



# NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE

**NSEJS - 2024**

**STUDENT QUESTION PAPER**

Paper Code 51 | Complete retyped paper for academic practice

**TIME**

**120 min**

**QUESTIONS**

**60**

**MAX. MARKS**

**216**

## STUDENT DETAILS

**Name** \_\_\_\_\_

**Class** \_\_\_\_\_ **Roll No.** \_\_\_\_\_

**Centre** \_\_\_\_\_

**Date** \_\_\_\_\_

**Instructions:** Attempt all 60 questions. In A-1 only one option is correct. In A-2 one or more options may be correct; marks are awarded only when every correct option and no incorrect option is marked.

## SECTION A-1

OUT OF THE FOUR OPTIONS, ONLY ONE IS CORRECT. MARK THE CORRECT OPTION.

1. In bilaterally symmetrical animals, segmentation of the 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

2. While discussing human evolution, Hominid stocks, Prehistoric Man and species of Modern Man are generally described on the basis of fossil records. Select the pair containing one member of a Hominid stock and one 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*

3. The median longitudinal section of the human brain shown below is marked with important parts 1 to 4.

The following functions or disorders are related to these parts:

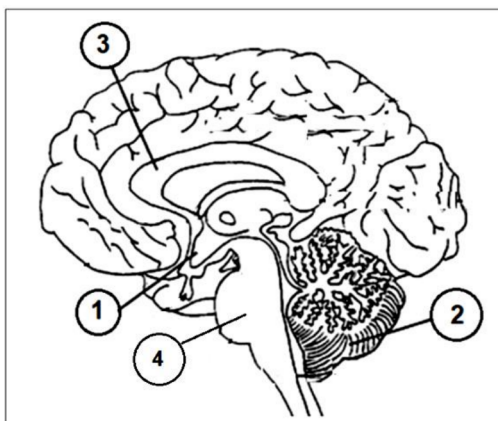
(i) Controls the sleep cycle, manages pain signals and contains the pneumotaxic centre involved in regulating breathing rhythm. Double vision (diplopia) can be a consequence of damage to this part.

(ii) Maintains homeostasis by directly influencing the autonomic nervous system or by managing hormones. It controls hunger and thirst and senses fullness while eating. Malfunction may cause Prader-Willi syndrome.

(iii) Plays an important role in controlling emotions and making decisions. Damage may interfere with judging size or distance, learning new words or skills, and reaching for objects. It is associated with Chiari malformation.

(iv) The largest structure of white matter; it enables the two sides of the brain to communicate and is related to coordination and complex problem-solving. Dysfunction may be associated with schizophrenia, dementia and other psychiatric disorders.

Correlate (i)-(iv) with labels 1-4 and choose the correct option.



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

4. Many insects are serious pests of crop plants. Sap-sucking insects can be controlled by spraying a systemic insecticide such as:

- (a) Chlorpyrifos (b) Malathion (c) Metasystox (d) Chlorantraniliprole

5. What kind of joint is found between the odontoid process of the second vertebra of mammals and the atlas vertebra?

- (a) Pivotal joint (b) Saddle joint (c) Sliding joint (d) Hinge joint

6. Match the items in Column I with those in Column II.

| Column I                                                                 | Column II                                                                          |
|--------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 1. Hexacanth<br>2. Renette cell<br>3. Respiratory tree<br>4. Piloerectum | (i) Goose flesh<br>(ii) <i>Ascaris</i><br>(iii) Sea cucumber<br>(iv) <i>Taenia</i> |

