

## ANSWER KEY

### NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE NSEJS-2024 [24-11-2024]

Code	51	52	53	54
Q.No.	Ans.	Ans.	Ans.	Ans.
1	d	d	c	d
2	c	c	d	c
3	b	c	d	b
4	c	b	c	c
5	a	c	b	a
6	c	d	a	c
7	d	c	<b>B</b>	d
8	a	d	c	a
9	a	c	d	a
10	c	d	c	c
11	c	b	a	c
12	d	d	c	d
13	d	c	c	d
14	b	b	a	b
15	c	d	b	c
16	b	b	d	b
17	c	d	d	d
18	d	c	c	c
19	d	c	b	c
20	c	b	c	b

Code	51	52	53	54
Q.No.	Ans.	Ans.	Ans.	Ans.
21	b	c	a	c
22	a	a	c	d
23	<b>B</b>	d	d	c
24	c	a	a	d
25	d	a	a	c
26	c	c	c	d
27	a	c	c	b
28	c	d	d	d
29	c	d	d	c
30	a	b	b	b
31	b	c	c	d
32	d	b	b	b
33	d	c	d	c
34	c	d	c	d
35	c	d	c	d
36	b	c	b	c
37	c	b	c	b
38	d	a	d	c
39	c	<b>B</b>	c	a
40	d	c	d	<b>B</b>

Code	51	52	53	54
Q.No.	Ans.	Ans.	Ans.	Ans.
41	c	d	c	d
42	d	c	d	c
43	b	a	b	a
44	d	c	d	c
45	c	c	c	c
46	b	a	b	a
47	d	b	d	b
48	b	d	b	d
49	a,b,d	a,b,c,d	a,b,c	a,b,d
50	c,d	a,c,d	c,d	c,d
51	b,c	a,b,c,d	a,d	b,c
52	a,c,d	b,c	a,b,c	a,c,d
53	a,b,c	a,b,d	a,b,d	a,b,c,d
54	c,d	c,d	c,d	a,c,d
55	a,d	b,c	b,c	a,b,c,d
56	a,b,c	a,c,d	a,c,d	b,c
57	a,b,c,d	a,b,c	a,b,c,d	a,b,c
58	a,c,d	c,d	a,c,d	c,d
59	a,b,c,d	a,d	a,b,c,d	a,d
60	b,c	a,b,c	b,c	a,b,c

**B = Bonus**

## SOLUTIONS

1. In bilaterally symmetrical animals, segmentation of body into a linear series of similar parts is called metamerism. In which of the following, did it appear for the first time?

- (a) Platyhelminthes (b) Arthropoda  
(c) Vertebrata (d) Annelida

**Ans. (d)**

**Sol.** Metameric segmentation first time reported in Annelida

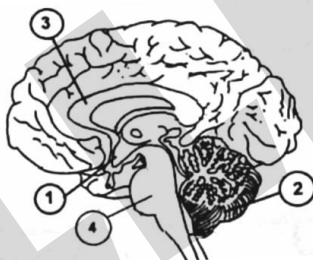
2. While discussing human evolution generally. Hominid stocks, Prehistoric and species of Modern Man are described on the basis of fossil records. Select the correct option showing the pair member of a Hominid stocks and a Prehistoric man:

- (a) *Homo erectus pekinensis* and *Homo habilis*  
(b) *Homo heidelbergensis* and *Homo sapiens neanderthalensis*  
(c) *Australopithecus* and *Homo habilis*  
(d) *Ramapithecus* and *Homo sapiens fossilis*

**Ans. (c)**

**Sol.** *Australopithecus* and *Homo habilis*

3. The median longitudinal section of human brain given here under is marked with important parts as 1 to 4.



Following are the functions/disorders related to these parts:

- (i) Controls the sleep cycle, manages pain signals and is the pneumotaxic center involved in breathing regulation. Double vision (diplopia) can be a consequence of damage to this part.  
(ii) It maintains homeostasis by directly influencing the autonomic nervous system or by managing hormones. Besides controlling hunger and thirst, it senses fullness when eating etc. It secretes feel good hormone (Dopamine). Malfunctioning causes Prader-Willi syndrome.  
(iii) Plays an important role in controlling emotions and making decisions. Damage to this part can interfere with judging the size of or distance from objects; makes it harder to learn new words or skills; causes trouble in reaching for objects. Responsible for congenital disorder like Chiari malformation.  
(iv) Largest structure of white matter; allows perception of depth and enables the two sides of brain to communicate. Relate with coordination and complex problem-solving. Dysfunction may cause Schizophrenia, dementia and other psychiatric disorders.

Correlate the above referred characteristics (i) - (iv) with the parts labeled (1-4) in the diagram above and choose the correct option

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

**Ans. (b)**

**Sol.** According to given diagram, functions and disorders are given below.

- (1) – (ii) it maintains homeostasis by directly influencing autonomic nervous system or by managing hormones. Besides controlling hunger and thirst, it senses fullness when eating etc. It secretes feel good hormone (Dopamine). Malfunctioning causes Prader- Willi syndrome.
- (2) – (iii) Plays an important role in controlling emotions and making decisions. Damage to this part can interfere with judging the size of or distance from objects; makes it harder to learn new words or skills; causes trouble in reaching for objects. Responsible for congenital disorder like Chiari malformation.
- (3) – (iv) Largest structure of white matter; allows perception of depth and enables the two sides of brain to communicate. Related with coordination and complex problem-solving. Dysfunction may cause Schizophrenia, dementia and other psychiatric disorders.
- (4) – (i) Controls the sleep cycle, manages pain signals and is the pneumotaxic center involved in breathing regulation. Double vision (diplopia) can be a consequence of damage to this part.

**4.** Many insects are serious pests of crop plants. Sap-sucking insects can be controlled by spraying systemic insecticide, like

- |                   |                         |
|-------------------|-------------------------|
| (a) Chloropyrifos | (b) Malathion           |
| (c) Metasystox    | (d) Chlorantraniliprole |

**Ans. (c)**

**Sol.** Metasystox

**5.** What kind of joint is found between the odontoid process of the 2<sup>nd</sup> vertebra of mammals and the atlas vertebra?

- |                   |                  |
|-------------------|------------------|
| (a) Pivotal Joint | (b) Saddle Joint |
| (c) Sliding Joint | (d) Hinge Joint  |

**Ans. (a)**

**Sol.** Joint is found between the odontoid process of 2<sup>nd</sup> vertebra of mammals and the atlas vertebra.

**6.** Match the items given under Column-1 with those of Column-2:

Column - I		Column - II	
1.	Hexacanth	(i)	Goose Flesh
2.	Renette Cell	(ii)	Ascaris
3.	Respiratory Tree	(iii)	Sea Cucumber
4.	Piloerectum	(iv)	Taenia

- |   |   |
|---|---|
| (a) 1 - (i); 2 - (iii); 3 - (ii) and 4 - (iv) | (b) 1 - (i); 2 - (ii); 3 - (iv) and 4 - (iii) |
| (c) 1 - (iv); 2 - (ii); 3 - (iii) and 4 - (i) | (d) 1 - (iii); 2 - (i); 3 - (iv) and 4 - (ii) |

**Ans. (c)**

**Sol.**

Column - I		Column - II	
1.	Hexacanth	(i)	Taenia
2.	Renette Cell	(ii)	Ascaris
3.	Respiratory Tree	(iii)	Sea Cucumber
4.	Piloerectum	(iv)	Goose Flesh

7. The tympanic cavity is connected with the auditory capsule through very fine openings. Choose the correct option of such opening:

- (a) Fossa ovalis and Fenestra ovalis                      (b) Fenestra rotundus and Fossa ovalis  
 (c) Foramen ovale and Fenestra ovalis                    (d) Fenestra ovalis and Fenestra rotundus

Ans. (d)

Sol. The tympanic cavity is connected with the auditory capsule through fenestra ovalis and fenestra rotundus.

