :

(1) $\sqrt{mk}\,t^{-1/2}$ (2) $\sqrt{2mk}\,t^{-1/2}$

(3) $\frac{1}{2}\sqrt{mk}\,t^{-1/2}$ (4) $\sqrt{\frac{mk}{2}}\,t^{-1/2}$

Ans. (4)

Sol. $P = Fv = mav$

$\Rightarrow K = mv\,\frac{dv}{dt}$

By integrating the equation

$\Rightarrow \int v\,dv = \int \frac{k}{m}dt$

$\Rightarrow \frac{v^2}{2} = \frac{k}{m}t \Rightarrow v = \sqrt{\frac{2k}{m}t}$

$a = \frac{dv}{dt} = \sqrt{\frac{2k}{m}}\left(\frac{1}{2}t^{-1/2}\right)$

$F = ma = m\left(\frac{1}{2}\right)\sqrt{\frac{2k}{mt}} \Rightarrow F = \sqrt{\frac{mk}{2t}}$

Hence option (4)