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

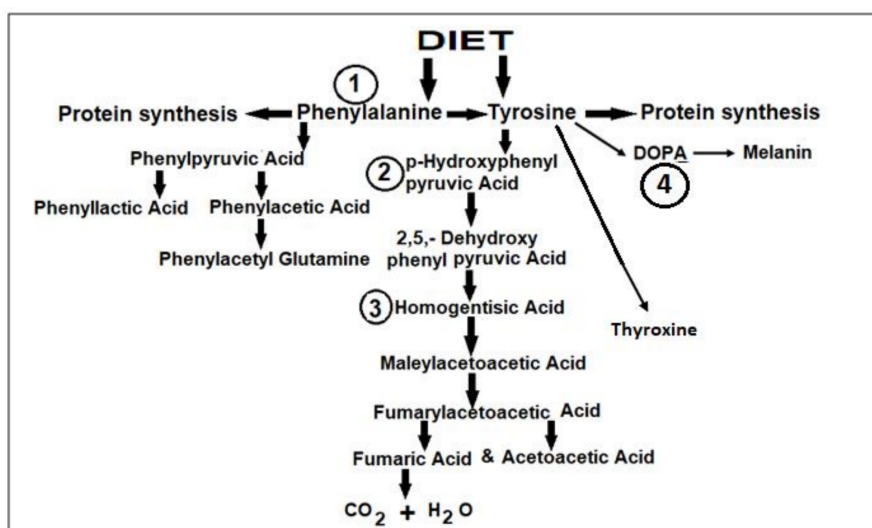
7. The tympanic cavity is connected with the auditory capsule through very fine openings. Choose the correct pair of openings.

- (a) Fossa ovalis and fenestra ovalis (b) Fenestra rotunda and fossa ovalis  
(c) Foramen ovale and fenestra ovalis (d) Fenestra ovalis and fenestra rotunda

8. At the time of this examination, all new vehicles sold and registered in India were required to comply with which version of emission standards?

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

9. In the flow chart below, accumulation of products marked 1 to 4 results in certain inborn diseases in humans. Give the correct sequence of diseases caused by accumulation of products 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

10. Match the plants in Column I with their characteristics in Column II.

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

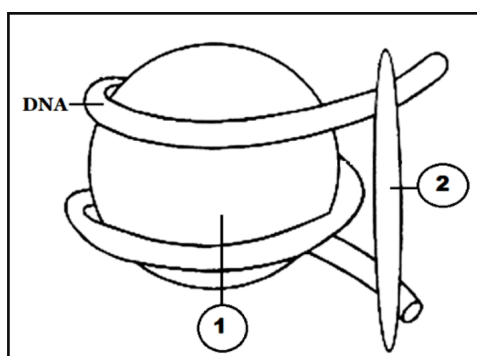
(a) 1-(iv), 2-(i), 3-(ii), 4-(iii)

(b) 1-(ii), 2-(iii), 3-(i), 4-(iv)

(c) 1-(ii), 2-(iv), 3-(i), 4-(iii)

(d) 1-(i), 2-(ii), 3-(iv), 4-(iii)

11. Under the electron microscope, chromatin appears as a string of bead-like repeating units called nucleosomes. The adjoining diagram shows one nucleosome. The labelled parts 1 and 2 together are made of a total of five components. Choose the option showing the correct set of those five components.



(a) H1, H2A, H2B, H3 and H4

(b) H1, H2B, H3A, H3B and H4

(c) H2A, H2B, H3, H4 and H1

(d) H1, H2, H3A, H3B and H4

12. Two statements marked Assertion (A) and Reason (R) are given below.

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

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

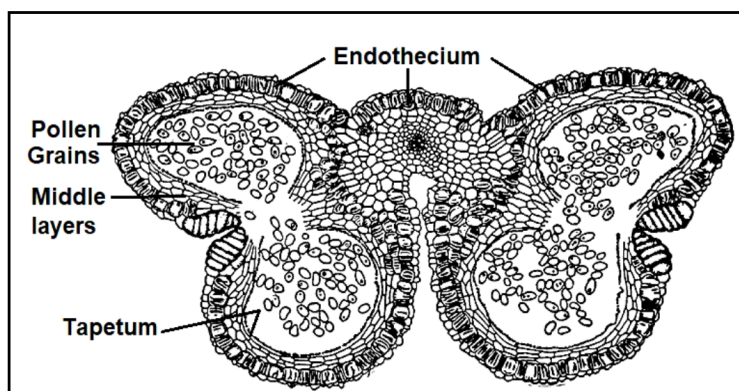
(a) Both A and R are true, and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false.