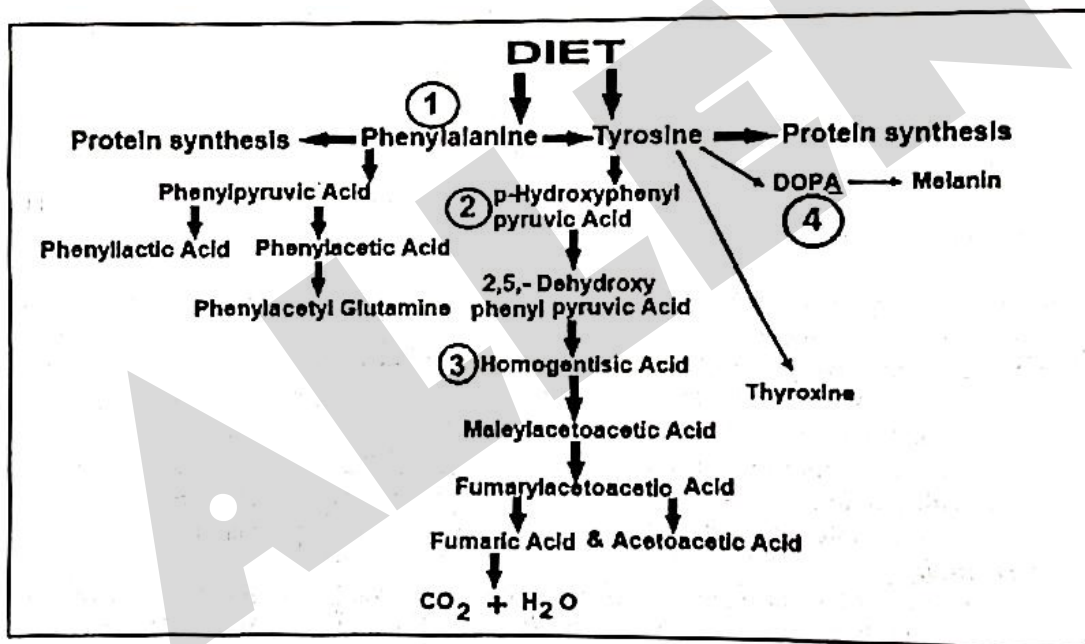
8. Currently, all new vehicles sold and registered in India should be compliant with which of the following versions of emission standards?

- (a) BS-VI                      (b) BS-IV                      (c) BS-V                      (d) BS-VII

Ans. (a)

Sol. Bharat stage (BS) emission norms based on European emission standards for all new vehicles in India. Currently BS-VI norms effect on 1 April 2020.

9. In the flow chart given below, accumulation of various product (marked 1 to 4) results in the some inborn diseases in man.



Given the correct sequence of diseases caused by accumulation of products marked as 1 to 4

- (a) Phenylketonuria, Tyrosinosis, Alkaptonuria and albinism  
 (b) Alkaptonuria, Albinism, Tyrosinosis and Phenylketonuria  
 (c) Tyrosinosis, Alkaptonuria, Phenylketonuria and Albinism  
 (d) Phenylketonuria, Alkaptonuria, Albinism and Tyrosinosis

Ans. (a)

Sol. Accumulation of phenylalanine cause phenylketonuria

P – Hydroxyphenyl pyruvic acid – Tyrosinosis

Homogentisic Acid – Alkaptonuria

DOPA – Albinism

10. Match the Plants mentioned in Column-1 with their characteristics in Column-2:

Column - I		Column - II	
1.	Wheat	(i)	Pseudostem and monocarpy
2.	Banyan Tree	(ii)	Glumes and lodicules
3.	Banana	(iii)	Seeds but no fruits
4.	Pine Tree	(iv)	Prop roots and hypanthia

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

Ans. (c)

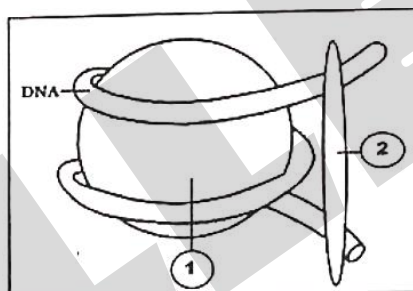
Sol. Banyan trees have prop root.

Banana have no true stem called as pseudostem.

Pine tree is gymnosperm which have naked seed but not fruit.

Wheat have glumes.

11. Under the electron microscope 'Chromatin' appears to have a string of bead like structure, as a number of repeating units, called ' Nucleosomes'. The adjoining diagram shows one such unit. The labeled parts 1 and 2 are its important constituents made up of a total of 5 components. Choose the correct option showing the correct sequence of the 5 component units included in the labeled parts 1 and 2.



- (a) H1, H2a, H2b, H3 and H4      (b) H1, H2b, H3b and H4  
 (c) H2a, H2b, H3, H4 and H1      (d) H1, H2, H3a, H3b and H4

Ans. (c)

Sol. (1) is octamer made from H2a, H2b, H3, H4

(2) is histone 1 (H1)

12. Two statements marked as ASSERTION (A) REASON (R) are given below. Choose the correct answer as per the given codes:

**ASSERTION (A) :** The eyes of nocturnal, cave and deep water dwelling animals have only rods in their retina.

**REASON (R) :** Rod provide high sensitivity to light, but with relatively low spatial discrimination and no ability to distinguish different wavelengths of light.

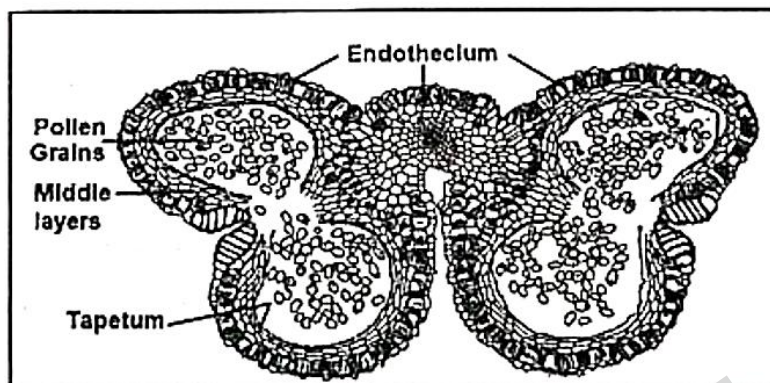
Choose the correction option

- (a) Both assertion (A) and reason (R) are true and the reason (R) is the correct explanation of the assertion (A).  
 (b) Both assertion (A) and reason (R) are true and the reason (R) is not the correct explanation of the assertion (A).  
 (c) Assertion (A) is true but reason (R) is false.  
 (d) Both assertion (A) and reason (R) are false.

