

INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE 2013-2014

Total time : 120 minutes

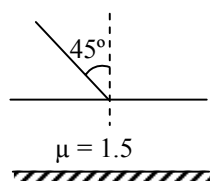
24-11-2013

(Total Marks : 240)

[CODE 514]

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT

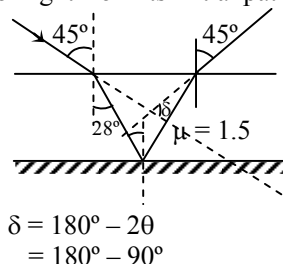
1. One side of a glass slab is silvered as shown in the figure. A ray of light is incident on the other side at angle of incidence  $i = 45^\circ$ . Refractive index of glass is given as 1.5. The deviation of the ray of light from its initial path when it comes out of the slab is (Given  $\sin^{-1} \frac{\sqrt{2}}{3} = 28^\circ$ )



- (a)  $90^\circ$  (b)  $180^\circ$  (c)  $120^\circ$  (d)  $45^\circ$

Ans. [a]

Sol. The deviation of the ray of light from its initial path when it comes out of the slab is  $90^\circ$ .



Angle of deviation  $\delta = 90^\circ$

2. The number  $5\sqrt{41}$  lies between-  
 (a) 29 and 30 (b) 30 and 31 (c) 31 and 32 (d) 32 and 33

Ans. [d]

Sol.  $(5\sqrt{41})^2$   
 $= 25 \times 41$   
 $= 1045$   
 $32^2 = 1024$   
 $33^2 = 1089$

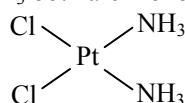
$\therefore 1024 < 1045 < 1089$

$\Rightarrow 32 < 5\sqrt{41} < 33$

3. Oxidation number and co-ordination number of Pt in cisplatin  $\text{PtCl}_2(\text{NH}_3)_2$  are respectively-  
 (a) +4 and 2 (b) +2 and 4 (c) 0 and 4 (d) +2 and 6

Ans. [b]

Sol.  $x + 2 \times (-1) + 2 \times 0 = 0$   
 $x = 2$  oxidation number  
 coordination number = 4  
 Cl &  $\text{NH}_3$  both are monodentate





8. Two circles each of radius 3 touch each other externally in the plane. In how many ways can a circle of radius 8 be placed in the plane touching each of these two circles ?

- (a) 2 (b) 4 (c) 6 (d) 8

Ans. [c]

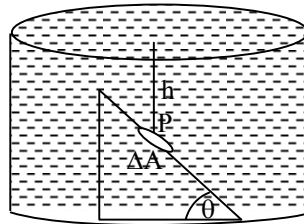
Sol. Number of way = 6

9. Which of these elements has the greatest electronegativity ?

- (a) Br (b) N (c) O (d) S

Ans. [c]

10. An inclined plane of inclination  $\theta$  is placed in water as shown in figure given below. Consider a small area ( $\Delta A$ ) around point P at a depth h. If density of water is  $\rho$  and acceleration due to gravity is g, the force experienced by  $\Delta A$  due to hydrostatic pressure is-



- (a)  $\rho gh(\Delta A)$  (b)  $\rho gh(\Delta A)\sin\theta$  (c)  $\rho gh(\Delta A)\cos\theta$  (d)  $\rho gh(\Delta A)\sec\theta$

Ans. [c]

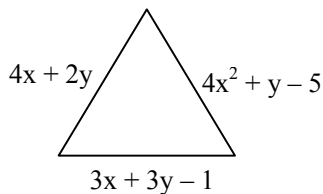
Sol. Hydrostatic pressure is  $P_H = \rho gh(\Delta A) \cos\theta$

11. If  $3x + 3y - 1$ ,  $4x^2 + y - 5$ ,  $4x + 2y$  are the sides of an equilateral triangle, its area is closest to the integer-

- (a) 84 (b) 85 (c) 86 (d) 87

Ans. [b]

Sol.