(d) Both A and R are false.

**13.** In the diagram below, what is the maximum number of different ploidy levels represented by the labelled parts?



- (a) Only haploid
- (b) Only diploid
- (c) Haploid and diploid
- (d) Haploid, diploid and polyploid

**14.** According to the cohesion theory for ascent of sap in tall trees, the combined forces opposing ascent are about 50 atm. What is the cohesive force of water that helps the continuous rise of sap in the tallest trees?

- (a)** 350 atm                      **(b)** 200 atm                      **(c)** 140 atm                      **(d)** 600 atm

**15.** Some human males show hypertrichosis of the ear pinna. Which of the following explains this genetic characteristic?

- (a) A dominant gene in males and a recessive allele in females  
(b) Aneuploidy  
(c) A holandric gene  
(d) Trisomy of an autosome

**16.** Which agreement protects the stratospheric ozone layer by phasing out the production and consumption of ozone-depleting substances?

- (a)** Kyoto Protocol      **(b)** Montreal Protocol      **(c)** Rio Summit      **(d)** Stockholm Convention

**17.** A sample of 1.0 litre of milk weighs 1.032 kg. The milk contains 4% milk fat by volume, and the density of the fat is  $865 \text{ kg m}^{-3}$ . 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

**18.** A research scholar requires 50 mL of aqueous  $\text{NaNO}_3$  solution containing 70.0 mg of  $\text{Na}^+$  per mL. The mass of  $\text{NaNO}_3$  required is:

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

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

- (a)  $2.10 \text{ \AA}$                       (b)  $2.47 \text{ \AA}$                       (c)  $4.20 \text{ \AA}$                       (d)  $3.42 \text{ \AA}$

**20.** Among 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

**21.** How many moles of the so-called 'electron gas' weigh one kilogram?

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

**22.** The electrostatic force between two tiny spherical balls carrying charges  $q_1$  and  $q_2$ , separated by a distance  $r$  in free space, is  $F = Kq_1q_2/r^2$ , where  $K = 9 \times 10^9$  in SI units. Two carbon-12 spheres of mass 1 g each are kept 1 cm apart and carry equal and opposite charges. If the attraction is  $1.0 \times 10^{-5}$  N, the ratio of excess electrons to total carbon atoms in the negative sphere is:

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

**23.** The table below lists five choices A-E for each property. Select the option giving the correct column letter for each row, in order.

| 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

**24.** On the Fahrenheit scale, water freezes at 32°F and boils at 212°F. On the Celsius scale, the corresponding points are 0°C and 100°C. A patient's temperature is 102.6°F. The Celsius temperature is:

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

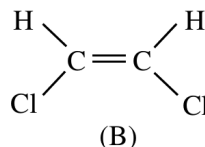
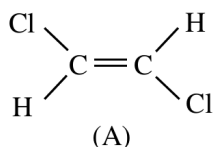
**25.** The pH of neutral pure water at 25°C is 7. When water is heated to 70°C, its pH:

- (a) decreases and the water becomes acidic (b) increases and the water becomes basic  
(c) remains 7 (d) decreases, but the water remains neutral

**26.** The concentration, in mol L<sup>-1</sup>, of H<sub>3</sub>O<sup>+</sup> in a solution of 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>

27. The normal boiling points of compounds A and B shown 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) Cannot be predicted

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

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

29. Which pair gives the most stable oxidation states of boron and thallium, respectively?

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

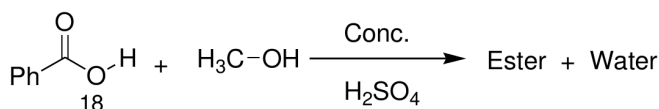
30. The substance most commonly used to generate gas in traditional automobile air bags is:

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

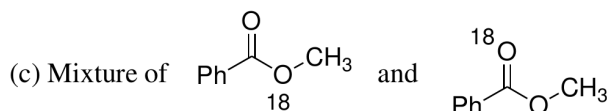
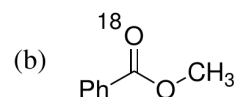
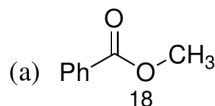
31. The metal most commonly used in magnetic resonance imaging (MRI) contrast solutions is:

