MATRIX HIGH SCHOOL

NSEJS 2022 - 2023

Answer & Solutions

1. In nineteenth century, farmers in Japan found that some seedlings of rice became very tall. They called it 'Bakanae Disease' or mad seedling disease. All these mad plants were found to be infected by a fungus, *Fusarium moniliforme*. This led to the discovery of a phytohormone, later named:

(a) Vernalin

(b) Auxin

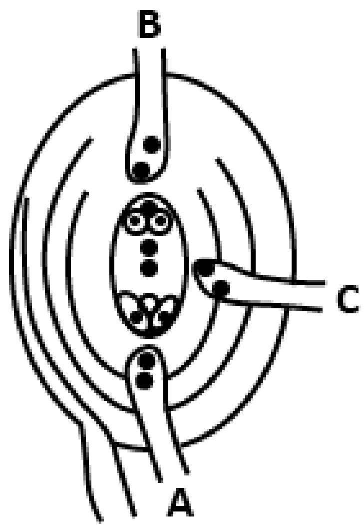
(c) Florigen

(d) Gibberellin

Sol. Gibberellin is a phytohormone, first derived from *Fusarium moniliforme* (asexual stage of *Gibberella fujikorai*) . It caused internodal elongation in rice.

∴ Ans (d) Gibberellin

2. In most angiosperms, when the ovule is mature, the pollen germinates on stigma, travels through style and ultimately enters the ovule. In the adjacent diagram, three possibilities of pollen tube entry are shown. What do A, B and C represent ?



(a) A-Mesogamy, B-Chalazogamy & C-Porogamy

(b) A-Porogamy, B-Chalazogamy & C-Mesogamy

(c) A-Chalazogamy, B-Mesogamy & C-Porogamy

(d) A & B-Porogamy, C-Chalazogamy

Sol. When the pollen tube enters through

(a) Micropylar end, it's called Porogamy
(b) Chalazal end, it's called Chalazogamy
(c) Integuments, it's called Mesogamy

∴ Ans (b) A-Porogamy

B-Chalazogamy

C-Mesogamy

3. It is a common observation that members of Cucurbitaceae, like bottle-gourd, pumpkin, watermelon, musk melon, etc. have large fruits while their stems are usually not more than a finger thick. What helps so much food to be translocated from leaves to the fruits for storage?

(a) Intraxylary phloem

(b) Sieve-tubes with companion cells

(c) Bicollateral vascular bundles

(d) Trichomes on internodes

Sol. Bicollateral vascular bundles are present in members of italics in which xylem bundle is sandwiched between two phloem bundles.

∴ Ans (c) Bicollateral vascular bundles

4. In some birds, black plumage gene is dominant over white plumage gene. One black bird was mated with white feathered bird. It resulted in all chicks with blue plumage. Selfing among these blue birds would result in:

(a) 1 black : 1 white : 2 blue x
(b) 9 blue : 3 black : 3 white
(c) 1 blue : 1 black : 1 white
(d) 3 blue : 1 white

Sol.

Black bird × White bird

BB   **bb**

↓

Bb
Blue bird

Bb × Bb

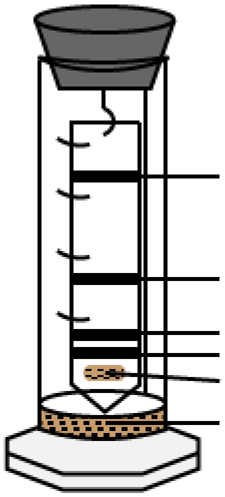
♀ \ ♂	B	b
B	BB (Black)	Bb (Blue)
b	Bb (Blue)	bb (White)

Phenotypic ratio :- Black : Blue : White

1 : 2 : 1

∴ Ans (a) : 1 Black : 1 White : 2 Blue

5. The adjacent diagram shows chromatographic separation of plant pigments, extracted from spinach leaves. The sequence of pigment bands from below upwards is :



(a) Chlorophyll b, Chlorophyll a, Carotenols & Carotenes

(b) Carotenes, Carotenols , Chlorophyll a & Chlorophyll b

(c) Chlorophyll a, Chlorophyll b, Carotenes & Carotenols

(d) Carotenols, Phycobilins, Chlorophyll a & Chlorophyll b

Sol. Ans : Option (a) - Chlorophyll b, Chlorophyll a, Carotenols & Carotenes

Paper chromatography helps in the separation and identification of plant pigments. These pigments separate as per the differences in their solubilities. The sequence of pigment bands from below upwards are as follows:

1 → Chlorophyll b

2 → Chlorophyll a

3 → Carotenols

4 → Carotenes

6. In some plants and fungi, some cell organelles are found which convert lipids to sugar in early stages of oil seed's germination. What are these?

(a) Glyoxysomes

(b) Lysosomes

(c) Ribosomes

(d) Liposomes

Sol. Ans - Option (a) - Glyoxysomes

Glyoxysomes are single membraned cell organelles found in oil seeds which help in conversion of oil into glucose for germination of seeds. These contain enzymes for glyoxylate cycle that converts fats into carbohydrates.

7. In the analysis of waste water, *Escherichia coli* is used as :

(a) A standard organism for performing a plate count
(b) An indicator of fecal contamination of water
(c) An indicator of the number of N_2 fixing bacteria in water
(d) A measure of the amino acid content of water

Sol. (b) An indicator of fecal contamination of water

Escherichia coli is found in the intestine of humans and other animals. So, if found in wastewater, it is an indicator of fecal contamination. We use coliform counting method to measure wastewater contamination.

8. Acid rain damages soil and lakes. Its high level depositions have damaged altitude forests since being encircled by acidic fogs and clouds. It also affects aquatic plants and animals. Which pH range is most suitable for the survival of aquatic biota ?

(a) $4.5 - 5.8$
(b) $6.5 - 7.5$
(c) $7.5 - 8.5$
(d) Above 9.0

Sol. (b) $6.5 - 7.5$

Neutral pH range, i.e., $6.5 - 7.5$, is most suitable for the survival of the aquatic biota. Acid rain will cause pH to fall the range of $4.5 - 5.8$. The aquatic biota will not survive in pH above 7.5 (basic) and it is not optimum for survival of aquatic biota.

9. Steroid hormones include sex hormones and hormones from adrenal cortex. Based on the intensity of action which of the following hormones is produced in large amount ?

(a) Estrone

(b) Estriol

(c) Estradiol

(d) Estrane

Sol. (c) Estradiol

Estrogen is the ovarian hormone produced in large amount which is also known as Estradiol.

10. In the vertebrae column of man, there are about 26 vertebrae. Which of the following vertebrae is related with the pelvis region ?

a) Lumbar

b) Coccygeal

c) Sacral

d) Cervical

Sol. (c) Sacral

Cervical - Neck (7)

Thoracic - Thorax (12)

Lumbar - Abdomen (5)

Sacral - Pelvis (5 fused)

Coccygeal - Lower pelvis (4 fused)

11. In following EMP pathway, enzymes catalyzing the reactions are numbered E_1 to E_{10}. At which enzyme levels, ATPs are generated at substrate level ?

Glucose $\xrightarrow{E_1}$ **Glucose-6-phosphate** $\xrightarrow{E_2}$ **Fructose-6-phosphate** $\xrightarrow{E_3}$ **Fructose1, 6 Diphosphate** $\xrightarrow{E_4}$ **Dihydroxyacetone Phos.** $\xrightarrow{E_5}$ **3 Phosphoglyceraldehyde** $\xrightarrow{E_6}$ **1,3 Diphophoglyceraldehyde** $\xrightarrow{E_7}$ **3 Phosphoglyceric Acid** $\xrightarrow{E_8}$ **2 Phosphoglyceric Acid** $\xrightarrow{E_9}$ **Phosphoenol Pyruvic Acid** $\xrightarrow{E_{10}}$ **Pyruvic Acid.**

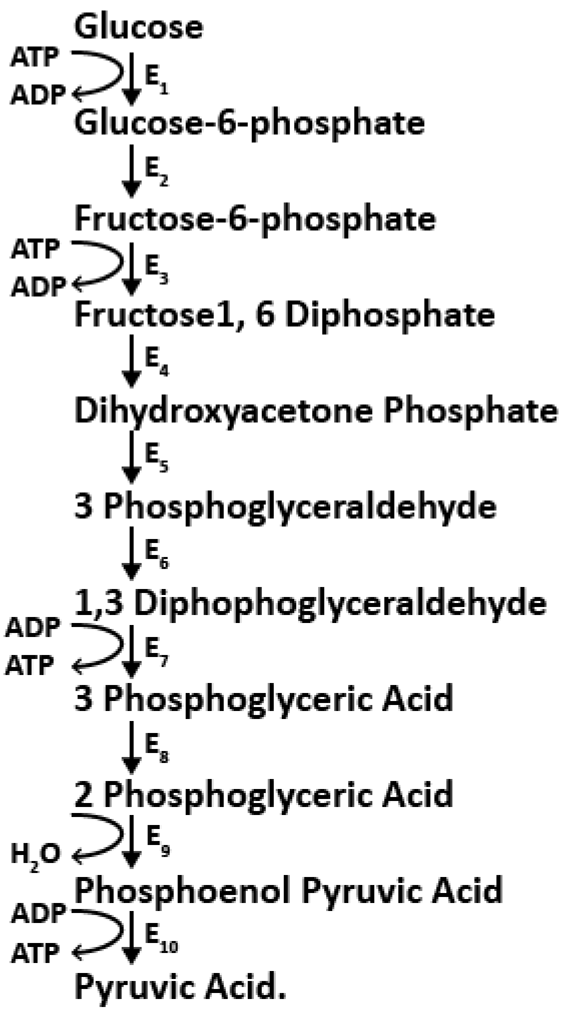
a) E_1 and E_3

b) E_3 and E_6

c) E_7 and E_{10}

d) E_6 and E_{10}

Sol. (c)



12. A thick whitish band of semicircular nerve fibers is found bulging upon the inner surface of the dorsal wall of each cerebral hemisphere of mammalian brain. Choose the name of this structure from the following?

a) Corpus albicans

b) Corpus luteum

c) Corpus striatum

d) Corpus callosum

Sol. (d) Corpus callosum

Corpus albicans and Corpus luteum are found in the ovary.

Corpus callosum is the nerve band that connects the right and left cerebral hemisphere.

Corpus striatum is a nucleus (a cluster of neurons) in the subcortical basal ganglia of the forebrain.