$$AB = BC$$

$$3x + 3y - 1 = 4x + 2y$$

$$\Rightarrow x - y + 1 = 0 \Rightarrow y = x + 1$$

$$AB = AC$$

$$\Rightarrow 4x + 2y = 4x^2 + y - 5$$

$$\Rightarrow 4x + 2(x + 1) = 4x^2 + x + 1 - 5$$

$$\Rightarrow 6x + 2 = 4x^2 + x - 4$$

$$\Rightarrow 4x^2 - 5x - 6 = 0$$

$$\Rightarrow 4x^2 - 8x + 3x - 6 = 0$$

$$\Rightarrow 4x(x - 2) + 3(x - 2) = 0$$

$$\Rightarrow (x - 2)(4x + 3) = 0$$

$$\Rightarrow x = 2, -\frac{3}{4}$$

$$\therefore x = 2, -\frac{3}{4}$$

$$y = 3, \frac{1}{4}$$

$$AB = 4x + 2y = 8 + 6 = 14 \quad (\because \text{for } x = -\frac{3}{4} \text{ and } y = \frac{1}{4}; 4x + 2y < 0)$$

$$\begin{aligned} \text{Area} &= \frac{\sqrt{3}}{4} \times 14^2 \\ &= \frac{\sqrt{3}}{4} \times 196 \\ &= 49 \times \sqrt{3} \\ &\simeq 85 \end{aligned}$$

12. The pH of a 0.025 M solution of KOH is-

- (a) 1.60                      (b) 3.69                      (c) 10.31                      (d) 12.40

Ans. [d]

Sol. 
$$\begin{aligned} \text{pH} &= -\log H^+ \\ &= -\log 25 \times 10^{-3} \\ &= (-) - 3 - \log 25 \\ &= 3 - \log 25 = 3 - 1.39 \\ &= 1.61 \end{aligned}$$

$$\text{pOH} = 14 - \text{pH} = 14 - 1.61 = 12.40$$

13. Consider the following two statements about light and sound. Choose the most appropriate option

- (i) When light and sound travel from air to water, light may bend towards normal while sound may bend away from normal  
 (ii) Sound is longitudinal wave while light is transverse wave.  
 (a) Statement (i) is correct while statement (ii) is incorrect  
 (b) Statement (i) and statement (ii) are both correct and statement (ii) is not the reason for statement(i)  
 (c) Statement (i) and statement (ii) are incorrect  
 (d) Statement (i) and statement (ii) are correct and statement (ii) is the correct reason for statement (i)

Ans. [b]

Sol. Statement (i) and Statement (ii) are both correct and Statement (ii) is not the reason for Statement (i).

14. If  $xy^2 = a^3$ ,  $yz^2 = b^3$  and  $zx^2 = c^3$  then  $z^3$  equals-

- (a)  $\frac{bc^4}{a^2}$                       (b)  $\frac{b^4c}{a^2}$                       (c)  $\frac{b^2c^4}{a^2}$                       (d)  $\frac{ab^4}{c^2}$

Ans. [b]

Sol. 
$$\begin{aligned} z &= \frac{c^3}{x^2} = \frac{c^3}{a^6} \cdot y^4 \\ z &= \frac{c^3}{a^6} \cdot \frac{b^{12}}{z^8} \\ \Rightarrow z^9 &= \frac{b^{12} \cdot c^3}{a^6} \\ \Rightarrow z^3 &= \frac{b^4 \cdot c}{a^2} \end{aligned}$$

15. How many H atoms are in 3.4 g of  $C_{12}H_{22}O_{11}$  ?  
 (a)  $6.0 \times 10^{23}$  (b)  $1.3 \times 10^{23}$  (c)  $3.8 \times 10^{22}$  (d)  $6.0 \times 10^{21}$

Ans. [b]