Ans. (d)

Sol. Both assertion (A) and reason (R) are false.

13. In the diagram given below, what are the maximum kinds of ploidy levels of the various parts labeled?



- (a) Only Haploid  
 (b) Only Diploid  
 (c) Haploid and Diploid  
 (d) Haploid, Diploid and Polyploid

**Ans. (d)**

**Sol.** Pollen grain – haploid  
 Endothecium – diploid  
 Middle layer – diploid  
 Tapetum – can be polyploid

14. According to Cohesion theory for the ascent of sap in tall trees, all the forces together which create obstacle in the ascent of sap and about 50 atm. What is the cohesive force of water which helps continuous rise of sap in tallest trees?  
 (a) 350 atm                      (b) 200 atm                      (c) 140 atm                      (d) 600 atm

**Ans. (b)**

**Sol.** 200 atm

15. Some human males show hypertrichosis of ear pinna. Which of the following is the cause of this genetic characteristic?  
 (a) A dominant gene in male and a recessive allele in female  
 (b) Aneuploidy  
 (c) Holandric gene  
 (d) Trisomy of an autosome

**Ans. (c)**

**Sol.** Hypertrichosis (hairs in ear) is Y-linked disorder. A gene present on Y-chromosomes called holandric gene.

16. Which of the following is the agreement to protect the stratospheric ozone layer by phasing-out production and consumption of ozone-depleting substances?  
 (a) Kyoto Protocol                      (b) Montreal Protocol  
 (c) Rio Summit                      (d) Stockholm Convention

**Ans. (b)**

**Sol.** Montreal protocol is for ozone depleting summit.

17. A sample of 1.0 liter milk weighs 1.032 kg. The milk contains 4% milk fat by volume having density  $865 \text{ kg/m}^3$ . The density of fat free (skimmed) milk in  $\text{kg/m}^3$  is  
 (a) 1036.95                      (b) 1037.95                      (c) 1038.95                      (d) 1040.95

**Ans. (c)**

**Sol.** In 1lt milk :

$$\text{Volume of milk fat} = 1 \times \frac{4}{100} = 0.04 \text{ lt}$$

$$\begin{aligned} \text{Wt. of milk fat} &= \text{Volume} \times \text{Density} = (0.04 \times 10^{-3} \text{ m}^3) \times (865 \text{ kg}) \\ &= 0.0346 \text{ kg} \end{aligned}$$

$$\text{Wt. of fat free milk} = 1.032 - 0.346 = 0.9974 \text{ kg}$$

$$\text{and volume of fat free milk} = 1 - 0.04 = 0.96 \text{ lt}$$

$$\text{Density of fat free milk} = \frac{0.9974 \text{ kg}}{0.96 \times 10^{-3} \text{ m}^3} = 1038.96 \text{ kg/m}^3$$

**18.** A research scholar requires 50 milliliter aqueous  $\text{NaNO}_3$  solution containing 70.0 mg of  $\text{Na}^+$  per milliliter. The amount of  $\text{NaNO}_3$  required for this purpose is

- (a) 0.350 g                      (b) 0.161 g                      (c) 29.75 g                      (d) 12.94 g

**Ans. (d)**

**Sol.** Wt. of  $\text{Na}^+$  present in 50 ml solution =  $70 \times 50 = 3500 \text{ mg}$

$$\text{Mole of } \text{Na}^+ \text{ in 50 ml solution} = \frac{3500 \times 10^{-3}}{23} = \text{mole of } \text{NaNO}_3$$

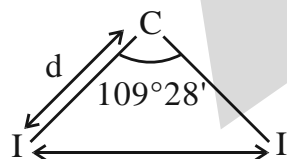
$$\therefore \text{Wt. of } \text{NaNO}_3 = \frac{3500 \times 10^{-3}}{23} \times 85 \text{ gm} = 12.934 \text{ gm}$$

**19.** One structural isomer of  $\text{C}_2\text{H}_4\text{I}_2$  contains both the Iodine (I) atoms attached to same carbon atom. The bond length of C-I bond is 2.10 Å. Assuming tetrahedral angles and additivity of covalent bond radii, the distance between two Iodine (I) atoms is (given that  $\sin 54.75^\circ = 0.815$  and  $\sin 109.5^\circ = 0.94$ )

- (a) 2.10 Å                      (b) 2.47 Å                      (c) 4.20 Å                      (d) 3.42 Å

**Ans. (d)**

**Sol.**



$$\begin{aligned} \text{Distance between two I atoms} &= 2d \sin \frac{109^\circ 28'}{2} \\ &= 2 \times 2.1 \times 0.815 \text{ \AA} \\ &= 3.423 \text{ \AA} \end{aligned}$$

**20.** Amongst the following, select the option in which all the oxides express acidic nature,

- (a) F-oxide, S-oxide, C-oxide, In-oxide  
(b) Cl-oxide, P-oxide, Ga-oxide, Be-oxide  
(c) At-oxide, Xe-oxide, Se-oxide, As-oxide  
(d) Br-oxide, Xe-oxide, Te-oxide, Sn-oxide

**Ans. (c)**

**Sol.** Oxides of At, Xe, Se and As are acidic in nature.

21. How many moles of the so called 'electron gas' weighs one kilogram?

- (a)  $\frac{6.02}{9.11} \times 10^{54}$                       (b)  $\frac{100}{6.02 \times 9.11} \times 10^6$   
(c)  $6.02 \times 10^{23}$                       (d)  $\frac{10}{9.11} \times 10^{30}$

**Ans. (b)**

**Sol.** No. of mole of  $e^- = \frac{\text{Wt. (in gm)}}{\text{Wt. of one mole } e^-}$

$$= \frac{1000 \text{ gm}}{9.11 \times 10^{-28} \times 6.023 \times 10^{23}}$$

$$= \frac{100}{6.02 \times 9.11} \times 10^6$$

22. The magnitude of electrostatic force between two tiny spherical balls carrying charge  $q_1$  and  $q_2$  separated by a distance  $r$  in free space is given by  $F = K \frac{q_1 q_2}{r^2}$  where the constant  $K = 9 \times 10^9$  in

SI units Two tiny spherical balls of carbon ( $^{12}\text{C}$ ) weighing 1 g each are kept 1 cm apart in free space. The two sphere carry equal and opposite charges. The magnitude of electrostatic force of attraction between the two charged sphere is  $F = 1.0 \times 10^{-5}$  N. The ratio of the number of excess electrons to total number of atoms in the negatively charged sphere is