13. In animal classification, symmetry of body is a diagnostic feature. Besides truly bilateral symmetrical animals, exceptionally some other animals also exhibit bilateral symmetry. Which of the following is an example of such animals ?

a) *Giardia*

b) *Cliona*

c) *Obelia*

d) *Trypanosoma*

Sol. *Giardia*

Giardia and *Trypanosoma* are parasitic organisms belongs to Protista.

- Symmetry in *Giardia* is Bilateral
- Symmetry in *Obelia* is Radial
- *Cliona* is asymmetrical.

14. Nissl's granules are in fact RNA bodies. In which of the following do they occur?

a) Osteon

b) Chondrion

c) Neuron

d) Myocytes

Sol. (c) Neuron

Nissl's granules are granular bodies present in the cyton part of a neuron. These granules are present in the cytoplasm and dendrites and are involved in synthesis and segregation of proteins.

15. One of the following statements is not applicable to viruses:

a) The protein capsid of the virus does not enter the host cell
b) The genetic material is either DNA or RNA, never both
c) The virion replicates autonomously outside the host
d) The virus replicates in a bacterial or other host cell

Sol. (c) The virion replicates autonomously outside the host

Viruses are non-cellular structures made up of protein coat and genetic material. Genetic material can be either RNA or DNA. Viruses cannot replicate outside the host.

16. Carolus Linnaeus, a Swedish botanist is credited with Binomial Nomenclature of plants and animals. While using binomials, he devised a system of classification of plants. His classification is:

a) Artificial
b) Natural
c) Phylogenetic
d) Cladistic

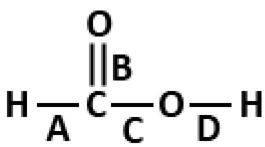
Sol. (a) Artificial

Artificial system of classification are based upon few characters (morphological) this system of classification was proposed by Carolus Linnaeus.

Natural system of classification was proposed by Bentham and Hooker.

Phylogenetic system of classification was proposed by Engler and Prantl.

17. Which bond will break when the following compound is dissolved in water ?



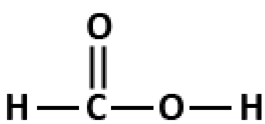
a) A

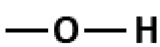
b) B

c) C

d) D

Sol. (d)



 bond will break

When an acid is dissolved in water,the covalent bond between the electronegative atom ‘O’ and Hydrogen atom breaks, yielding a H^+ and negative ion.

Hence, the correct option is ‘d’.

18. If the number of compounds formed by H, C, Cl and Co are N_1, N_2, N_3, N_4 respectively, the correct order is

a) $N_1 > N_2 > N_3 > N_4$

b) $N_1 > N_2 > N_4 > N_3$

c) $N_2 > N_1 > N_4 > N_3$

d) $N_2 > N_4 > N_3 > N_1$

Sol. (a) $N_1 > N_2 > N_3 > N_4$

The number of compounds formed by H is the maximum followed by C, Cl and Co.

Therefore, the correct option is (a) .

$$N_1 > N_2 > N_3 > N_4$$

19. Heaviest nuclide which does not show radioactive nature is :

a) Bismuth

b) Lead

c) Technetium

d) Neptunium

Sol. (b)

Lead is not radioactive in nature.

Bismuth, Technetium , Neptunium are radioactive in nature.

Hence, the correct answer is option ‘b’. .

20. 1 kg of aqueous urea solution (mole fraction of solute =0.2) is diluted to 5 kg. Mole fraction of solute in dilute solution is :

a) 0.2
b) 4×10^{-2}
c) 0.029
d) 0.971

Sol. (c)

Mole fraction (Urea) =0.2

∴ 1 mole solution contains 0.2 mol Urea 0.8 mol H_2O.

0.2 mol Urea = $0.2 \times 60 = 12\, g$

0.8 mol H_2O. = $0.8 \times 18 = 14.4\, g$

Total mass of solution = 26.4 g

26.4 g of solution contains —- 12 g Urea

$1g \rightarrow \frac{12}{26.4}$

$1000\ g \rightarrow \frac{12}{26.4} \times 1000 = 454.5\ g$ Urea

$$n = \frac{454.5}{60} = 7.57 \text{ moles}$$

Moles of water in dilution solution = $5000 - 454.5\ g$

= 4545.5 g

$$n = \frac{454.5}{18} = 252.52 \text{ moles}$$

$$n_{Urea} = \frac{7.57}{7.57 + 252.52} = \frac{7.57}{260.09} = 0.029$$

The correct option is (c)

21. Nickel forms a gaseous compound of the formula $Ni(CO)_x$, What is the value of x if under similar conditions of temperature and pressure, methane effuses 3.24 times faster than the compound?

a) 3.9
b) 2.1
c) 4.7
d) 3.0

Sol. (a)

Graham's law of diffusion

$$\frac{r_{CH_4}}{r_{gas}} = \sqrt{\frac{M_{gas}}{M_{CH_4}}}$$

$$\frac{3.24\,x}{x} = \sqrt{\frac{M_{gas}}{16}}$$

$$3.24 = \sqrt{\frac{M_{gas}}{16}}$$

$$\Rightarrow (3.24)^2 = \frac{M_{gas}}{16}$$

$\Rightarrow$ Mass of gas = $3.24 \times 3.24 \times 16$

$= 167.96\ g$

Because $M = 58.7 + (28)x$

$\Rightarrow 167.96 = 58.7 + (28)x$

$\Rightarrow 28\,x = 167.96 - 58.7$

$\Rightarrow x = \frac{109.26}{28} = 3.9$

∴ Option a

22. Inter-particle distance between Li and H in LH is $1.596\ A°$. Observed dipole moment of LiH is $1.94 \times 10^{-29} C.m.$ The percentage (%) ionic character in LiH is

a) 56.0%
b) 90.8 %
c) 76.8%
d) 100%

Sol. (c)

Observed dipole moment = $1.964 \times 10^{-29} cm$

Theoretical dipole moment = (1 electric charge) × (Interparticle distance)

$= 1.602 \times 10^{-19} C \times 1.596 \times 10^{-10} m$

$= 2.557 \times 10^{-29} C.m$

% Ionic character = $\frac{Experimental\ dipole\ moment}{Theoretical\ dipole\ moment} \times 100$

$= \frac{1.964 \times 10^{-29}}{2.557 \times 10^{-29}} \times 100$

$= 76.8\ \%$

Answer is option c

23. What is the percentage of $MgCO_3$ in a mixture of $MgCO_3$ and $CaCO_3$ if its 2g require 2g H_2SO_4 for complete neutralization ?

(a) 89 %
(b) 11 %
(c) 50 %
(d) 25 %

Sol. (b) For $CaCO_3$, Let x g of $CaCO_3$ react with y g of H_2SO_4

$\therefore \frac{x}{100} = \frac{y}{98} \Rightarrow 98x = 100y$ ....(1)

For $MgCO_3$, Let $2 - x$ g of $MgCO_3$ react with $2 - y\ g$ of H_2SO_4

$\therefore \frac{2-x}{84} = \frac{2-y}{98}$

$\Rightarrow 98(2 - x) = 84(2 - y)$

$\Rightarrow 196 - 98x = 168 - 84y$

$\Rightarrow 196 - 168 = 98x - 84y$

$\Rightarrow 28 = 98x - 84y$ ……(2)

From equation (1)

$y = \frac{98x}{100}$, Put the value in equation (1)

$\Rightarrow 28 = 98x - 84 \times \frac{98x}{100} = \frac{98x \times 100 - 84 \times 98x}{100}$

$\Rightarrow 28 = \frac{1568x}{100} \Rightarrow x = 1.78\,g$

For $MgCO_3 = 2 - x = 2 - 1.78 = 0.22\,g$

% of $MgCO_3 = \frac{0.22}{2} \times 100$= 11 %

24. Sum of the oxidation states of all the carbon atoms in toluene molecule is :

(a)-1

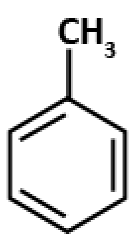
(b)$-\frac{7}{8}$

(c)$-\frac{8}{7}$

(d) -8

Sol. (d)

Sum of all oxidation states of toluene :



Formula - $C_6H_5CH_3$

Oxidation state of carbon = x

$\Rightarrow 6(x) + 5(1) + x + 3(1) = 0$

$\Rightarrow 7x + 8 = 0$

$\Rightarrow x = \frac{-8}{7}$ (Oxidation state of 1 carbon)

Now for total number of carbon :

Total number of carbon = 7

Sum of oxidation state = 7 $\times \frac{-8}{7} = -8$

Option d

25. Oxidation state of oxygen in O_2PtF_6 is :

(a) $-\frac{1}{2}$

(b) -2

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

(d) -1

Sol. (c)

The $O_2[PtF_6]$ molecule exist as $O^+_2[PtF_6]^-$

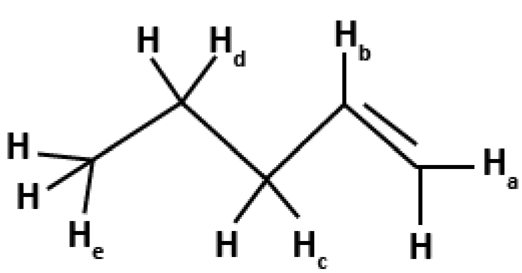
Now, Let oxidation number be 'O' atom in O_2^+ be x.

So, $2x = +1$

$x = +\frac{1}{2}$

So, correct answer for this is option (c).

26. When attacked by $Br^{\cdot}$, which H- atom will be replaced most readily?



(a) H_a

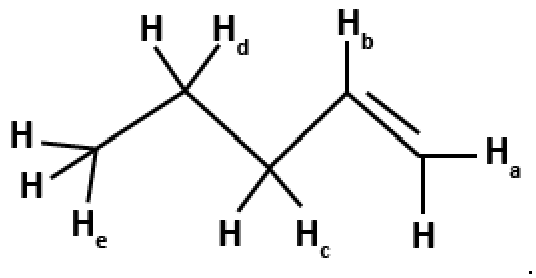
(b) H_b

(c) H_c

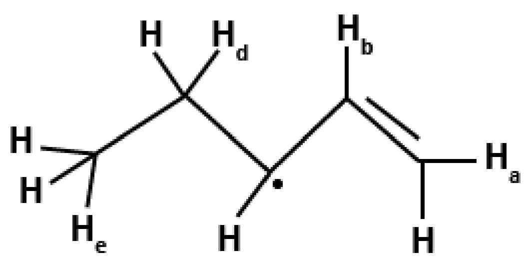
(d) H_d

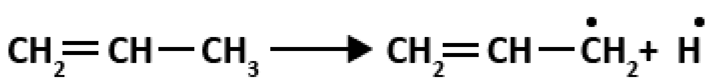
Sol. (c)

$H^{\cdot} + Br^{\cdot} \rightarrow HBr$



In the above compound, if H_c is removed allylic radical is formed which is resonance stabilized.