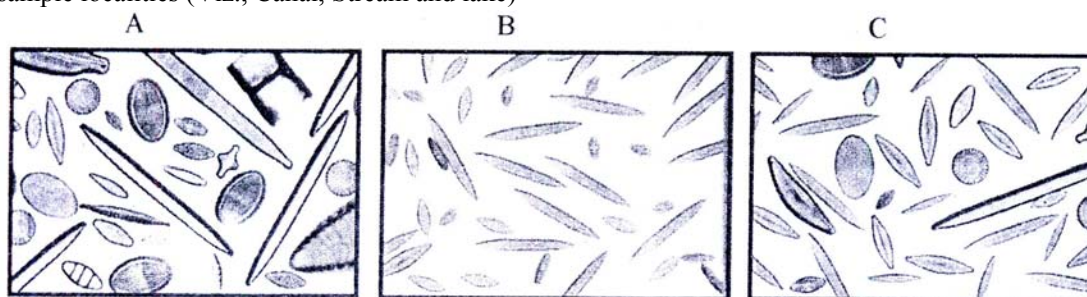
Sol. Molecular mass of  $C_{12}H_{22}O_{11} = 342$  u

$$\begin{aligned} \text{H atoms} &= \frac{3.4}{342} \times 6.022 \times 10^{23} \times 22 \\ &= 1.3 \times 10^{23} \end{aligned}$$

Passage Q(16-18)

Diatoms are the most common photosynthetic aquatic microorganisms group of algae which are unicellular and can exist as colonies in the shape of filaments or ribbons, fans, zigzags or stars depending on the quality of the water. Diatom communities are a popular tool for studies of water quality and pollution management. Karthik from Bangalore recently went on a field trip from Bangalore to Mysore. On the way he stopped his car at a sewage canal, a lake and a mountain stream and collected water samples from all of these places for his lab work. After a careful analysis of his water samples, he observed that diatoms came with varying size/shape and the size/shape increases has (have ?) something to do with the water quality.

16. Below are the diatoms observed under a microscope by Karthik. Help him to recognize the correct order of sample localities (Viz., Canal, Stream and lake)



- (a) A-Mountain stream, B-Sewage Canal, C-Lake (b) A-Sewage Canal, B-Lake, C-Mountain Stream  
 (c) A-Lake, B-Mountain stream, C-Sewage Canal (d) A-Mountain stream, B-Lake, C-Sewage canal

Ans. [a]

17. What is the take home message from the above experiment-  
 (a) Diatoms come in different sizes and shapes  
 (b) The difference in size and shapes from different water samples is suggestive of the intensity of water pollution  
 (c) Karthik enjoyed collecting samples from different locations  
 (d) Nothing can be inferred from the above experiment

Ans. [a]

18. In the above experiment, difference in sizes and shapes of diatoms should be inferred as-

- (a) Different species of diatoms (b) Different genera of diatoms  
 (c) Different families of diatoms (d) Different orders of diatoms

Ans. [a]

19. The percentage change in acceleration due to gravity at an altitude equal to radius of earth compared to that on the surface of earth is given by-

- (a) 25% increase (b) 35% decrease (c) 75% decrease (d) 25% decrease

Ans. [c]

Sol. Acceleration due to gravity

$$\begin{aligned} g &= \frac{Gm}{(R+h)^2} \quad \dots(i) \\ h &= R \end{aligned}$$



$$g' = \frac{Gm}{(R + R)^2} = \frac{Gm}{4R^2} \quad \dots(ii)$$

from eq.(i) & (ii)

$$g' = g/4$$

\* 75% acceleration decreases

20. Let a, b be two positive real numbers such that  $a < b < \frac{1}{a}$  and let  $x = \left(a + \frac{1}{a}\right) - \left(b + \frac{1}{b}\right)$ . Then-

(a) x is always greater than zero

(b) x is always less than zero

(c) x = 0

(d) No such definite conclusion can be drawn about x

Ans. [b]

Sol.  $x = \left(a + \frac{1}{a}\right) - \left(b + \frac{1}{b}\right) \quad a < b < \frac{1}{a}$

Let a = -3, b = -2

$$x = \left(-3 - \frac{1}{3}\right) - \left(-2 - \frac{1}{2}\right)$$

$$= \frac{-10}{3} + \frac{5}{2} = \frac{-20 + 15}{6} = \frac{-5}{6}$$

∴ x is always less than zero.