- (a)  $4.15 \times 10^{-14}$               (b)  $2.08 \times 10^9$               (c)  $5.02 \times 10^{-22}$               (d)  $6.02 \times 10^{-23}$

**Ans. (a)**

**Sol.** Let magnitude of charge on each carbon ball =  $q$  coulomb.

$$\therefore F = 1 \times 10^{-5} = 9 \times 10^9 \times \frac{q \times q}{(10^{-2})^2}$$

$$q^2 = \frac{10^{-9}}{9 \times 10^9}$$

$$\therefore q = \frac{1}{3} \times 10^{-9} \text{ coulomb}$$

$\therefore$  No. of excess electron on each ball

$$= \frac{\text{Total charge}}{\text{Charge of each electron}}$$

$$= \frac{\frac{1}{3} \times 10^{-9}}{1.6 \times 10^{-19}} = \frac{1}{4.8} \times 10^{10}$$

$$\text{No. of carbon atom in each ball} = \frac{1}{12} \times 6.02 \times 10^{23}$$

$$\therefore \frac{\text{No. of excess electron}}{\text{No. of carbon atoms}} = \frac{\frac{1}{4.8} \times 10^{10}}{\frac{6.02}{12} \times 10^{23}} = 4.15 \times 10^{-14}$$



23. The correct choice for the properties of the atomic species shown in the following

Properties	A	B	C	D	E
Smallest ionic radius	Li <sup>+</sup>	Na <sup>+</sup>	K <sup>+</sup>	Be <sup>2+</sup>	Mg <sup>2+</sup>
Highest electronegativity	Cl	S	O	He	N
Highest electron affinity	N	Cl	F	Be	O
Highest magnetic moment	Cr <sup>+</sup>	Fe <sup>2+</sup>	Cu <sup>2+</sup>	Ni <sup>4+</sup>	Sc <sup>3+</sup>

- (a) D, D, B, A                      (b) A, D, B, D                      (c) D, C, B, E                      (d) D, C, E, A

**Ans.** Bonus

24. On Fahrenheit scale of temperature, the freezing point of water is marked as 32°F and the boiling point of water is marked as 212°F. While the freezing point and boiling point of water on the Celsius scale are marked as 0°C and 100°C respectively.

During the routine checkup of some patient, a doctor measures the temperature of the patient as 102.6°F. The temperature of patient on Celsius scale is

- (a) 37.0 °C                      (b) 39.0 °C                      (c) 39.2 °C                      (d) 39.4 °C

**Ans.** (c)

**Sol.**  $\frac{^{\circ}\text{C}}{5} = \frac{^{\circ}\text{F} - 32}{9}$   
 $\frac{^{\circ}\text{C}}{5} = \frac{102.6 - 32}{9}$   
 $^{\circ}\text{C} = 39.2$

25. The pH of neutral pure water at 25 °C is 7. When water is heated to 70 °C the pH value

- (a) decreases and its nature turns acidic                      (b) increases and its nature turns basic  
(c) remain constant as 7                      (d) decreases but its nature remains neutral

**Ans.** (d)

**Sol.** On increasing temperature, dissociation of water increases, so concentration of H<sup>+</sup> and OH<sup>-</sup> both increases and nature of water remain neutral.

$$\text{pH} = \log \frac{1}{[\text{H}^+]}$$

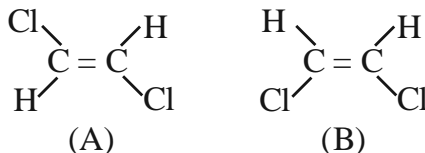
26. The concentration (mole/liter) of hydronium ion [H<sub>3</sub>O<sup>+</sup>] for a solution having pH 8.26 is

- (a) 10<sup>-7</sup>                      (b) 1 × 10<sup>-9</sup>                      (c) 5.5 × 10<sup>-9</sup>                      (d) 3.2 × 10<sup>-3</sup>

**Ans.** (c)

**Sol.**  $\text{pH} = -\log [\text{H}^+] = 8.26$   
 $\therefore [\text{H}^+] = 10^{-8.26}$   
 $= 10^{0.74} \times 10^{-9}$   
 $= 5.5 \times 10^{-9}$

27. The expected values of the normal boiling point of the two compounds A and B given below are  $T_A$  and  $T_B$  respectively. Then



- (a)  $T_A < T_B$       (b)  $T_A = T_B$       (c)  $T_A > T_B$       (d) Can't be predicted

**Ans. (a)**

**Sol.** Boiling point of polar isomer > boiling point of non-polar isomer.

28. Which of the following is the strongest material (in terms of tensile strength)?

- (a) Diamond      (b) Tungsten      (c) Graphene      (d) Steel

**Ans. (c)**

**Sol.** Tensile strength of Diamond = 20 GPa

Tensile strength of Tungstene = 980 GPa

Tensile strength of Graphene = 130 GPa

Tensile strength of Steel = 400-1000 MPa

29. Which pair of the following group 13 elements represents the pair of the most stable oxidation state of the pair?

- (a)  $B^+$ ,  $Tl^+$       (b)  $B^{3+}$ ,  $Tl^{3+}$       (c)  $B^{3+}$ ,  $Tl^+$       (d)  $B^+$ ,  $Tl^{3+}$

**Ans. (c)**

**Sol.** On moving down the group lower oxidation states of elements is more stable due to inert pair effect.

30. To have a secured and safe travel, air bags are being used in modern vehicles/automobiles for road journey. The substance most often used in the air bags in automobiles is

- (a)  $NaN_3$       (b)  $Na_3N$       (c)  $KO_2$       (d) Acurite

**Ans. (a)**

**Sol.**  $NaN_3$  is used in air bags. On collision  $NaN_3$  decompose. Due to which  $N_2$  gas is released which inflate air bags.

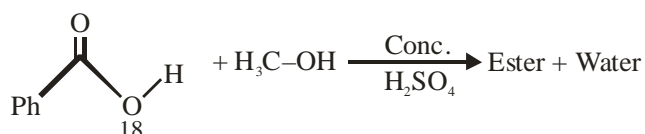
31. Most predominantly used metal in magnetic resonance imaging (MRI) contrast solutions is

- (a) Lr      (b) Gd      (c) Pm      (d) Sm

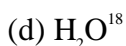
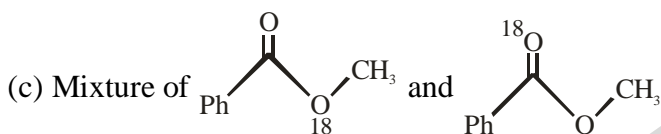
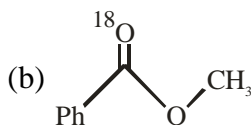
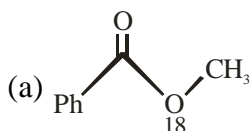
**Ans. (b)**

**Sol.** Gadolinium based MRI contrast agents are used for diagnosis.

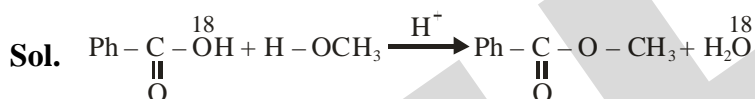
32. An esterification process has been represented by the following chemical reaction



The fate of the labeled oxygen ( $\text{O}^{18}$ ) atom in the product is :



Ans. (d)



33. Which of the following motions has largest magnitude of acceleration? Assume that all moving in straight line with constant acceleration.