So, correct answer is (c).

27. Consider the molecules having formula $C_{10}H_{16}$. Which of the following structural features are not possible within this set of molecules ?

(a)2 triple bonds

(b) 1 ring and 1 triple bond

(c)3 double bonds

(d)None of these

Sol. (a)

Degree of unsaturation,

$$DU = \frac{[(2n_C+2) - (n_H + n_X - n_N)]}{2}$$

where , n_C = No. of carbon atoms

n_H = No. of Hydrogen atoms

n_X = No. of halogen atoms

n_N = No. of N atoms

So, for $C_{10}H_{16}$, $DU = \frac{[(2\times10+2)-(16+0-0)]}{2}$

$= 11 - 8 = 3$

(a) One triple bond is equivalent to two double bond. So, for 2 triple bonds, DU =4
(b) For one ring, DU =1 and for one triple bond, DU=2 So, overall DU=3
(c) For one double bond, DU =1, so for 3 double bond, DU =$3 \times 1 = 3$,
(d) None

Hence, correct answer is (a).

28. Which metal adsorbs hydrogen to large extent?

a) Al
b) Cr
c) Pd
d) Zn

Sol. (c)

Palladium acts as a good adsorbent and used in hydrogenation reaction due to its adsorption property.

So, correct answer is (c).

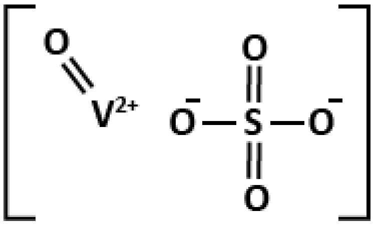
29. Among the following the compound which is both paramagnetic and coloured is:

a) $K_2Cr_2O_7$
b) $(NH_4)_2[TiCl_6]$
c) $VOSO_4$
d) $K_3[Cu(CN)_4]$

Sol. (c)

Among, given options $VOSO_4$ will be both paramagnetic and coloured both

- Vanadyl sulphate



Cation is VO^{2+}

Let oxidation state of $V = x$

$x - 2 = + 2$

$x = + 4$

Atomic number of $V = 23 \rightarrow [Ar]\, 3d^3 4S^2$

$\rightarrow$ So, for $V^{4+} = [Ar]\, 3d^1 4S^0$

So, its V^{4+} has 1 unpaired electron.

So, it is both coloured and paramagnetic

So, right option is (c). .

30. A mixture of HCOOH and $H_2C_2O_4$ is heated with Conc.H_2SO_4. The gases produced were passed through KOH solution where their volume decreased by $\frac{1}{6}$. Ratio of two acids in the mixture :

a) 1: 4

b) 4 : 1

c) 1 : 1

d) data insufficient

Sol. (b)

Let moles of HCOOH and $H_2C_2O_4$ taken are x and y respectively.

$$\underset{x}{HCOOH} \xrightarrow[\Delta]{Conc.H_2SO_4} H_2O + \underset{x}{CO}$$

$$\underset{y}{H_2C_2O_4} \xrightarrow[\Delta]{Conc.H_2SO_4} H_2O + \underset{y}{CO_2} + \underset{y}{CO}$$

Total moles of gases = $x + y + y \Rightarrow$ 2y +x

After absorption with KOH, total volume left is $\frac{1}{6}^{th}$ of initial volume

i.e., $\frac{1}{6}[2y + x]$.

As absorbed gas is CO_2 only. So,

$y = \frac{1}{6}[2y + x] \Rightarrow 6y = 2y + x$

$x = 4y \rightarrow x : y = 4 : 1$

So, Option (b) is correct.

31. The correct order of energy levels in H- atom is

a) 3s = 3p=3d > 2s

b) 3d > 3p > 3s > 2s

c) 3d > 3p= 3s > 2s

d) 3d > 3p > 3s = 2s

Sol. (a)

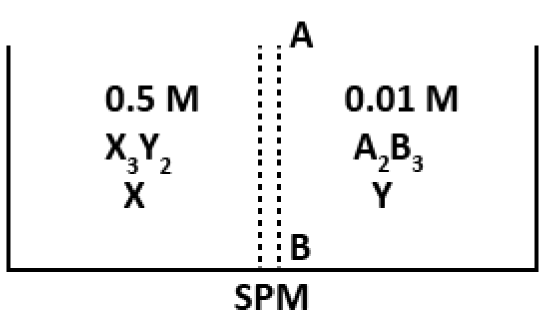
Correct order of energy levels for Hydrogen is

3s = 3p=3d > 2s

As Hydrogen is unielectron atom So, in Hydrogen energy of different shells and subshells depends only upon principal quantum number (n).

Correct option is ‘a’. .

32. X_3Y_2 when reacts with A_2B_3 in aqueous solution, it given brown colour. These are separated by a semipermeable membrane AB as shown in figure. Assuming that electrolytes are completely ionized in solution then due to osmosis there is:



a) Brown colour formation in side X

b) Brown colour formation in side Y

c) Brown colour is formed in both sides X and Y

d) No brown colour formation in sides X or Y

Sol. (d)

As in this case brown colour appears only when both X_3Y_2 & A_2B_3 meets up. But as we know through semi permeable membrane solute can't pass. So, it will not pass to either side i.e., X or Y .So no colour will be formed.

Correct option is '(d)'.

33. A particle of mass 0.3 kg starts moving from rest, in one dimension, under a force that delivers constant power $P = 1.5$ watt. The kinetic energy of the particle will be $K.E = 15$ Joule after a time of

a) $5\,S$

b) $10\,S$

c) $12\,S$

d) $15\,S$

Sol. (b)

$m = 0.3\,kg$

$P = 1.5\,watt$

Change in kinetic Energy.$(\Delta\,K.E.) = 15\,J$

By Work Energy theorem

$W_f = \Delta K.E$

$P \times t = 15$

$1.5 \times t = 15$

$t = \frac{15}{1.5}$

$t = 10\,sec$

∴ Option (b) is correct.

34. A trolley of mass $200\,kg$ carrying a sandbag of mass $20\,kg$ is moving on a frictionless horizontal track with speed $36\,km/hr$. After a while, sand starts leaking out of the bag on the floor of the trolley at the rate $0.04\,kg/sec$. What is the speed of trolley after the entire sand bag is empty?

a) $8\,m/S$

b) $9.2\,m/S$

c) $10\,m/S$

d) $10.8\,m/S$

Sol.

$m_1 = 200\,kg$

$m_2 = 20\,kg$

$V_{system} = 36\,km/h = 36 \times \frac{5}{18} = 10\,m/s$

Initial momentum of the system $(p_i) = (m_1 + m_2)V_{sys}$

$= (200 + 20) \times 10$

$p_i = 2200\,kg\,m/s$

As the sand is leaking and still remaining in the trolley.

Total mass of the trolley still remain same by conservation of momentum

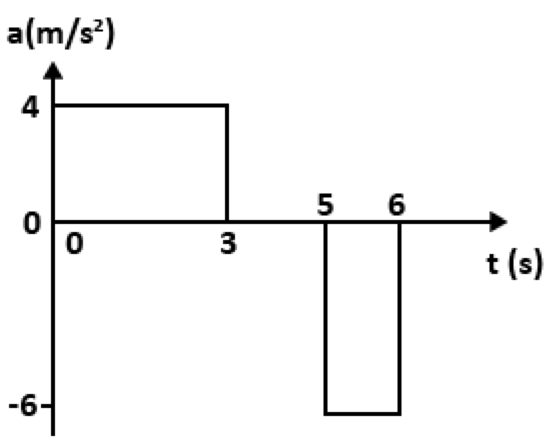
$p_i = p_f$

$2200 = 220 \times v_f$

$v_f = 10\,m/s$

∴ option (c) is correct.

35. A particle, initially at rest at origin, starts moving under acceleration a along positive x direction. The acceleration versus time graph is shown in figure.



The displacement and the velocity of the particle after 6 second are:

a) 51 meter, 6 m/s

b) 33 meter, 6 m/s

c) 42 meter, 18 m/s

d) 27 meter, 24 m/s

Sol. (a)

In time $0 - 3\ sec$

$\Delta v = 4 \times 3 = 12\ m/s$

$\because$ Initial velocity $(v_1) = 0$

$\therefore v_2 - v_1 = 12\ m/s$

$v_2 = 12\ m/s$

In time $5 - 6\ sec$

$\Delta v = -\ 6 \times 1 = -\ 6\ m/s$

$\because$ Initial velocity at $5\ sec\ (v_2) = 12\ m/s$

$\therefore v_3 - v_2 = -\ 6$

$v_3 = -\ 6 + 12$

$v_3 = 6\ m/s$

$\therefore$ final velocity is $6\ m/s$

Distance traveled in $0 - 3\ sec\ (S_1) = \frac{V_2^2 - V_1^2}{2a} = \frac{(12)^2 - 0}{2 \times 4}$

$S_1 = \frac{12 \times 12}{2 \times 4} = 18\ m$

Distance traveled in $3 - 5\ sec\ (S_2) = v_2 \times t$

$= 12 \times 2$

$= 24\ m$

Distance traveled in $5 - 6\ sec\ (S_3) = \frac{V_3^2 - V_2^2}{2 \times a}$

$S_3 = \frac{(6)^2-(12)^2}{2\times-6} = 9\, m$

Total displacement $= S_1 + S_2 + S_3 = 18 + 24 + 9$

$= 51\, m$

∴ option (a) is correct

36. Gravitational potential energy of a system of two particles of masses m_1 and m_2, separated by distance r, is given by $U = -\frac{Gm_1m_2}{r}$, where G is the universal Gravitational constant.