21. Which of the following species has standard enthalpy of formation as 0 kJ mol<sup>-1</sup> ?

(a) H<sub>2</sub>O<sub>(l)</sub>

(b) Na<sub>(g)</sub>

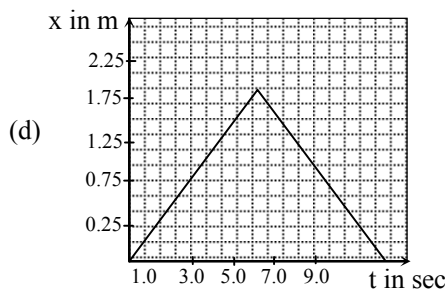
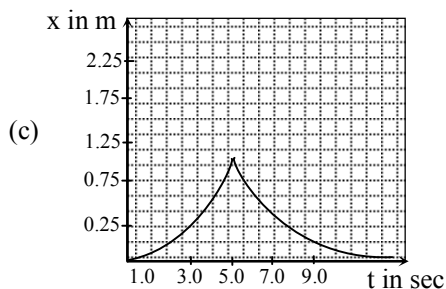
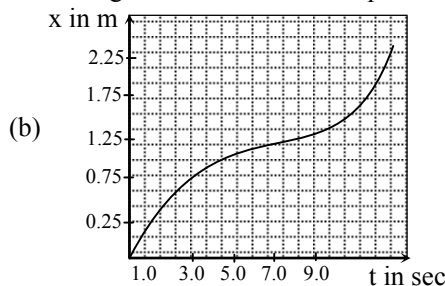
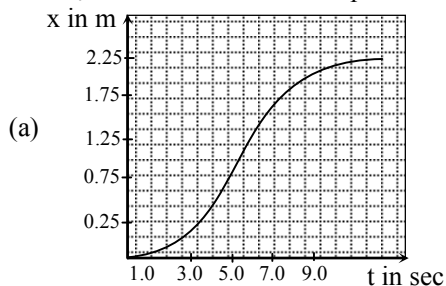
(c) Na<sub>(s)</sub>

(d) CO<sub>2(g)</sub>

Ans. [c]

Sol. Standard enthalpy of formation of any substance in elemental state is considered 0 kJ/mol.

22. A particle accelerates with a constant acceleration a<sub>0</sub> and reaches a maximum velocity and then decelerates with a<sub>0</sub> and comes to rest. The position time graph describing the situation is best represented by-



Ans. [a]



26. Let T be the number of 4-digit integers, each ending in 3 (in units place) and each divisible by 11. Then-  
 (a)  $70 \leq T \leq 79$                       (b)  $80 \leq T \leq 89$                       (c)  $90 \leq T \leq 99$                       (d)  $T \geq 100$

**Ans.** [b]

**Sol.** There are 9000 4-digit numbers. From which around  $\frac{9000}{11}$  numbers will be divisible by 11 and from them  $\frac{9000}{11 \times 10}$  numbers around will be having unit digit 3.  
 So the numbers will be fall between  $80 \leq 90$ .

27. 1.000 mL of 0.1000 mol L<sup>-1</sup> hydrochloric acid was diluted to 100.0 mL with deionised water. 10.00 mL of this solution was diluted to 100.0 mL again using deionised water. What is the pH of the final solution ?  
 (a) 2    (b) 3    (c) 4    (d) 5

**Ans.** [c]

**Sol.**  $M_1V_1 = M_2V_2$   
 $0.1 \times 1 = M_2 \times 100$   
 $M_2 = \frac{1}{1000}$   
 $M_2V_2 = M_3V_3$   
 $0.001 \times 10 = M_3 \times 100$   
 $M_3 = 1 \times 10^{-4}$   
 pH = 4

28. While playing Football, Dimple fell down and was badly wounded on her left ankle. The Doctor prescribed her antibiotics for a week which should have healed her of the wound in a week. However, Dimple's wound did not heal in a week. What among the following could have been the reason for inability of the wound to heal in the prescribed time frame given by the doctor ?  
 (a) Prescribed medicine's date was expired.  
 (b) Dimple wouldn't have taken the full course of the antibiotics  
 (c) Both a & b could be the reason  
 (d) Doctor's inability to prescribe the correct medicine for the wound.