- (a) A bus moving with an initial velocity 72 km/hr comes to rest in 2.50 s
- (b) A rock during its free fall near the earth surface
- (c) A car accelerates from rest to a velocity  $v = 108$  km/hr in 4.00 s
- (d) A train, starting from rest, takes 6.00 s to cover a distance of 216m

Ans. (d)

Sol. (A)  $a_1 = \frac{0-20}{2.5} = -8 \text{ m/s}^2$

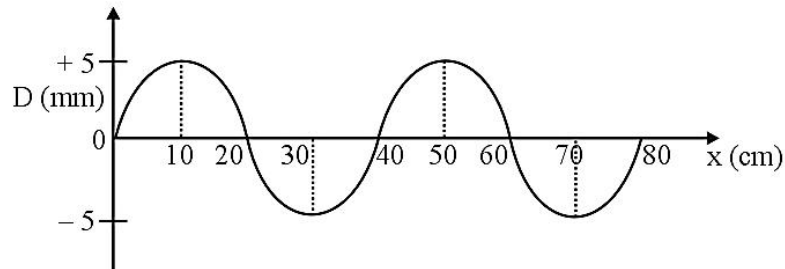
(B)  $a_2 = 10 \text{ m/s}^2$

(C)  $a_3 = \frac{30-0}{4} = 7.5 \text{ m/s}^2$

(D)  $216 = \frac{1}{2} \times a_4 \times 6^2$

$a_4 = 12 \text{ m/s}^2$

34. A sound wave is propagating in a medium in the +x direction at a speed of 360 m/s. At a given instant, a snapshot of the plot of displacement (D) of various particles of medium from their equilibrium position (taken along y axis) vs the position (x) of particle on x axis, shown in figure below. The incorrect option is



- (a) the amplitude of wave is 5 mm  
 (b) the frequency of wave is 900 Hz  
 (c) after 0.01 sec the trough of the wave will occur at  $x = 20$  cm and  $x = 40$  cm  
 (d) this wave will travel a distance of 1.62 km along +x axis in 4.5 sec

Ans. (c)

Sol.  $A = 5$  mm,  $V_s = 360$  m/s

$$\lambda = 40 \text{ cm, } V_s = f\lambda$$

$$\Rightarrow f = \frac{V_s}{\lambda} = \frac{360}{40 \times 10^{-2}} = 900 \text{ Hz}$$

Distance travelled by wave in 0.01

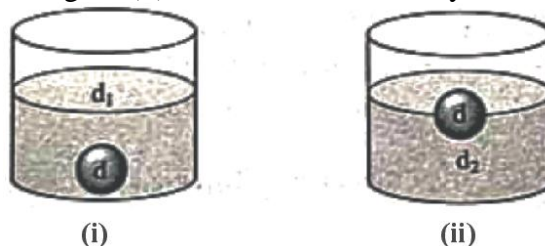
$$\text{See} = \Delta x_1 = 360 \times 0.01 = 36 \text{ cm}$$

Distance travelled in 4.5 sec

$$= \Delta x_2 = 360 \times 4.5 = 1620 \text{ m} \\ = 1.62 \text{ km}$$

Option (c) is the answer

35. When placed inside a liquid of density  $d_1$ , a sphere sinks, as shown in figure (i). When placed inside a liquid of density  $d_2$ , the same sphere floats with half of its volume appearing above the liquid surface, as shown in figure (ii). Given that the density of the sphere is  $d$



If  $F_1$  and  $F_2$  are buoyant forces acting on the sphere in the two situations (i) and (ii) respectively due to that two liquids, then the ratio  $\frac{F_1}{F_2}$  equals

- (a)  $\frac{d_1}{d_2}$                       (b)  $\frac{d_1}{2d_2}$                       (c)  $\frac{d_1}{d}$                       (d)  $\frac{d}{d_2}$

Ans. (c)

**Sol.**  $F_1 = d_1 \cdot \frac{4}{3} \pi R^3 \cdot g$

$$F_2 = d_2 \cdot \left( \frac{4}{3} \pi R^3 \cdot \frac{1}{2} \right) \cdot g$$

$$\Rightarrow \frac{F_1}{F_2} = \frac{d_1}{(d_2/2)} = \frac{2d_1}{d_2}$$

$$d_2 = 2d$$

$$\frac{F_1}{F_2} = \frac{2d_1}{2d} = \frac{d_1}{d}$$

**36.** A car is moving on a horizontal cement road with uniform velocity 90 km/hr. Read the statements regarding motion of car.

$S_1$ : The acceleration of car is zero

$S_2$ : No force is acting on the car,

$S_3$ : Kinetic energy and linear momentum of car are constant during this motion

$S_4$ : Engine of car is doing no work

Now choose the correct option

(a) Only the statements  $S_1$  and  $S_2$  are true

(b) Only the statements  $S_1$  and  $S_3$  are true

(c) Only the statements  $S_1$ ,  $S_2$  and  $S_3$  are true

(d) All the statements  $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$  are true

**Ans. (b)**

**Sol.**  $S_1$  = Correct, uniform velocity means acceleration is zero.

$S_2$  = Wrong, There are forces acting on car like friction, air resistance etc. but they are balancing each other, due to which net force is zero.

$S_3$  = K.E. = constant,  $\vec{P}$  = constant  
= correct.

$S_4$  = Wrong. Engine of car is doing +ve work done against net resistive force.

**37.** A particle is moving along circular path of diameter  $D = 14$  cm with constant speed  $v$ . It takes 0.02 second to complete an arc which subtends on angle of  $45^\circ$  at the center. If  $f$  is its frequency of revolution, then the correct option is

(a)  $v = 5.5 \text{ m sec}^{-1}$ ,  $f = 6.25 \text{ Hz}$

(b)  $v = 5.5 \text{ m sec}^{-1}$ ,  $f = 12.5 \text{ Hz}$

(c)  $v = 2.75 \text{ m sec}^{-1}$ ,  $f = 6.25 \text{ Hz}$

(d)  $v = 2.75 \text{ m sec}^{-1}$ ,  $f = 12.5 \text{ Hz}$

**Ans. (c)**

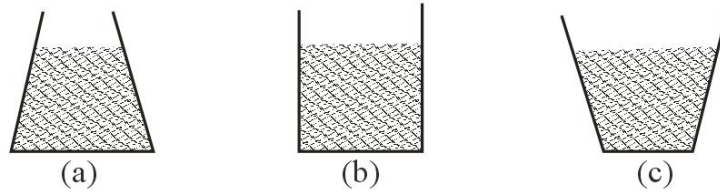
**Sol.**  $\frac{\pi}{4} = \omega \times (0.02)$ ,  $\omega = \frac{25}{2} \pi$

$$\omega = 2\pi f, f = 6.25 \text{ Hz.}$$

$$V = \omega R = \left( \frac{25}{2} \pi \right) \times \left( \frac{0.14}{2} \right)$$

$$= 2.75 \text{ m/s}$$

38. The same liquid is filled in vessels of three different shapes up to the same height, as shown in figures (a), (b) and (c). Each vessel has equal base area.