Consider two stars, each of mass M, initially separated by distance d and at rest with respect to each other. The two stars start moving towards each other under their mutual gravitational attraction. The stars can be treated as point objects and motion is assumed non-relativistic. As measured from the laboratory frame, the speed of each star when they are at a distance $\frac{d}{2}$ apart from each other is

a) $\sqrt{\frac{GM}{d}}$

b) $\sqrt{\frac{2GM}{d}}$

c) $\sqrt{\frac{GM}{2d}}$

d) $\sqrt{\frac{GM}{4d}}$

Sol. (a)

Initial $P.E(U_1) = \frac{-GM^2}{d}$

Initial $K.E(K_1) = O$

final $P.E.(U_2) = -\frac{GM^2}{\frac{d}{2}} = \frac{-2GM^2}{d}$

Let final $K.E$ be K_2

By conservation of Energy

$K_1 + U_1 = U_2 + K_2$

$K_2 = U_1 - U_2 = \frac{-GM^2}{d} - \left(\frac{-2GM^2}{d}\right)$

$K_2 = -\frac{GM^2}{d} + \frac{2GM^2}{d}$

$K_2 = \frac{GM^2}{d}$

$\frac{1}{2}MV^2 + \frac{1}{2}MV^2 = \frac{GM^2}{d}$

$$V^2 = \frac{GM}{d}$$

$\Rightarrow v_f = \sqrt{\frac{GM}{d}}$

∴ option (a) is correct.

37. An engine approaches a vertical cliff with constant speed $72\ km/hour$. When the engine is at a distance $0.7\ km$ from the cliff, it blows a whistle. The driver hears the echo after a time (Speed of sound in air is $330\ m/s$.)

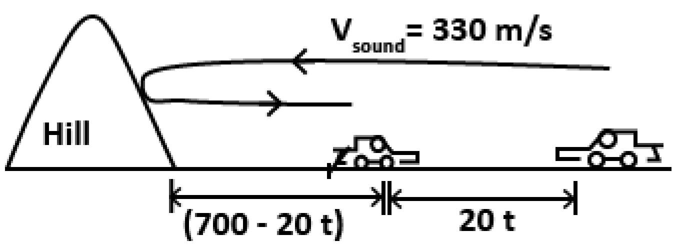
a) $3.88\ S$

b) $4.00\ S$

c) $4.12\ S$

d) $4.24\ S$

Sol.



Let's suppose the echo heard by driver in time 't' after blows the whistle

∴ In this time, distance covered by car $= 20\ t$

∴ In this time distance covered by Sound $(d) = 700 + (700 - 20t)$

$$= 1400 - 20t$$

And we know

$(d) = V_{sound} \times t$

$1400 - 20t = 330t$

$$t = \frac{1400}{350} = 4\ sec$$

Correct option:- (b)

38. A vessel contains a liquid $-\ 1$ of density $0.8\ gm/cm^3$ over a liquid $-\ 2$ of density $13.6\ gm/cm^3$. The two liquids are immiscible. A homogeneous solid sphere floats with half of its volume immersed in liquid $-\ 1$ and other half in liquid $-\ 2$. The density of the material of the sphere in gm/cm^3 is

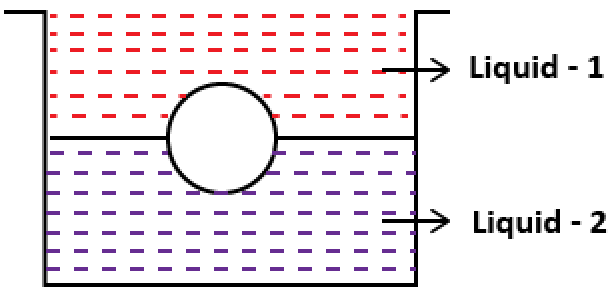
a) 3.3

b) 6.4

c) 7.2

d) 12.8

Sol.



As the sphere floats in the liquid. Therefore, it’s weight will be equal to the upthrust force on it.

Weight of sphere = $\frac{4}{3}\pi R^3\rho g$ ...(i)

Upthrust due to liquid $-$ 1 and liquid $-$ 2

$= \frac{2}{3}\pi R^3\sigma_{liq-1}g + \frac{2}{3}\pi R^3\sigma_{liq-2}g$ ...(ii)

Equating (i) and (ii)

$\frac{4}{3}\pi R^3\rho g = \frac{2}{3}\pi R^3 \times 0.8\, g + \frac{2}{3}\pi R^3 \times 13.6\, g$

$\Rightarrow 2\rho = 0.8 + 13.6 = 14.4$

$\Rightarrow \rho = 7.2\ gm/cm^3$

Option c is correct

39. One fine morning, Mr. Ravi visited Gandhi park with his grandson. When he was just on a bridge over the lake in the park, an old wooden toy ‘just’ dropped from his hand. The toy went straight down to hit surface of calm water, then sinked into water to a certain depth below water surface and returns back due to upthrust of water to the hands of Mr.Ravi in the same position from where it was dropped. Assuming this position to be at height 19.6 meter above the surface of water, and density of material of toy to be just half the density of water in lake, the total time in which toy is received back to the hand of Mr. Ravi is calculated to be

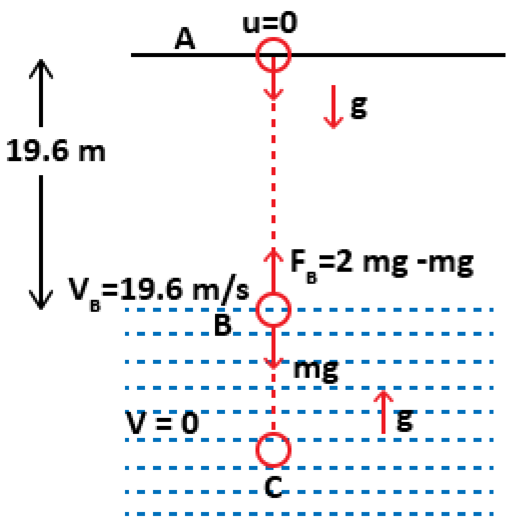
a) 2 second

b) 4 second

c) 8 second

d) 16 second

Sol.



Velocity at $B \rightarrow$

from III^{rd} equation of motion $\rightarrow$

$v_B^2 = 0 + 2 \times 9.8 \times 19.6$

$V_B = 19.6\, m/s$

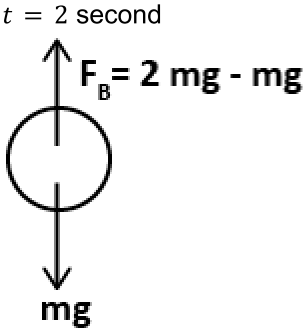
Hence time taken from A to B $\rightarrow$

From I^{st} equation of motion

$19.6 = 9.8\, t \Rightarrow t = 2\, sec$

Time taken from B to $C \rightarrow$

We know at C, the velocity become zero,
Hence, $O = 19.6 - 9.8t$
$t = 2$ second

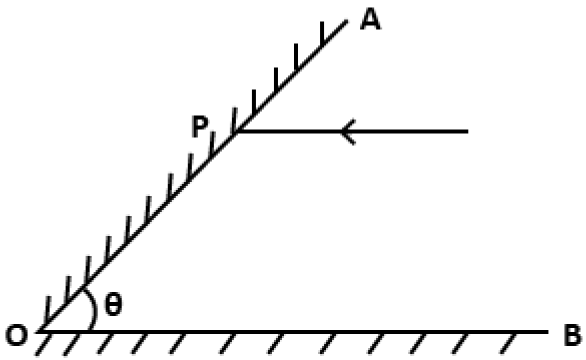


Then time taken from C to B is also same as B to C and time taken from B to A is same as A to B.
Hence Total time $(T) = t_{AB} + t_{BC} + t_{CB} + t_{BA}$

$T = 2 + 2 + 2 + 2 = 8$ second

Correct option (c).

40. Two plane mirrors OA and OB are inclined at an angle θ as shown in figure. A ray of light incident parallel to BO strikes the mirror OA at point P. It gets reflected from mirror OA and then reflected from the mirror OB, the ray finally emerges parallel to OA. The value of angle θ is



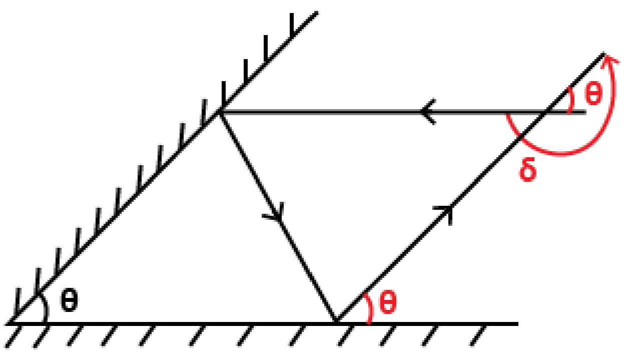
a) 90^0

b) 60^0

c) 45^0

d) 30^0

Sol. (b)



According to geometry

net deviation = $180^0 + \theta$

And we know

Formula δ

$\delta_{net} = 2(\pi - \theta)$

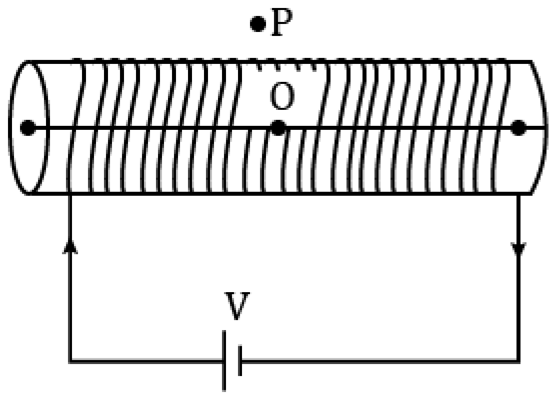
$180^0 + \theta = 2\pi - 2\theta$ $\{2\pi = 360^0\}$

$3\theta = 360^0 - 180^0$

$\theta = 60^0$

Correct option (b)

41. A long solenoid of length $2\ m$ and radius $10\ cm$ having 2000 turns per meter carries a current of $1.0\ A$. The strength of magnetic field (B) is maximum at point



a) A at the left end

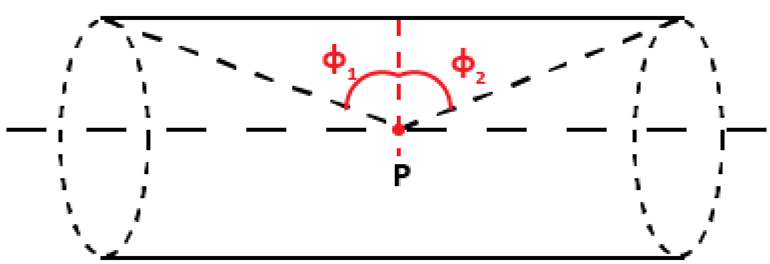
b) B at the right end

c) O at the center of solenoid

d) P outside the solenoid

Sol. (c)

For a solenoid



$B = \frac{\mu_0 ni}{2}\{\sin\theta_1 + \sin\theta_2\}$

$\mu_0 \rightarrow$ Permeability of free space

$n \rightarrow$ turns per unit length

$i \rightarrow$ current

For a long Solenoid at center point $'P'$ $\phi_1 = \phi_2 = \frac{\pi}{2}$

$B = \frac{\mu_0 ni}{2}\left\{\sin\frac{\pi}{2} + \sin\frac{\pi}{2}\right\}$

$B = \mu_0 ni \rightarrow$ maximum magnetic field at center.