**Ans.** [d]

29. Which of the following situation is impossible ?  
 (a) A body having velocity and acceleration in opposite directions  
 (b) A body having zero velocity and non zero acceleration  
 (c) A body having constant acceleration and variable velocity  
 (d) A body having constant velocity and variable acceleration

**Ans.** [d]

**Sol.** A body having constant velocity and variable acceleration. When body move with constant velocity. The acceleration of the body will be zero.

30. At what time (to the nearest second) immediately after 4 O' clock will angle between the hands of the clock be the same as that at 4 O' clock ?  
 (a) 4<sup>h</sup> 42<sup>m</sup>50<sup>s</sup>                      (b) 4<sup>h</sup> 43<sup>m</sup>38<sup>s</sup>                      (c) 4<sup>h</sup> 43<sup>m</sup>40<sup>s</sup>                      (d) 5<sup>h</sup> 5<sup>m</sup>27<sup>s</sup>

**Ans.** [b]

**Sol.** Angle between hands at 4 O' clock = 120°  
 Let the angle be 120° after x seconds



$$\text{Speed of hour hand} = \left(\frac{1}{120}\right)^\circ / \text{second}$$

$$\text{Speed of minute hand} = \left(\frac{1}{10}\right)^\circ / \text{second}$$

$$\therefore \text{After } x \text{ seconds angle} = \frac{x}{10} - \frac{x}{120} - 120^\circ = 120^\circ$$

$$\Rightarrow x = 2618.2 \text{ seconds} = 43.63 \text{ minute} = 43 \text{ minute, } 38.18 \text{ seconds}$$

$$\therefore \text{Time} = 4 \text{ Hr } 43 \text{ minute } 38.18 \text{ seconds}$$

31. 0.5755 g of a compound, containing sulfur and fluorine only, has a volume of 255.0 mL at 288.0 K and 50.01 kPa. What is the molecular formula of this compound ?

(a) S<sub>2</sub>F<sub>2</sub>                      (b) SF<sub>2</sub>                      (c) SF<sub>4</sub>                      (d) SF<sub>6</sub>

Ans. [c]

Sol.  $PV = nRT$                        $\therefore n = \frac{w}{M}$

$$PV = \frac{w}{M} RT \qquad 1 \text{ atm} = 101 \text{ kPa}$$

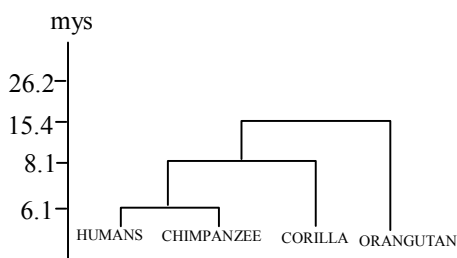
$$M = \frac{wRT}{PV} \qquad 50.01 \text{ kPa} = 0.5 \text{ atm}$$

$$= \frac{0.5755 \times 0.821 \times 288}{0.5 \times 0.255}$$

$$M \approx 108$$

molecular mass of SF<sub>4</sub> = 108

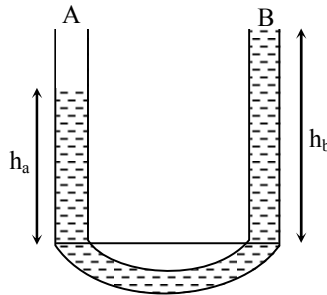
32. Given here is a phylogenetic tree (family tree) of greater apes. Which of the following statements cannot be true from the tree ? (mya-million years ago)



- (a) Humans did not evolve from chimpanzees                      (b) Humans and chimpanzees are evolutionary cousins  
 (c) Orangutans evolved much earlier than Humans                      (d) Humans are highly evolved among great apes

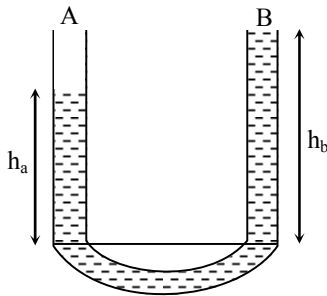
Ans. [c]