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

32. An esterification reaction is shown below. Identify the fate of the labelled oxygen-18 atom in the product.



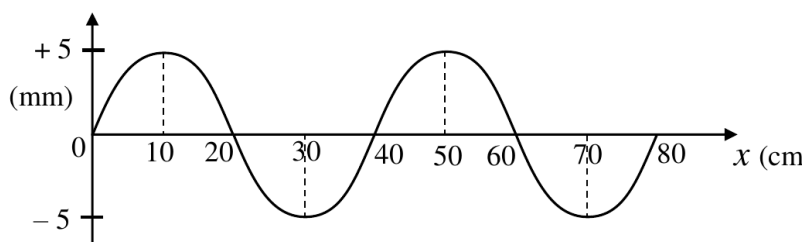
The fate of the labelled oxygen ( $O^{18}$ ) atom in the product is:



33. Which motion has the largest magnitude of acceleration? Assume all objects move in a straight line with constant acceleration.

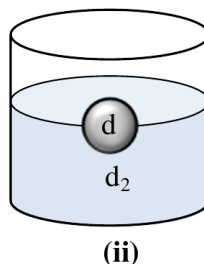
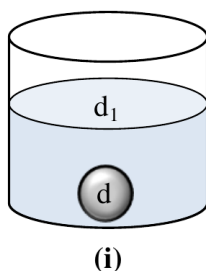
- (a) A bus with initial speed  $72 \text{ km h}^{-1}$  comes to rest in 2.50 s.  
 (b) A rock is in free fall near Earth's surface.  
 (c) A car accelerates from rest to  $108 \text{ km h}^{-1}$  in 4.00 s.  
 (d) A train starts from rest and covers 216 m in 6.00 s.

**34.** A sound wave travels in the  $+x$  direction at  $360 \text{ m s}^{-1}$ . The graph is a snapshot of particle displacement  $D$  versus position  $x$ . Which statement is incorrect?



- (a) The amplitude is 5 mm.
- (b) The frequency is 900 Hz.
- (c) After 0.01 s, troughs will occur at  $x = 20 \text{ cm}$  and  $x = 40 \text{ cm}$ .
- (d) The wave travels 1.62 km in the  $+x$  direction in 4.5 s.

**35.** A sphere of density  $d$  sinks in a liquid of density  $d_1$ , as in (i). In a liquid of density  $d_2$ , it floats with half its volume above the surface, as in (ii). If  $F_1$  and  $F_2$  are the buoyant forces in the two cases, then  $F_1/F_2$  equals:



- (a)  $d_1/d_2$
- (b)  $d_1/(2d_2)$
- (c)  $d_1/d$
- (d)  $d/d_2$

**36.** A car moves on a horizontal cement road with uniform velocity  $90 \text{ km h}^{-1}$ .

$S_1$ : The acceleration of the car is zero.

$S_2$ : No force acts on the car.

$S_3$ : Its kinetic energy and linear momentum remain constant.

$S_4$ : The engine does no work.

Choose the correct option.

- (a) Only  $S_1$  and  $S_2$  are true.
- (b) Only  $S_1$  and  $S_3$  are true.
- (c) Only  $S_1$ ,  $S_2$  and  $S_3$  are true.
- (d) All  $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$  are true.

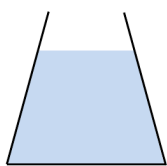
**37.** A particle moves with constant speed  $v$  on a circular path of diameter 14 cm. It takes 0.02 s to cover an arc subtending  $45^\circ$  at the centre. If  $f$  is its frequency of revolution, choose the correct pair.