42. A tank with a square base of area $2.0\ meter^2$ is divided by a vertical partition in the middle. The bottom of the partition has a small hinged door of area $10\ cm^2$. The tank is filled with water in one compartment and a liquid of relative density 1.8 in other compartment, both to a height 5.0 meter. The force necessary to keep the door close is approximately ($g = 9.8\ m/s^2$)

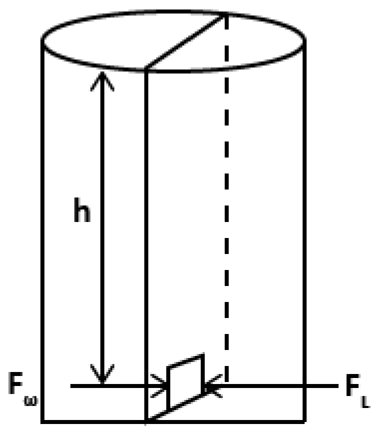
a) $0.04\ N$

b) $3.9\ N$

c) $39\ N$

d) Zero

Sol. (c)



$\delta_L = \delta_W \times 1.8$

$\delta_L = 1800\ kg/m^3$

$A = 10\ cm^2 = 10 \times 10^{-4}$

$= 10^{-3} m^2$

F_W = Force exerted by water

F_L = Force exerted by liquid

$F_W = (\rho_w gh + P_{atm})A$

$F_L = (\rho_L gh + P_{atm})A$

$F_{net} = F_L - F_W$

$= (\rho_L gh + P_{atm})A - (\rho_w gh + P_{atm})A$

$= (\rho_L - \rho_W)ghA$

$= (1800 - 1000) \times 9.8 \times 5 \times 10^{-3}$

$= 800 \times 9.8 \times 5 \times 10^{-3}$

$= 39.2\ N$

Option (c)

43. An electron is projected horizontally towards east in uniform magnetic field B. The electron is deflected towards north by the magnetic field. The magnetic field is directed

a) East wards

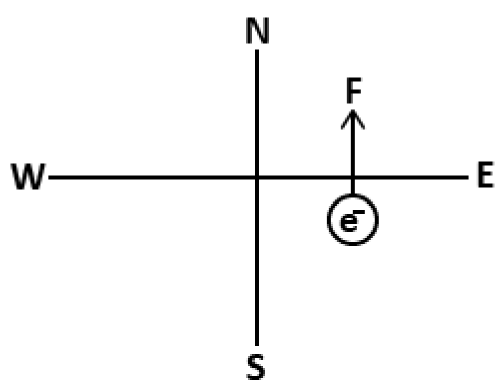
b) West wards

c) Upward

d) Downward

Sol. (c)

By applying Fleming's left hand.



As force acting on negative charge is in the north direction, so force on positive charge will be in south direction, hence the magnetic field will be in upward direction.

44. Sir CV raman announced the discovery of Raman Effect on February $28, 1928$. He received 1930 Nobel prize in Physics for this discovery. Raman Effect is the discovery of

a) Dispersion of light

b) Total Internal Reflection of light

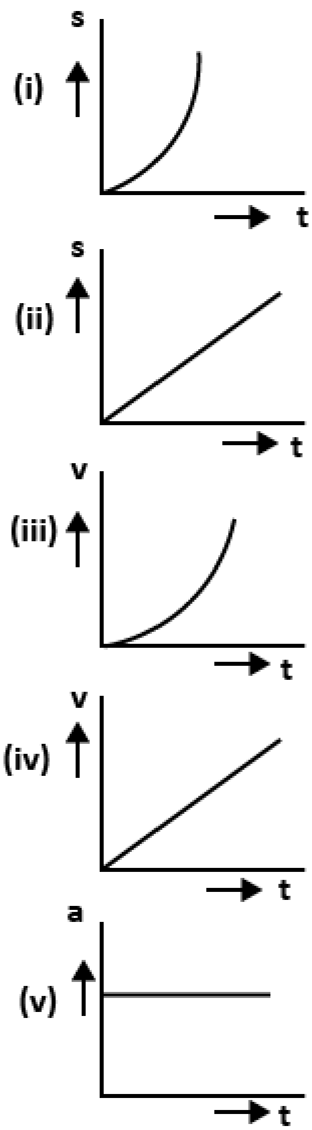
c) Refraction of light

d) Inelastic scattering of light

Sol. (d)

Raman scattering or Raman effect is the inelastic scattering of photons by matter, meaning that there is both an exchange of energy and a change in light’s direction.

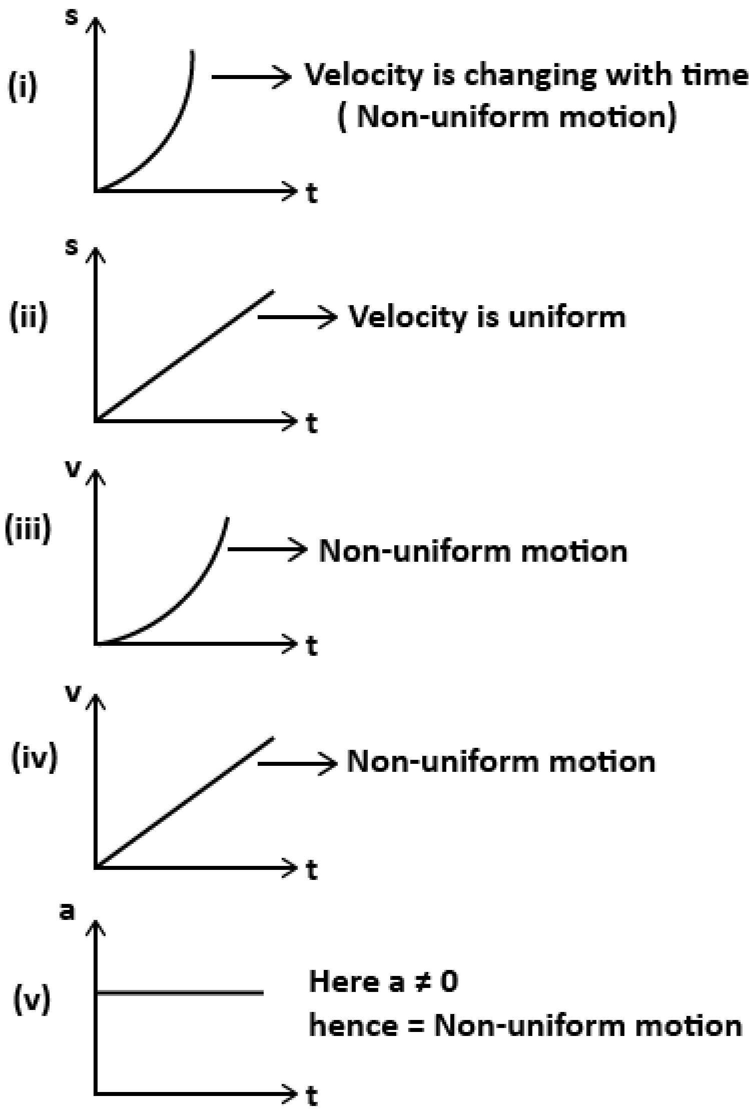
45. Figures (i) to (v) show graphical representation of motion in one-dimension. Here s,v, a and t represent the displacement, the velocity, the acceleration and the time respectively.



Which of the above graphs represent uniform motion ?

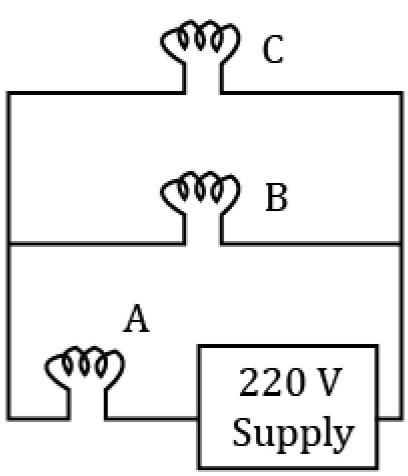
(a) (i) only
(b) (ii) only
(c) (i) (iv) and (v)
(d) (iv) and (v)

Sol.



Hence option (b) is correct.

46. Three identical electric bulbs A, B and C having specification $60\ W, 220\ V$ are connected across a $220\ V$ supply as shown. The total power dissipated in three bulbs is close to



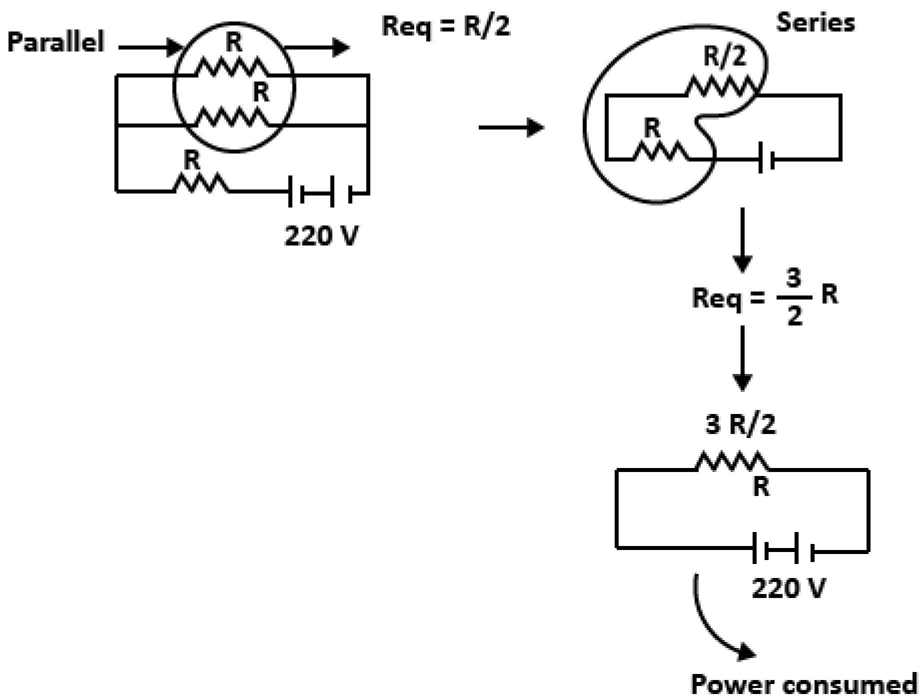
a) $180\ W$

b) $60\ W$

c) $30\ W$

d) $40\ W$

Sol. (d)