33. A liquid (A) of density  $1.6 \text{ g cm}^{-3}$  and liquid (B) of unknown density is poured into a U-tube as shown in the figure. The liquids are immiscible. If height of A is  $h_A = 26.6 \text{ cm}$  and height of B is  $h_B = 50 \text{ cm}$  the density of B is -



- (a)  $0.85 \text{ g cm}^{-3}$       (b)  $3.01 \text{ g cm}^{-3}$       (c)  $0.33 \text{ g cm}^{-3}$       (d)  $1.18 \text{ g cm}^{-3}$

Ans. [a]  
Sol.



Given

	Liquid A	Liquid B
Density	$D_A = 1.6 \text{ g/cm}^3$	$D_B = ?$
(height)	$h_A = 16.6 \text{ cm}$	$h_B = 50 \text{ cm}$

pressure =  $dgh$

$P_A = P_B$

$\Rightarrow$

$d_A g h_A = d_B g h_B$

$1.6 \times 26.6 = 50 d_B$

$D_B = 0.85 \text{ g/cm}^3$

density of liquid B is  $0.85 \text{ g/cm}^3$

34. If a and b are two positive real numbers such that  $\frac{a^2 + b^2}{ab} = 6$ , then a positive value of  $\frac{a}{b}$  lies between -
- (a) 2 and 3      (b) 3 and 4      (c) 4 and 5      (d) 5 and 6

Ans. [d]

Sol.  $\frac{a^2 + b^2}{ab} = \frac{a}{b} + \frac{b}{a} = 6$

Let  $\frac{a}{b} = x$

$\Rightarrow x + \frac{1}{x} = 6$

$\Rightarrow x^2 - 6x + 1 = 0$

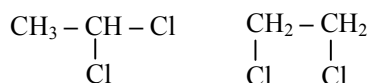
$\Rightarrow x = \frac{6 \pm \sqrt{36 - 4}}{2} = \frac{6 \pm 4\sqrt{2}}{2}$   
 $= 3 \pm 2\sqrt{2}$

$$\begin{aligned} \therefore \frac{a}{b} &= x = 3 \pm 2\sqrt{2} \\ &= 3 \pm 2 \times 1.41 \\ &= 3 \pm 2.82 \\ &\approx 5.82, 0.18 \\ \therefore 5 &< \frac{a}{b} < 6 \end{aligned}$$

35. The isomerism which exists between  $\text{CH}_3\text{CHCl}_2$  and  $\text{CH}_2\text{ClCH}_2\text{Cl}$  is -  
 (a) chain isomerism (b) functional group isomerism  
 (c) positional isomerism (d) metamerism

Ans. [c]

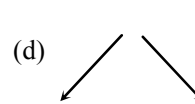
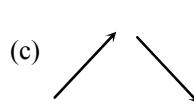
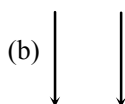
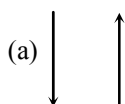
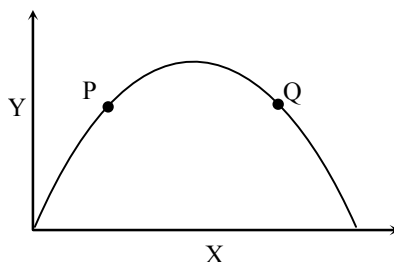
Sol.



36. The term Biodiversity refers to -  
 (a) Species Diversity (b) Genetic diversity  
 (c) Ecosystem diversity (d) All of the above

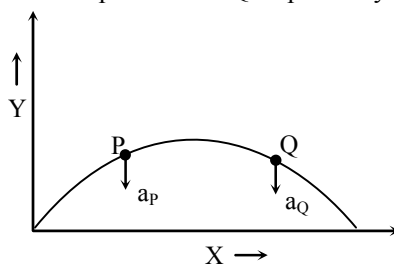
Ans. [d]

37. Diagram shows trajectory of a cricket ball. The set of arrows which show the direction of the acceleration of ball at points P and Q respectively is -



Ans. [b]

Sol. The direction of the acceleration of ball at point P and Q respectively is in downward.