- (a)  $v = 5.5 \text{ m s}^{-1}$ ,  $f = 6.25 \text{ Hz}$
- (b)  $v = 5.5 \text{ m s}^{-1}$ ,  $f = 12.5 \text{ Hz}$
- (c)  $v = 2.75 \text{ m s}^{-1}$ ,  $f = 6.25 \text{ Hz}$
- (d)  $v = 2.75 \text{ m s}^{-1}$ ,  $f = 12.5 \text{ Hz}$



**38.** The same liquid is filled to the same height in three vessels of different shapes. Each vessel has the same base area. Let  $P_a$ ,  $P_b$ ,  $P_c$  be the pressures at their bases, and  $W_a$ ,  $W_b$ ,  $W_c$  the weights of liquid. Choose the correct relation.

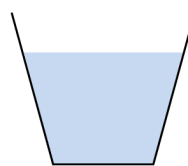
(c). Each vessel has equal base area.



(a)



(b)



(c)

(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  $W_a < W_b < W_c$

**39.** An ant moves with constant speed along the principal axis of a concave mirror of focal length  $f$ , from a point  $5f$  from the pole towards the focus  $F$ .

$S_1$ : Its image moves with constant speed.

$S_2$ : The image has the same velocity as the ant when the ant is at the centre of curvature  $C$ .

$S_3$ : The image moves slowly at first and faster near the end.

$S_4$ : The image moves faster at first and slower near the end.

(a) Only  $S_1$  is correct.

(b)  $S_2$  and  $S_3$  are correct.

(c) Only  $S_3$  is correct.

(d)  $S_2$  and  $S_4$  are correct.

**40.** Which of the following cannot be used as a unit of electric current?

(a) coulomb/second

(b) joule/(coulomb-ohm)

(c) watt/volt

(d) volt/(coulomb-metre)

**41.** Using  $E = mc^2$ , the energy equivalent of one atomic mass unit  $u$  is closest to: ( $1 u = 1.6605 \times 10^{-27} \text{ kg}$ ;  $c = 2.9979 \times 10^8 \text{ m s}^{-1}$ )

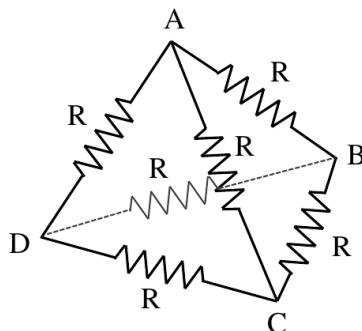
(a) 931 J

(b) 931 eV

(c) 931 MeV

(d) 931 keV

**42.** Each resistance in the tetrahedral network is  $R = 12 \Omega$ . The equivalent resistance between any two vertices is:



(a)  $2 \Omega$

(b)  $3 \Omega$

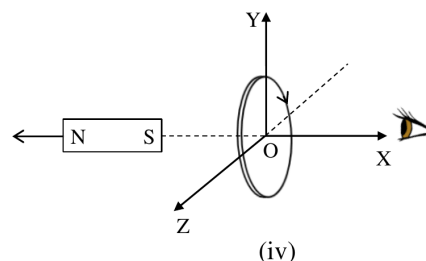
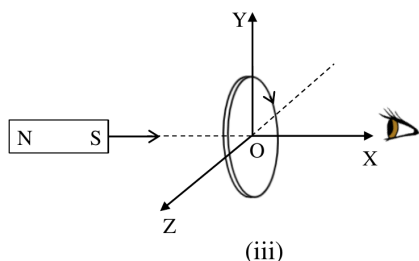
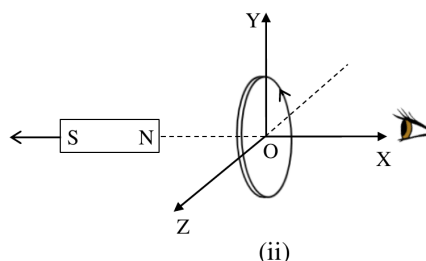
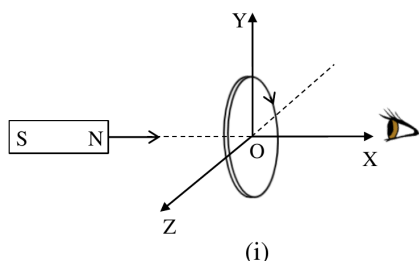
(c)  $4 \Omega$

(d)  $6 \Omega$

**43.** Two particles of masses 1 kg and 4 kg have equal kinetic energy. The ratio of the magnitudes of their linear momenta is:

- (a) 1 : 4                      (b) 1 : 2                      (c) 2 : 1                      (d) 1 : 16

**44.** All conducting coils shown are in the Y-Z plane. A magnet is moved along +X or -X with constant speed. The indicated current directions are viewed from +X. Identify the diagrams showing the correct direction of induced current.