Let  $P_a$ ,  $P_b$  and  $P_c$  are the values of liquid pressure on the base of vessels in figure (a) (b) and (c) respectively.  $W_a$ ,  $W_b$  and  $W_c$  are the weights of liquid contained in vessels in figure (a), (b) and (c)

respectively. Choose the correct option

- (a)  $P_a < P_b < P_c$  and  $W_a < W_b < W_c$       (b)  $P_a = P_b = P_c$ , and  $W_a = W_b = W_c$   
 (c)  $P_a < P_b < P_c$  and  $W_a = W_b = W_c$       (d)  $P_a = P_b = P_c$ , and  $W_a < W_b < W_c$

**Ans. (d)**

**Sol.**  $P = \rho gH$ , so pressure will be same at the base.

$$W \propto \text{volume}$$

$$V_c > V_b > V_a$$

$$W_c > W_b > W_a$$

$$P_a = P_b = P_c$$

39. An ant moves at constant speed on the principal axis of concave mirror of focal length  $f$ , from a point at distance  $5f$  from the pole of the mirror to the focus  $F$  of the mirror. During the motion of the ant (consider the ant as a point), its image formed by the mirror

Statement  $S_1$ : moves with constant speed

Statement  $S_2$ : has same velocity as that of the ant when the ant is at center of curvature  $C$  of the mirror.

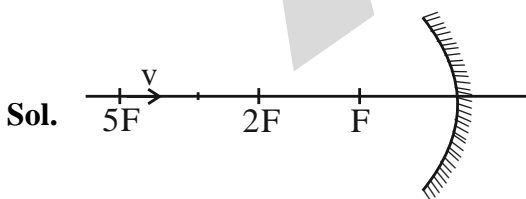
Statement  $S_3$ : moves slower in the beginning and faster towards the end

Statement  $S_4$ : moves faster in the beginning and slower towards the end

Now, choose the correct option :

- (a) Only the statement  $S_1$  is correct      (b) Statements  $S_2$  and  $S_3$  are correct  
 (c) Only the statement  $S_3$  is correct      (d) The statements  $S_2$  and  $S_4$  are correct

**Ans. (c)**



$$\Rightarrow S_1 = \text{wrong.} \quad v_1 = -m^2 v_0$$

$$m = \text{variable,} \quad v_1 = \text{variable}$$

$$\Rightarrow S_2 = \text{wrong} \quad \vec{v}_1 \text{ will be in opposite direction of } \vec{v}_0.$$

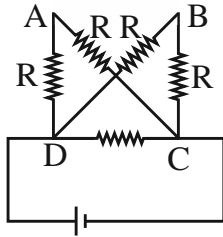
Speed will be same, but not the velocity.

$$\Rightarrow S_3 = \text{Correct.}$$

Initially  $m < 1$ , later  $m > 1$

$$\Rightarrow S_4 = \text{wrong.}$$





$$\frac{1}{R_{DC}} = \frac{1}{2R} + \frac{1}{2R} + \frac{1}{R}$$

$$R_{DC} = \frac{R}{2} = 6\Omega$$

43. Two particles of mass 1 kg and 4 kg are moving with equal kinetic energy. Ratio of magnitudes of their linear momenta is (Assume nonrelativistic velocity)
- (a) 1:4                      (b) 1 : 2                      (c) 2:1                      (d) 1 : 16

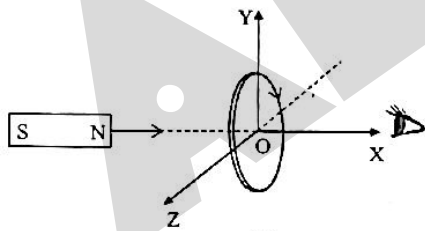
Ans. (b)

Sol.  $\frac{P_1}{P_2} = \frac{\sqrt{2m_1k_1}}{\sqrt{2m_2k_2}}$

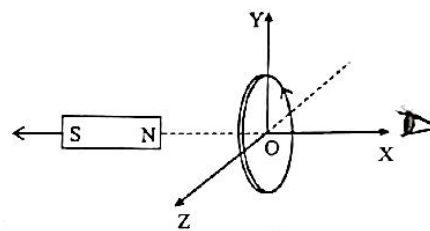
$$k_1 = k_2$$

$$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \frac{1}{2}$$

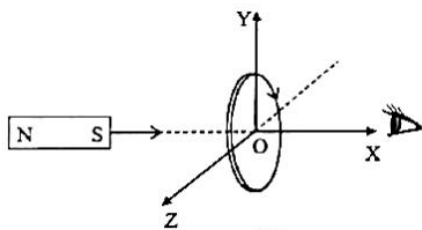
44. In the following figures, all the conducting coils are in Y-Z plane. The magnet is moved along +X axis or - X axis with a constant speed  $v$ . The direction of induced current in the coils has been shown, as viewed from +X axis. Identify the diagram/diagrams which show correct direction of induced current.



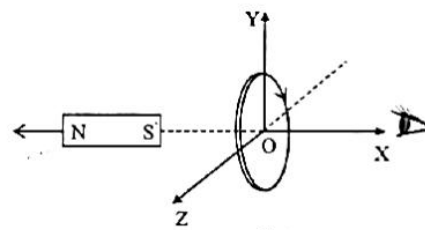
(i)



(ii)



(iii)



(iv)

- (a) only (i), (ii) and (iii)  
 (b) only (iii)  
 (c) only (ii), (iii) and (iv)  
 (d) only (i), (ii) and (iv)

Ans. (d)

Sol. By Lenz law option (d) is correct.