38. Sucharitha purchases  $x$  pencils at Rs  $x$  each,  $y$  pens at Rs  $y$  each and  $z$  notebooks at Rs  $z$  each. She purchases altogether 50 items and pays Rs. 1000/=. The cost of  $y$  pencils,  $z$  pens and  $x$  notebooks is -  
 (a) Rs 600/= (b) Rs. 750/= (c) Rs. 500/= (d) Rs. 350/=

Ans. [b]

Sol.  $(x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$   
 $(50)^2 = 1000 + 2(xy + yz + zx)$



$$2500 - 1000 = 2(xy + yz + zx)$$

$$\frac{1500}{2} = xy + yz + zx$$

$$750 = xy + yz + zx$$

39. The metal that does not give H<sub>2</sub> on treatment with dilute HCl is -  
 (a) Zn (b) Fe (c) Ag (d) Ca

**Ans.** [c]

**Sol.** In reactivity series Ag present below H.

40. On a field trip in North America, students noticed that when threatened, Horned lizards (Genus : Phrynosoma) squirt blood at the attackers. When the professor asked what could have been the reason behind such behaviour of Horned lizards, one student said that certain sensory receptors had fired and triggered a neuronal reflex culminating in increasing the pressure in their sinus cavities until the blood vessels in the corners of the eyes burst. Another student said that it was just an act to frighten off the predator. Thus it can be said that -  
 (a) The first response is correct, while the second is incorrect  
 (b) Both explanations are reasonable and can be scientifically tested  
 (c) The first response is biological, while the second is philosophical  
 (d) The first explanation is testable as a scientific hypothesis, while the second is not

**Ans.** [d]

41. If temperature of a certain mass of aluminum having specific heat capacity of 0.8 J/g°C is lowered by 6°C and heat lost is 96J, then mass of aluminum is -

- (a) 16 g (b) 48 g (c) 60 g (d) 20 g

**Ans.** [d]

**Sol.**  $Q = ms\Delta t$

$$96 = m \times 0.8 \times 6$$

$$m = 20 \text{ g}$$

42. The number of real values of a for which the cubic equation  $x^3 - 3ax^2 + 3ax - a = 0$  has all real roots one of which is a itself, is -

- (a) 0 (b) 1 (c) 2 (d) 3

**Ans.** [b]

**Sol.**  $f(x) = x^3 - 3ax^2 + 3ax - a = 0$   
 $a^3 - 3a^3 + 3a^2 - a = 0$

$$\Rightarrow 2a^3 - 3a^2 + a = 0$$

$$\Rightarrow a(2a^2 - 3a + 1) = 0$$

$$\Rightarrow a = 0$$

Consider

$$2a^2 - 3a + 1$$

For this discriminant,

$$D = 9 - 4 \times 2 \times 1 > 0$$

$$\therefore \text{Number of real values} = 1 + 2 = 3$$

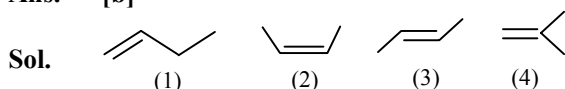
OR

$$\begin{array}{r}
 x^2 - 2ax + (3a - 2a^2) \\
 x - a \overline{) x^3 - 3ax^2 + 3ax - a} \\
 \underline{\pm x^3 \mp ax^2} \\
 -2ax^2 + 3ax - a \\
 \underline{\mp 2ax^2 \pm 2a^2x} \\
 (3a - 2a^2)x - a \\
 \underline{(3a - 2a^2)x - 3a^2 + 2a^3} \\
 (-2a^3 + 3a^2 - a)
 \end{array}$$

Cubic in 'a'  $\Rightarrow$  3 values of a.