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

**45.** A kettle filament is made from wire of length  $L$  and diameter  $D$ . At a fixed line voltage it takes 6 min to heat 500 mL of water through  $40^\circ\text{C}$ . It is replaced by a wire of the same material, length  $2L$  and diameter  $2D$ . Assuming no heat loss, the new heating time is:

- (a) 12 min                      (b) 6 min                      (c) 3 min                      (d) 1.5 min

**46.** A train moves with constant velocity  $v$ . A wagon breaks away and then moves with uniform retardation until it stops. During the stopping time, the wagon covers  $d_1$  and the train covers  $d_2$ . The ratio  $d_1/d_2$  is:

- (a)  $1/3$                       (b)  $1/2$                       (c)  $2/3$                       (d) 1

**47.** A person with myopia cannot see clearly beyond 2.5 m. The power of the correcting lens is:

- (a) +2.5 D                      (b) +0.4 D                      (c) -2.5 D                      (d) -0.4 D

**48.** Planet 1 has mass  $M$  and radius  $R$ . Planet 2 has mass  $2M$  and radius  $2R$ . If surface accelerations due to gravity are  $g_1$  and  $g_2$ , then  $g_1 : g_2$  is:

- (a) 1 : 2                      (b) 2 : 1                      (c) 1 : 4                      (d) 4 : 1

## SECTION A-2

ANY NUMBER OF OPTIONS (4, 3, 2 OR 1) MAY BE CORRECT. ALL CORRECT OPTIONS AND NO INCORRECT OPTION MUST BE MARKED.

49. Which plant or plants have an edible aril?

- (a) Litchi (*Litchi chinensis*) (b) Rambutan (*Nephelium lappaceum*)  
(c) Cashew (*Anacardium occidentale*) (d) Nutmeg (*Myristica fragrans*)

50. Which statement or statements about viruses are incorrect?

- (a) They are usually potentially infectious. (b) They reproduce through genetic material only.  
(c) Their envelope is made of glycolipids. (d) They possess ribosomes.

51. Which major division or divisions of algae are characterised by two flagella?

- (a) Rhodophyta (b) Phaeophyta (c) Chlorophyta (d) Cyanophyta

52. Which statement or statements are true?

- (a) All immunoglobulins are glycoproteins.  
(b) Eosinophils are not polymorphonuclear phagocytes.  
(c) Cilia in the windpipe act as mechanical barriers.  
(d) Human B cells bear IgM and IgD immunoglobulins on their surface.

53. Which of the following colloids are used as medicines?

- (a) Argyrol (b) Sulfur sol (c) Milk of magnesia (d) Purple of Cassius

54. In which processes is the nitrogen atom reduced?

- (a)  $\text{NH}_4^+ \rightarrow \text{N}_2$  (b)  $\text{NH}_2^- \rightarrow \text{NO}$   
(c)  $\text{NO}_2 \rightarrow \text{NO}_2^-$  (d)  $\text{NO}_3^- \rightarrow \text{NH}_4^+$

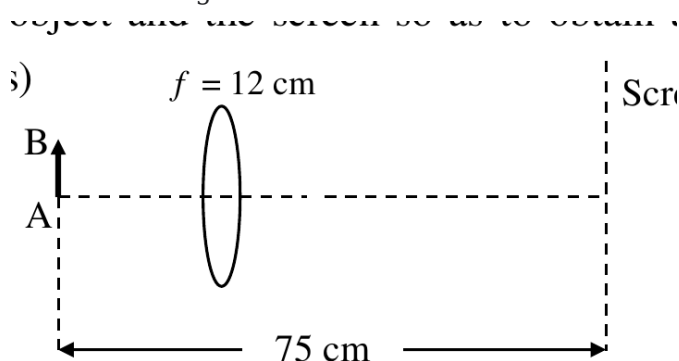
55. One mole of  $\text{H}_3\text{PO}_x$  is completely neutralised by 40 g of NaOH. Which statements are true?