45. The heater filament of an electric kettle is made up of a conducting wire of length  $L$  and diameter  $D$ . When connected to a line voltage source, it takes 6 minute to raise the temperature of 500 ml of water by  $40^\circ\text{C}$ . If the heater filament is replaced by a new one of same material but length  $2L$  and diameter  $2D$ , the time taken for heating the same quantity of water through the same temperature difference will be (Assume that entire system is thermally insulated)
- (a) 12 minute                      (b) 6 minute                      (c) 3 minute                      (d) 1.5 minute

**Ans. (c)**

**Sol.**  $Q_1 = Q_2$

$$P_1 t_1 = P_2 t_2$$

$$\frac{V^2}{R_1} t_1 = \frac{V^2}{R_2} t_2$$

$$t_2 = \left( \frac{R_2}{R_1} \right) t_1$$

$$t_2 = \frac{\left[ \frac{\rho(2L)}{\pi(2r)^2} \right]}{\left( \frac{\delta L}{\pi r^2} \right)} \times 6$$

$$t_2 = 3 \text{ minute}$$

46. On straight rails a train is moving with constant velocity  $v$ . Suddenly a wagon breaks away from train. The train continues to move with same velocity while the wagon moves with constant retardation. After breaking away from train, the wagon covers distance  $d_1$  before coming to rest and the train covers distance  $d_2$  in the same duration,  $\frac{d_1}{d_2}$  is

- (a)  $\frac{1}{3}$                       (b)  $\frac{1}{2}$                       (c)  $\frac{2}{3}$                       (d) 1

**Ans. (b)**

**Sol.** For wagon :

$$V = U + at$$

$$0 = v - at$$

$$t = \frac{v}{a} \dots(1)$$

$$V^2 = U^2 + 2ad_1$$

$$0^2 = v^2 - 2ad_1$$

$$A = \frac{v^2}{2d_1} \dots(2)$$

From train :

$$d_2 = v \times t \dots(3)$$

from (1), (2) and (3)

$$d_2 = v \times \frac{v}{a} = \frac{v^2}{a} = \frac{v^2}{\left(\frac{v^2}{2d_1}\right)}$$

$$d_2 = 2d_1$$

$$\frac{d_1}{d_2} = \frac{1}{2}$$

47. A person with short-sightedness (myopia) cannot see objects clearly, beyond 2.5 meter. The power of lens required to correct his vision is

(a) + 2.5D

(b) +0.4D

(c) -2.5D

(d) -0.4D

Ans. (d)

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

$$-\frac{1}{2.5} - \frac{1}{-\infty} = \frac{1}{f}$$

$$\frac{1}{f} = -\frac{1}{2.5}$$

$$P = \frac{1}{f} = -\frac{10}{25} = -0.4D$$

48. The mass and radius of the planet-one are M and R respectively. The mass and radius of planet-two are 2M and 2R respectively. Assume that both the planets have spherical shape. Acceleration

due to gravity on the surface of planet-one and planet-two are  $g_1$  and  $g_2$  respectively  $\frac{g_1}{g_2}$  must be

(a) 1 : 2

(b) 2 : 1

(c) 1 : 4

(d) 4 : 1

Ans. (b)

Sol.  $g_1 = \frac{Gm}{R^2}$

$$g_2 = \frac{G(2m)}{(2R)^2} = \frac{Gm}{2R^2}$$

$$\frac{g_1}{g_2} = \frac{2}{1}$$

49. Which of the following plant(s) has/have edible aril?

(a) Litchi (*Litchi chinensis*)

(b) Rambutan (*Nephelium lappaceum*)

(c) Cashew (*Anacardium occidentale*)

(d) Nutmeg (*Myristica fragrans*)

Ans. (a,b,d)

Sol. Litchi (*Litchi chinensis*) → edible part → Aril

Rambutan (*Nephelium lappaceum*) → edible part → Aril

Nutmeg (*Myristica fragrans*) → edible part → Aril

50. Which of the following statement(s) regarding Viruses is/are incorrect?  
 (a) Usually potentially infectious (b) Reproduction by genetic material  
 (c) Envelope made of Glycolipids (d) Presence of Ribosomes

**Ans. (c,d)**

**Sol.** Envelope made of Glycolipids, Presence of Ribosomes

51. Which of the following major Division(s) of Algae is/are characterised by two flagella?  
 (a) Rhodophyta (b) Phaeophyta (c) Chlorophyta (d) Cyanophyta

**Ans. (b,c)**

**Sol.** Phaeophyta, Chlorophyta

52. Which of the following statement(s) is/are true?  
 (a) All immunoglobulins are glycoproteins ,  
 (b) Eosinophils are not polymorphonuclear phagocytes  
 (c) Cilia in the windpipe are mechanical barriers  
 (d) Human  $\beta$  cells bear IgM and IgD immunoglobulins on their surface

**Ans. (a,c,d)**

**Sol.** All immunoglobulins are glycoproteins ,  
 Cilia in the windpipe are mechanical barriers  
 Human  $\beta$  cells bear IgM and IgD immunoglobulins on their surface.

53. Which, of the following colloids is/are medicines?  
 (a) Argyrol (b) S-sol (c) Milk of Magnesia (d) Purple of Cassius

**Ans. (a,b,c)**

**Sol.** Argyrol is a silver sol used as eye lotion.  
 S-sol is used as germicides.  
 Milk of magnesia ( $Mg(OH)_2$ ) is used to treat stomach disorder.

54. In which of the following process, the N-atom is reduced  
 (a)  $NH_4^+ \rightarrow N_2$  (b)  $NH_2^- \rightarrow NO$  (c)  $NO_2 \rightarrow NO_2^-$  (d)  $NO_3^- \rightarrow NH_4^+$

**Ans. (c,d)**

**Sol.**  $NH_2^- \rightarrow N_2$

$NH_2^- \rightarrow NO$

$NO_2 \rightarrow NO_2^-$

$NO_3^- \rightarrow NH_4^+$

55. Which of the following statement(s) is/are true, if one mole of  $H_3PO_x$ , is completely neutralized by 40 g NaOH?  
 (a)  $x = 2$  and acid is monobasic  
 (b)  $x = 3$  and acid is dibasic  
 (c)  $x = 4$  and acid is tribasic  
 (d)  $x = 2$  and acid does not form an acid salt

**Ans. (a,d)**

**Sol.**  $H_3PO_2 + NaOH \rightarrow NaH_2PO_2 + H_2O$

56. Select the correct statement(s) regarding an element having 2K, 8L, 9M and 2N electrons. -

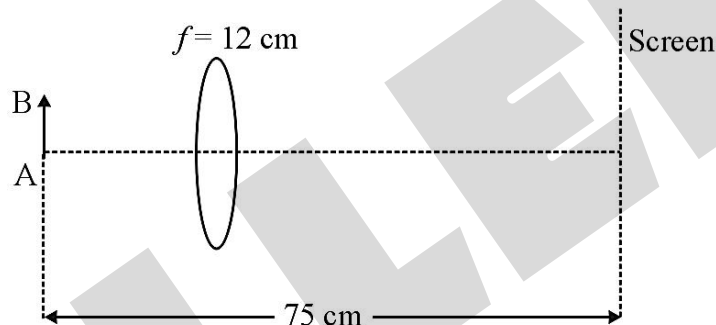
- (a) It contains 1 unpaired electron
- (b) It contains 1 d-electron
- (c) It contains 12-p electron
- (d) It is a non-metal

**Ans. (a,b,c)**

**Sol.**  ${}_{21}\text{Sc} : 1s^2 2s^2 2p^6 3s^2 2p^6 3d^1 4s^2$

Sc is a metal. It contains one unpaired electron in d-orbital.