Given: $(60\ W, 220\ V)$

$\downarrow \quad \downarrow$

$P_r \quad V_r$

P_r = rated power

V_r = rated voltage

$R = \frac{V_r^2}{P_r} = \left(\frac{220\times220}{60}\right)\Omega$

Power consumed $\Rightarrow P_C = \frac{V^2}{R_{eq}} = \frac{220\times220}{\frac{3R}{2}}$

$\Rightarrow P_C = \frac{2\times220\times220}{3\times\frac{220\times220}{60}}$

$= \frac{2\times60}{3}$

$P_C = 40\ W$

Option (d)

47. A copper wire is stretched to decrease its radius by 0.15%. The percentage change in the resistance of wire is

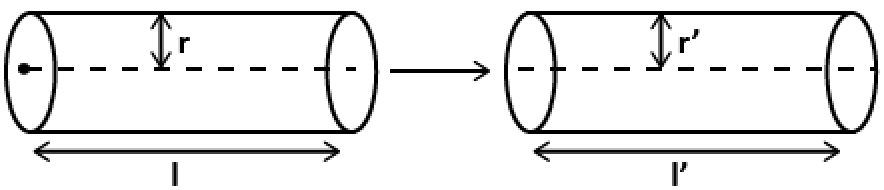
a) $+\ 0.3\%$

b) $-\ 0.3\%$

c) $+\ 0.6\%$

d) $-\ 0.6\%$

Sol.



$\because R = \frac{\rho l}{A}$ ...(1)

Volume of the conductor remain same

$V = A \times l$

So, $l = \left(\frac{V}{A}\right)$ ...(2)

From eq (1) & (2)

$R = \frac{\delta \times \frac{V}{A}}{A} = \frac{\delta V}{A^2}$

$\because A = \pi r^2$

$R = \frac{\delta V}{(\pi r^2)^2} = \left(\frac{\delta V}{\pi^2 \times r^4}\right)$

Now apply error method

$\frac{\Delta R}{R} \times 100 = \frac{\Delta \delta}{\delta} \times 100 + \frac{\Delta V}{V} \times 100 + 4 \times \left(\frac{\Delta r}{r} \times 100\right)$

$= 4 \times (0.15)$

$\frac{\Delta R}{R} \times 100 = 0.6\%$

Hence : option (c)

48. Speed of sound in air is directly proportional to square root of absolute temperature of air (keeping other parameters constant). The speed of sound in air at $273\ K$ and 1 atm is $332\ m/s$.On a clear day, when temperature in the laboratory was $27^{0}C$, an experiment was performed to measure the speed of sound in air in the laboratory. The measured value comes out to be $352\ m/s$. the percentage error in this measurement is

a) 0.2%

b) 1.15%

c) 3.15%

d) 6.02%

Sol. (b)

Given: $V \alpha \sqrt{T} \Rightarrow V = K\sqrt{T}$

at $T_0 = 273k, P_\alpha = 1\ atm, V_0 = 332 m/s$

at $T = 27^{0}C = 273 + 27 = 300\ k$

Measured value $= V_m = 352\ m/s$

let V_ϵ = Exact speed of sound at $300\ k$

$\because V_0 = k\sqrt{273}$

$V_\epsilon = \sqrt{300}$

$\frac{V_\epsilon}{V_0} = \sqrt{\frac{300}{273}} = 1.048$

$V_\epsilon = 1.048 \times V_0 = 1.048 \times 332$

$V_\epsilon = 348\ m/s$

% age error:- $\left|\frac{\Delta V}{V_\epsilon}\right| \times 100 = \frac{|V_\epsilon - V_m|}{V_\epsilon} \times 100$

$= \left|\frac{348-352}{348}\right| \times 100$

$= \left|\frac{4}{348}\right| \times 100 = 1.149\%$

$= 1.15\%$

Option (b) is correct.

49. Which of the following evolutionary lineages of man can be categorized under prehistoric man?

a) *Ramapithecus*

b) *Homo habilis*

c) *Homo sapiens fossilis*

d) *Homo heidelbergensis*

Sol. (b) and (d)

Human evolution is generally studied with the evolution of apes as they are closely related to man than any other animal.

Ramapithecus evolved prior to ape man.

Homo habilis and *Homo heidelbergensis* are categorized under prehistoric man whereas *Homo sapiens fossils* is

categorized under historic man.

Ans: (b) and (d)

50. Select the set of diseases caused by deficiency of $B-$ complex Vitamins:

a) Beri-Beri & Pelagra

b) Dermatitis & Wernicke-Korsakoff Syndrome

c) Cheilosis & Pernicious anaemia

d) Marasmus & Kwashiorkor

Sol. (a,b & c)

The diseases in options a, b & c are vitamin-B complex deficiency diseases while Kwashiorkor and Marasmus are protein deficiency diseases.

Vitamin	Deficiency Diseases
B_1	Beri-Beri, Wernicke Korsakoff syndrome
B_2	Cheilosis
B_3	Pellagra
B_6	Dermatitis
B_{12}	Pernicious anaemia

51. After rainy season, a Biology teacher took the students on a plant collection tour. From a pond, they collected a beaker of water with aquatic plants in it. The students are likely to find which of the following organisms in it?

a) *Spirogyra, Azolla, Riccia fluitans* & *Cosmarium*

b) *Ulothrix, Chlorella, Chara* & *Ricciocarpus natans*

c) *Marchantia, Funaria, Lycopodium* & *Gnetum*

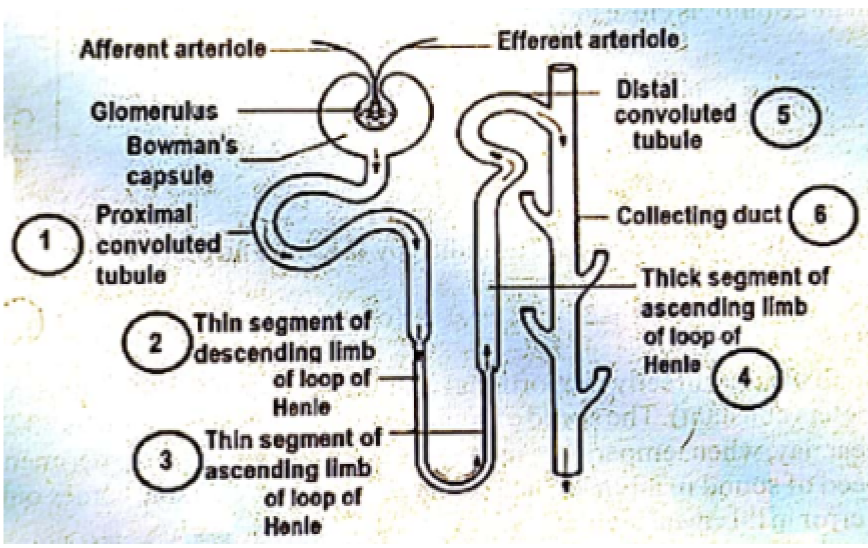
d) *Salvinia molesta, Azolla, Chlorella* & *Cladophora*

Sol. (a,b,d)

Water was collected from pond, which means it will have the presence of freshwater plants.

In option C, *Gnetum* is a Gymnosperm and *Lycopodium* is a Pteridophyta. Both are land plants.

52. Various parts of mammalian uriniferous tubules (nephrons), play an important role in Urine formation through processes like ultrafiltration, selective reabsorption by active transport, reabsorption by passive osmosis and secretion. While the filtrate flows through different parts of the uriniferous tubules (Numbered 1-6 in the diagram given below), not only its volume is reduced but its composition is also considerably changed, due to exchange of materials between the filtrate and the blood of the peritubular capillaries.



From among the numbered parts (1-6) in the above diagram, the options are given in a manner that they highlight two aspects separately, i.e., parts(s) having columnar epithelial cells with 'brush border', suitable for reabsorption and those parts completely or poorly permeable to water. Select-out the desired options :

a) $4, 5$

b) 1

c) $2, 3$

d) $2, 3, 6$

Sol. (b,c,d)

Descending limb is permeable to water and the ascending limb of the loop of Henle is impermeable/poorly permeable to water.

Proximal convoluted tubule is lined by simple cuboidal brush border epithelium.

Loop of Henle is lined by simple squamous epithelium.

Collecting duct is also permeable to water and is lined by cuboidal epithelium.

80% water is reabsorbed in PCT.

Option : B,C,D are correct.

53. The $0.01\ M\ NH_4Cl$ solution at 25^0C has:

a) $[Cl^-_{aq}] < 10^{-2}M$

b) $[NH^-_{4\ aq}] < 10^{-2}M$

c) $pOH > 7$

d) $[H^+] < 10^{-7}M$

Sol. (b,c,d)

$NH_4Cl + H_2O \leftleftharpoons NH_4OH + HCl$

$NH_4^+ + Cl^- + H_2O \leftleftharpoons NH_4OH + H^+ + Cl^-$

$NH_4^+ + H_2O \leftleftharpoons NH_4OH + H^+$

NH_4Cl is a salt of strong acid and weak base. It does not ionise completely as shown above.

Its solution would be acidic in nature since it produce H^+ ions.

$\therefore\ [NH_4^+] < 10^{-2}M,$

$[H^+] > 10^{-7}M$ and

$pOH > 7$

Hence, the correct options are (b),(c),(d).