- (a)  $x = 2$  and the acid is monobasic. (b)  $x = 3$  and the acid is dibasic.  
(c)  $x = 4$  and the acid is tribasic. (d)  $x = 2$  and the acid does not form an acid salt.

56. Select the correct statements about an element having 2 electrons in K, 8 in L, 9 in M and 2 in N shells.

- (a) It contains one unpaired electron. (b) It contains one d-electron.  
(c) It contains twelve p-electrons. (d) It is a non-metal.

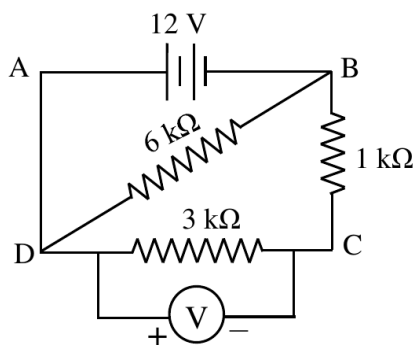
**57.** A screen is 75 cm from an illuminated object AB. A thin convex lens of focal length 12 cm is placed between them so that a real image forms on the screen. Choose all correct statements.



- (a) The lens-object distance may be 15 cm. (b) The lens-object distance may be 60 cm.  
(c) The image may be larger than the object. (d) The image may be smaller than the object.

**58.** In the circuit below, a voltmeter of resistance  $6000\ \Omega$  is connected across the  $3\ \text{k}\Omega$  resistor. The battery has negligible internal resistance. Choose all correct statements.

$6000\ \Omega$  has been connected across 3

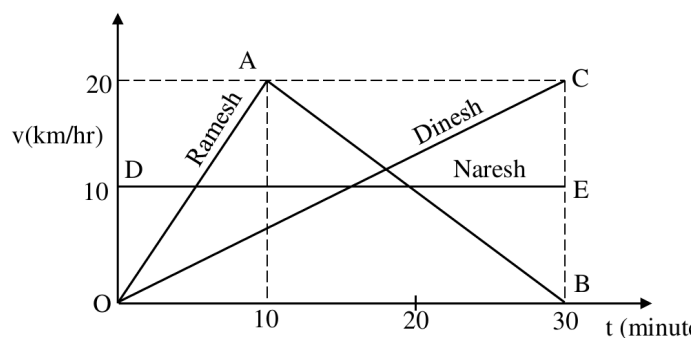


- (a) The voltmeter reads 8 V. (b) The current through the  $1\ \text{k}\Omega$  resistor is 2 mA.  
(c) The current drawn from the battery is 6 mA. (d) The power dissipated in the  $6\ \text{k}\Omega$  resistor is 24 mW.

**59.** A train moving at  $108\ \text{km h}^{-1}$  approaches a hill. When its engine is 1200 m from the hill, it produces a whistle of frequency 550 Hz. The speed of sound is  $330\ \text{m s}^{-1}$ . Choose all correct statements.

- (a) The echo is heard after  $1/9$  minute. (b) The engine is 1000 m from the hill when the echo is heard.  
(c) The wavelength of the sound is 60 cm. (d) The echo is heard after  $20/3$  s.

60. The velocity-time graphs for Ramesh (OAB), Naresh (DE) and Dinesh (OC) over 0-30 min are shown below. Which statements are correct?



- (a) Dinesh travels the maximum distance.      (b) All three athletes travel equal distances.  
(c) Dinesh's acceleration is  $40 \text{ km h}^{-2}$ .      (d) None of the athletes is in uniform motion.

## ROUGH WORK