57. The screen S is placed at a distance of 75 cm in front of an illuminated object AB. A thin convex lens of focal length  $f = 12$  cm is placed somewhere between the object and the screen so as to obtain a real image of the object on the screen. Choose the correct option(s)



- (a) Distance between lens and object may be 15 cm
- (b) Distance between lens and object may be 60 cm
- (c) Image size may be larger than object size
- (d) Image size may be smaller than object size

**Ans. (a,b,c,d)**

**Sol.** (a)  $\frac{1}{50} - \frac{1}{(-15)} = \frac{1}{f}$

$$f = 12$$

option A = correct

(b)  $\frac{1}{15} - \frac{1}{(-60)} = \frac{1}{f}$

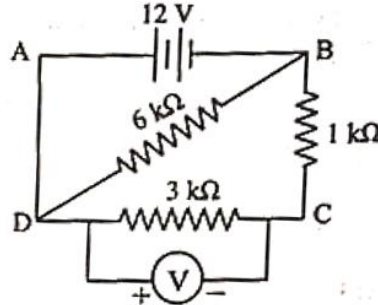
$$f = 12.$$

Option B = correct.

(c) Correct if  $V > U$

(d) Correct if  $V < U$

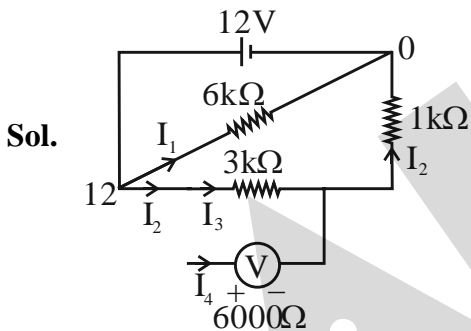
58. In the circuit shown in adjacent figure, a voltmeter of resistance  $6000\ \Omega$  has been connected across  $3\ \text{k}\Omega$  resistor. Internal resistance of battery is negligible.



Choose the correct option(s)

- (a) Voltmeter reading is 8 volt
- (b) Current passing through  $1\ \text{k}\Omega$  resistor is 2 mA
- (c) Current drawn from battery is 6 mA
- (d) Electrical power dissipated in  $6\ \text{k}\Omega$  resistor is 24 mili-watt

Ans. (a,c,d)



$$I_1 = \frac{12}{6000} = 0.002\ \text{A}$$

$$I_2 = \frac{12}{3000} = 0.004\ \text{A}$$

$$I_3 = I_2 \times \frac{2}{3}, \quad I_4 = I_2 \times \frac{1}{3}$$

(a) Voltmeter reading =  $I_4 \times \frac{1}{3} \times 6000 = 8\ \text{V}$

(b)  $I_2 = 0.004\ \text{A} = 4\ \text{mA}$

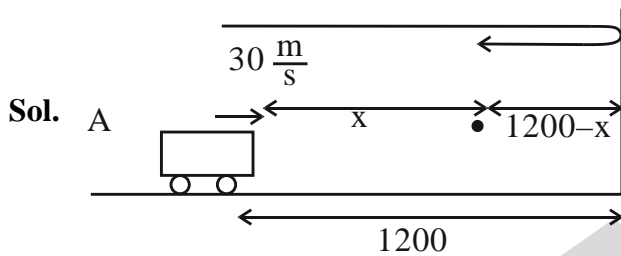
(c)  $I_1 + I_2 = 6\ \text{mA}$

(d)  $P = I_1^2 \times 6000 = 24\ \text{mW}$

59. A train, moving on a straight horizontal track with constant speed of 108 km/hour approaches a hill. When the engine of train is at distance 1200 m from hill, it produces a whistle of frequency 550 Hz. Assuming that the speed of sound in air is 330 m/s, the correct option(s) is/are

- (a) the echo from hill will be heard by driver after  $\frac{1}{9}$  minute
- (b) the distance of engine from hill at which echo is heard by driver is 1000 m
- (c) the wavelength of sound produced by whistle is 60 cm
- (d) the echo from hill will be heard by driver after  $\frac{20}{3}$  second

Ans. (a,b,c,d)



$$v_s = 330 \text{ m/s}$$

$$f = 550 \text{ m/s}$$

If echo is heard at 'B'.

$$\text{Time taken by sound wave to reach at B} = t_1 = \frac{2400 - x}{330}$$

Time taken by car to reach at B =

$$t_2 = \frac{x}{30}$$

$$t_1 = t_2 \Rightarrow \frac{2400 - x}{330} = \frac{x}{30}$$

$$x = 200 \text{ m}$$

$$t_1 = \frac{2200}{330} \text{ sec} = \frac{20}{3} \text{ sec}$$

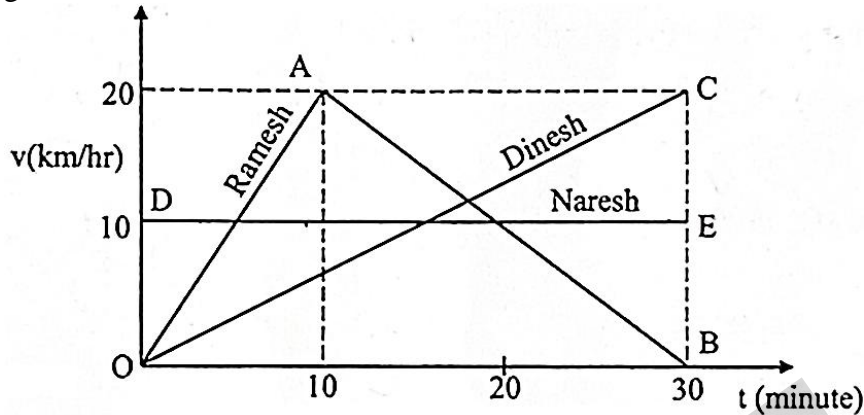
$$= \frac{1}{9} \text{ minute}$$

$$\text{distance engine from hill} = 1200 - x$$

$$= 1200 - 200$$

$$= 1000 \text{ m}$$

60. Velocity-time graphs of three athletes Ramesh, Naresh and Dinesh for a given duration (0-30 Minute) are given below.



Graph OAB is v-t graph for athlete Ramesh, graph DE is v-t graph for athlete Naresh and graph OC is v-t graph for athlete Dinesh. The graphs are linear. Which of the following option(s) is/are correct during given interval of time?

- (a) Athlete Dinesh has travelled maximum distance
- (b) Athletes Ramesh, Naresh and Dinesh each have travelled equal distance
- (c) Acceleration of athlete Dinesh is  $40 \text{ km/hr}^2$
- (d) None of the athletes is in uniform motion

**Ans. (b,c)**

**Sol.** Distance = area under the velocity-time graph

For Ramesh  $\rightarrow$

$$D = \frac{1}{2} \times \left( \frac{30}{60} \right) \times 20$$

$$= \frac{300}{60} = 5 \text{ km}$$

For Dinesh  $\rightarrow$

$$D = \frac{1}{2} \times \left( \frac{30}{60} \right) \times 20$$

$$= \frac{300}{60} = 5 \text{ km, distance by naresh} = 5 \text{ km}$$

Acceleration = slope of v-t graph

For dinesh  $\rightarrow$

$$a = \frac{20}{\left( \frac{30}{60} \right)} = 40 \frac{\text{km}}{\text{hr}^2}$$

Naresh is in uniform motion.

Option (b), (c)