54. Amphoteric nature of AI_2O_3 is employed in which of the following process/es?

a) Bayer's process

b) Hall's process

c) Serpek's process

d) Dow's process

Sol. a & b

In Hall's process :

Concentration of Bauxite is done by :-

$AI_2O_3.2H_{2o}(S) + Na_2CO_3(aq) \rightarrow 2NaAIO_2(aq) + CO_2(g) + 2H_2O(R)$

$2NaAIO_2(aq) + 3H_2O + CO_2(g) \rightarrow 2AI(OH)_3 \downarrow + Na_2CO_3$

$AI(OH)_3 \xrightarrow{\Delta} AI_2O_3 + 3H_2O$

Alumina (Pure)

Bayer's process : Concentration of Bauxite :

$$AI_2O_3.2H_{2o} + 2NaOH \rightarrow 2NaAIO_2 + 2H_2O$$

(Impure) $NaAIO_2 + 2H_2O \rightarrow AI_2(OH)_3 \downarrow + NaOH$

$AI(OH)_3 \xrightarrow{\Delta} AI_2O_3 + 3H_2O$

Alumina (Pure)

Answer: In both option A and B Amphoteric nature of AI_2O_3 is employed.

55. As a general trend the First Ionization Energy (IE_1) of elements decreases on moving down in a group in the periodic table. Keeping the observation in mind select the correct order of elements with respect to their IE_1

I. $Li > Na > K > Rb > CS > Fr$

II. $Li > Na > K > Rb > CS < Fr$

III. $Sr < Ba > Ra$

IV. $Sr > Ba < Ra$

V. $Cu > Ag > Au$

VI. $Cu > Ag < Au$

VII. $Cd > Hg$

VIII. $Cd < Hg$

a) I, V, VII

b) $II, IV, VIII$

c) III, V, VII

d) $II, VI, VIII$

Sol. (b,d)

For alkali metals, the order of IE_1, is $Li > Na > K > Rb > Cs < Fr$

Francium has slightly greater IE_1, than Cs due to relativistic effect.

- Order of IE_1 for Sr, Ba and Ra is $Ra > Sr > Ba$

Ra has poor shielding due to the lanthanoid contraction.

So, order will be $Sr > Ba < Ra$

- $Cu - 3d^{10}4s^1$

– $Ag - 4d^{10}5s^1$

$Au - 4f^{14}5d^{10}6s^1$

In Cu, $4s$ electron has to be removed while in Ag, $5s$ electron has to be removed. So, IE_1 of $Cu > Ag$

For Au, due to improper shielding nuclear charge increases. So, $Au > Ag$.

So, order is $Au > Cu > Ag$

So, order will be $Cu > Ag < Au$

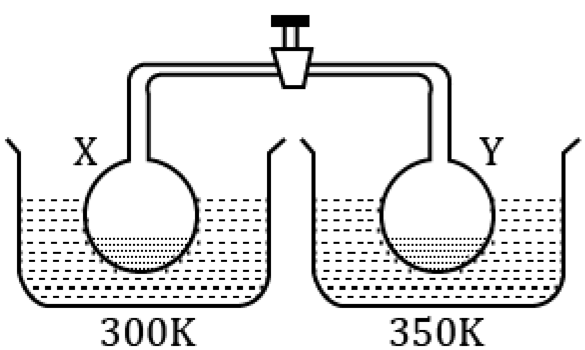
- Hg has week shielding of f –orbitals.

So, $Hg > Cd$.

So, statement $II, IV, VI, VIII$ are correct.

∴ Correct answer is (b) and (d).

56. Two containers each containing water in liquid state are connected by a valve as shown in the diagram



Given that vapour pressure of water at $300\ K$ and $350\ K$ are 22 torr and 40 torr, select correct statement(s):

a) The final pressure in each container after the valve is opened, while keeping the containers at their respective temperatures, is equal but more than 22 torr.

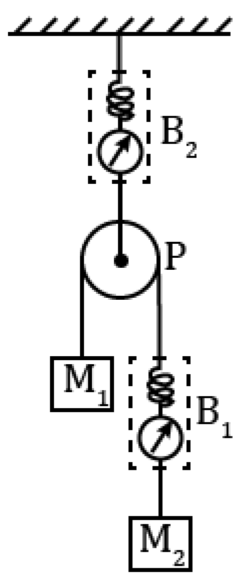
b) The final pressure in each container after the vale is opened, while keeping the containers at their respective temperatures, is 40 torr.
c) Mass of water is decreased in container X.
d) Mass of water is decreased in container Y.

Sol. (a & d)

The vapour pressure in container Y is higher than vapour pressure in the container X. When the valve is opened, vapours from X will rush towards Y side & a new physical equilibrium will be re-established. As temperature an Y side is higher it will produce more vapours & mass of water will decrease on Y side but it will increase on X side. So, final pressure of both sides will be equal, but higher than 22 torr.

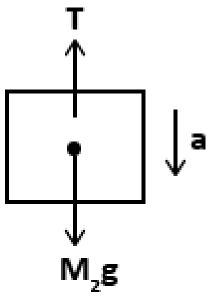
So, the right options are both a & d.

57. Two blocks M_1 and M_2 of masses $3\ kg$ and $6\ kg$ respectively are connected through a string and spring balance B_1. The string passes over a massless and frictionless pulley P. The pulley is suspended from a rigid support through spring balance B_2. Strings are massless and inextensible. Masses of spring balances are negligible. The system is released from rest. At the instant when masses M_1 and M_2 are moving with same speed $(g = 9.8\ m/sec^2)$

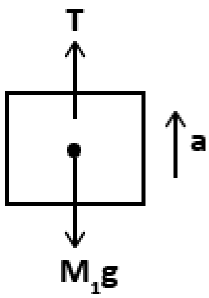


a) reading of B_1 is $4.5\ kg\ wt$.
b) reading of B_1 is $4.0\ kg\ wt$.
c) reading of B_2 is $9.8\ kg\ wt$.
d) acceleration of M_1 is $\frac{9.8}{3} mS^{-2}$

Sol.



$M_2 g - T = M_2 a$ ...(1)



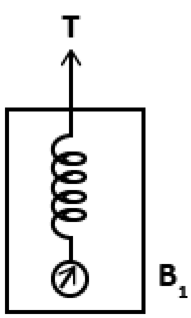
$T - M_1 g = M_1 a$ ...(2)

(1)+(2)

$(M_2 - M_1)g = (M_1 + M_2)a$

$a = \left(\frac{M_2 - M_1}{M_1 + M_2}\right)g = \left(\frac{6-3}{9}\right) \times 9.8$

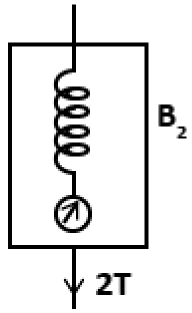
$a = \frac{9.8}{3} m/S^2$



$B_1 = T = \frac{2m_1 m_2}{m_1 + m_2} \times g = \frac{2\times6\times3}{6+3} \times 9.8$

$B_1 = \frac{2\times6\times3}{9} \times 9.8 = 4 \times 9.8$

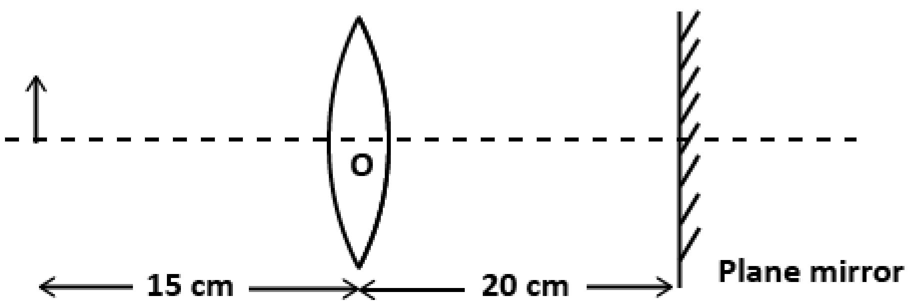
$B_1 = 4\, kg\, wt$



$B_2 = 2T = 2 \times 4 = 8\, kg\, wt$

∴ Option (b,d) are correct.

5**8.** Focal length of a thin convex lens is $10\ cm$. An object is placed at a distance $15\ cm$ in front of the lens and a plane mirror is kept at $20\ cm$ on the other side as shown in figure.



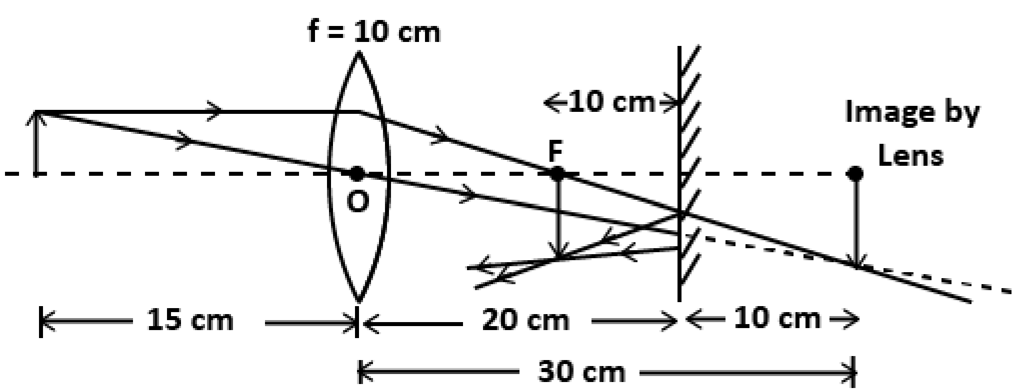
a) The final image is formed at distance $10\ cm$ from lens towards the mirror

b) The final image is formed at a distance $30\ cm$ from lens means $10\ cm$ behind the mirror.

c) The final image has magnification $m =- 2$

d) The final image has magnification $m =+ 2$

Sol.



By Applying Len’s formula

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

This image acts as a virtual object for the mirror, and by properties of the plane mirror.

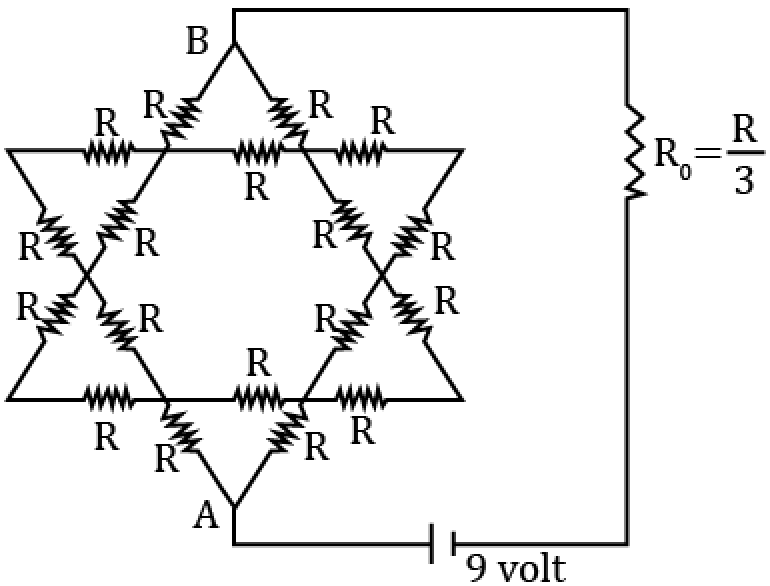
Final image will be formed at

Distance $10\ cm$ from the lens towards the mirror, and Magnification

$m = \frac{v}{u} = \frac{30}{-15} =- 2$

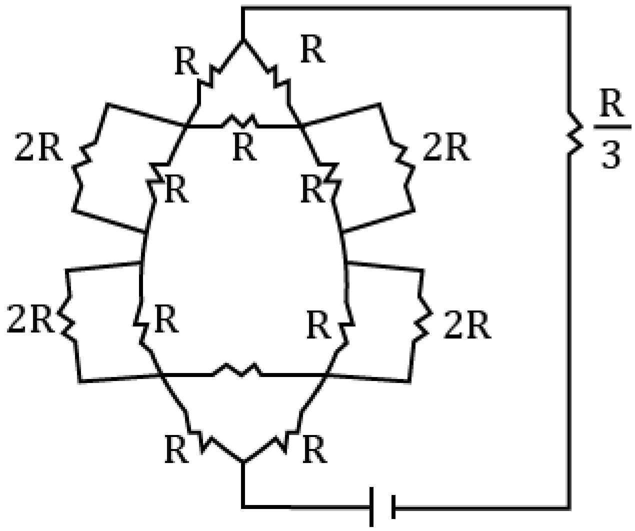
Correct option (a) and (c)

59. Given network of 18 resistors, each equal to $R = 3\ \Omega$, is connected in series with resistor R_0 to a source $emf = 9\ volt$. Choose the correct option.

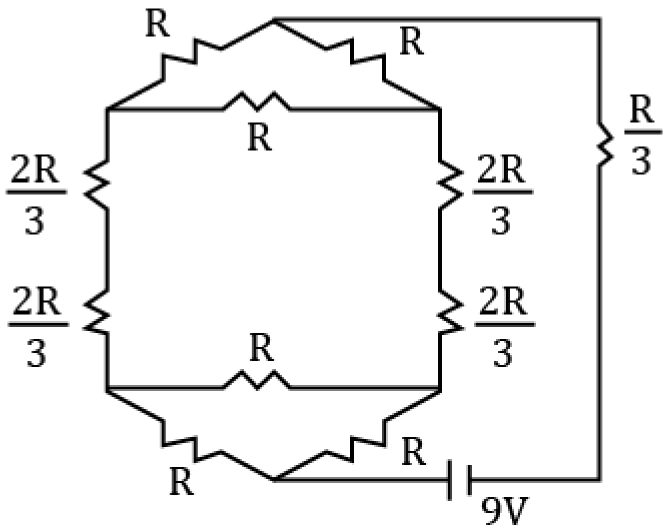


a) Current drawn from battery is $1.5\ A$
b) Potential difference between A and B is $7.5\ V$
c) Electrical power dissipated in R_0 is 2.25 watt
d) Electrical power dissipated in network between A and B is 12.25 watt.

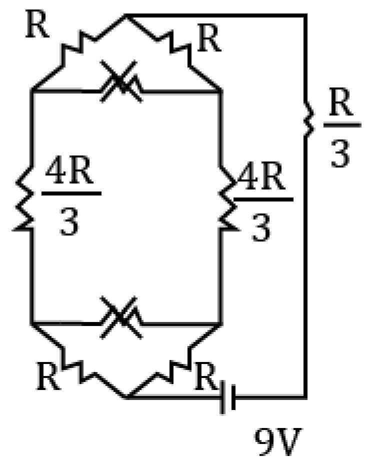
Sol. (a,b & c).

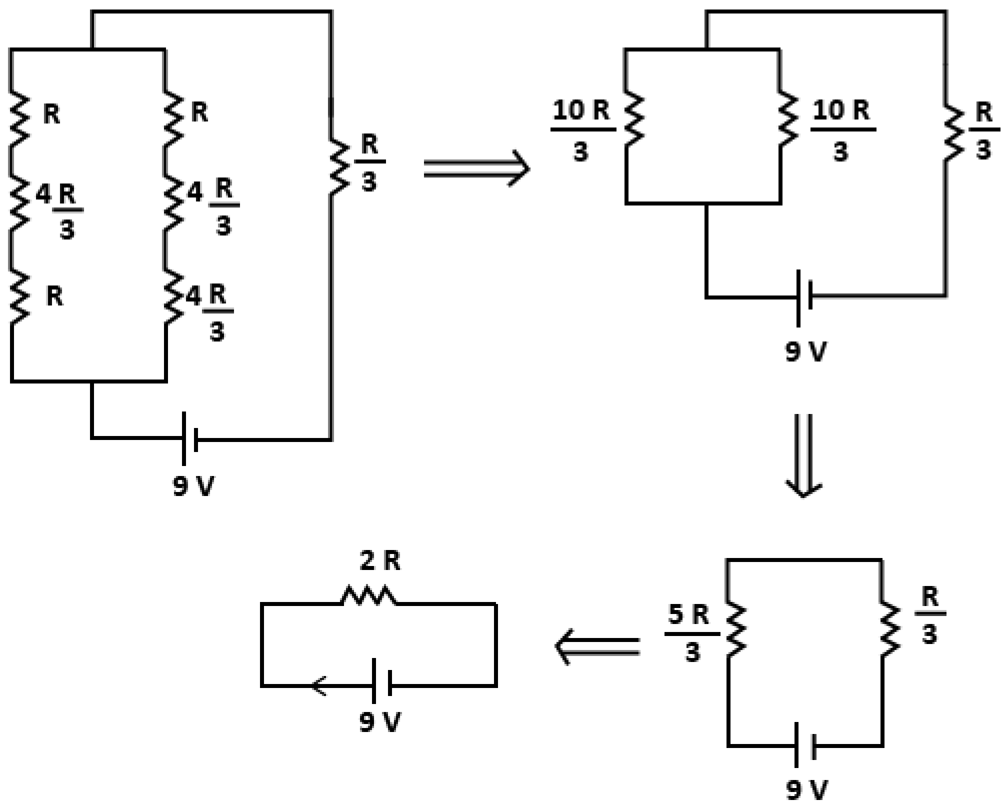

R
R
R
2R
2R
R
R
2R
2R
R
R
R
R
$\frac{R}{3}$

⇓


R
R
R
$\frac{2R}{3}$
$\frac{2R}{3}$
$\frac{2R}{3}$
$\frac{2R}{3}$
R
R
R
$\frac{R}{3}$
9V

⇒


R
R
$\frac{4R}{3}$
$\frac{4R}{3}$
R
R
$\frac{R}{3}$
9V



$R_{eq} = 2R$

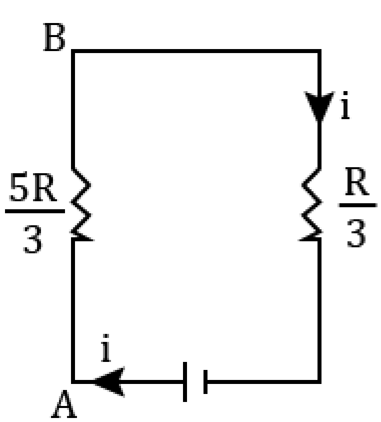
$R_{eq} = 2 \times 3$

$R_{eq} = 6\,\Omega$

$i = \frac{V}{R}$

$i = \frac{9}{6} = 1.5\,A$ Option (a)

b)



$V_A - V_B = i\left(\frac{5R}{3}\right)$

$= \frac{3}{2} \times \frac{5\times3}{3}$

$= 7.5V$ Option (B)

c) $P = i^2 \frac{R}{3}$

$= \left(\frac{3}{2}\right)^2 \times \frac{3}{3} = \frac{27}{12} = 2.25\,W$ Option (C)

d) $P = Vi$

$= 7.5 \times \frac{3}{2}$

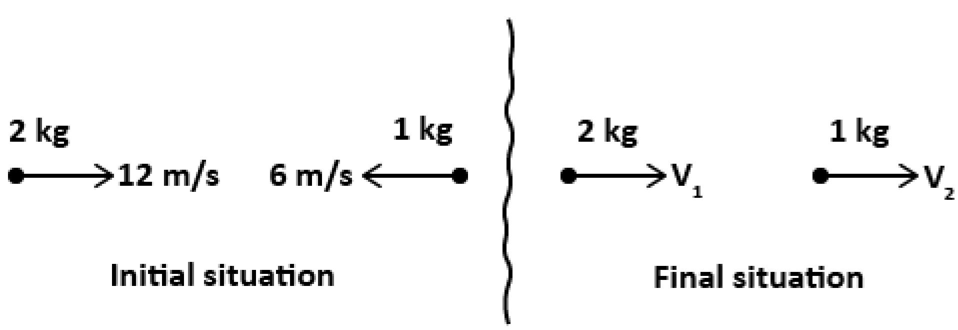
$= 11.25\,W$ option (d) is incorrect

Options (a), (b) and (c) are correct.

60. Two bodies of masses $m_1 = 2\,kg$ and $m_2 = 1\,kg$ are moving towards each other in the same straight line with speed $12\,m/s$ and $6\,m/s$ respectively as shown in figure. The bodies can be assumed as point masses. After some time, the two bodies undergo elastic collision. After the collision

(a) The two bodies merely exchange their velocities
(b) m_1 comes to rest
(c) m_2 moves with speed $18\,m/s$ towards right
(d) m_1 and m_2 move with same speeds but they reverse their directions of motion.

Sol.



Given: Elastic collision

Apply linear momentum conservation

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$2 \times 12 + 1 \times (-6) = 2 \times v_1 + 1v_2$

$24 - 6 = 2v_1 + v_2$

$18 = 2v_1 + v_2$ …(1)

$\because e = \frac{Velocity\ of\ separation}{Velocity\ of\ approach} = \frac{V_2 - V_1}{12+6} = 1$

$v_2 - v_1 = 18$ …(2)

Now solve equation (1) & (2)

$v_1 = 0\, m/s$

$v_2 = 18\, m/s$

Option (b) & (c) are correct.