43. The maximum number of isomers for an alkene with molecular formula  $C_4H_8$  is -  
 (a) 5 (b) 4 (c) 2 (d) 3

Ans. [b]



44. People residing in coastal area usually do not face the problem of Thyroxin hormone deficiency because their food intake will be rich in one of the following minerals -

- (a) Sodium (b) Chlorine (c) Iodine (d) Phosphorus

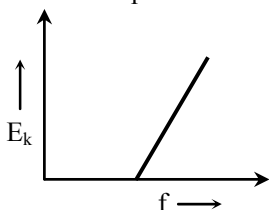
Ans. [c]

45. In photoelectric effect, the maximum kinetic energy ( $E_k$ ) of photoelectrons depends on frequency ( $f$ ) of light incident on a metal surface of work function ( $\phi$ ). In an experiment  $f$  is varied and  $E_k$  is measured. To determine value for Planck's constant ( $h$ ) -

- (a) Plot  $E_k$  against  $\Psi$  and find intercept of best fitted line  
 (b) Plot  $E_k$  against  $\phi$  and find slope of line of best fit.  
 (c) Plot  $E_k$  against  $\Psi$  and find slope of line of best fit.  
 (d) Plot  $E_k$  against  $\phi$  and find intercept of best fitted line

Ans. [b]

Sol. Plot  $E_k$  against  $f$  and find slope of line of best fit.

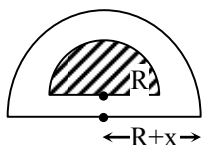


46. Around a lawn which is of semicircular shape a pavement of uniform width is laid. If the ratio of the area of the lawn to the area of the pavement is 25 : 24, then the ratio of the outer and inner perimeters of the pavement is -

- (a)  $\frac{7}{5}$                                       (b)  $\frac{6}{5}$                                       (c)  $\frac{5}{4}$                                       (d)  $\frac{5}{2\sqrt{6}}$

Ans. [a]

Sol.



$$\frac{(\pi R^2)}{\pi(R+x)^2 - \pi R^2} = \frac{R^2}{x \cdot (2R+x)} = \frac{25}{24}$$

$$\Rightarrow \frac{R/x}{\left(2 + \frac{x}{R}\right)} = \frac{25}{24}$$

$$\Rightarrow \frac{y}{\frac{2}{1} + \frac{1}{y}} = \frac{25}{24} \Rightarrow \frac{y}{2y+1} = \frac{25}{24} \quad \left(y = \frac{R}{x}\right)$$

$$\frac{y^2}{2y+1} = \frac{25}{24}$$

$$\Rightarrow 24y^2 - 50y - 25 = 0$$

$$\Rightarrow 24y^2 - 60y + 10y - 25 = 0$$

$$\Rightarrow 12y(2y-5) + 5(2y-5) = 0$$

$$\Rightarrow y = \frac{5}{2}, -\frac{5}{12} \quad \therefore y = \frac{5}{2}$$

$$\Rightarrow \frac{R}{x} = \frac{5}{2}$$

$$\therefore \text{Ratio of perimeters} = \frac{\pi(R+x)}{\pi R}$$

$$= 1 + \frac{x}{R} = 1 + \frac{2}{5} = \frac{7}{5}$$

47. The method that cannot be used for removing permanent hardness of water is -

- (a) adding sodium carbonate                                      (b) distillation  
(c) adding caustic soda    (d) boiling

Ans. [d]

48. In angiosperm plants, companion cell is associated with which one of the following elements ?

- (a) Sieve tube                                      (b) Tracheids                                      (c) Vessels                                      (d) xylem fibre

Ans. [a]

49. Essential requirement for the operation of a step down transformer is -

- (a) Laminated iron core  
(b) Electrical connection between primary and secondary coils  
(c) Magnetic interaction between primary and secondary coils  
(d) Non magnetic core

Ans. [c]

Sol. Magnetic interaction between primary and secondary coils.



**Sol.** Given  $t = 6$  second  
Speed of sound  
 $v = 350$  m/second

$$\text{Velocity} = \frac{\text{distance}}{\text{time}}$$

$$\begin{aligned} \text{Distance} &= \text{velocity} \times \text{time} \\ &= 350 \times 6 \\ &= 2100 \text{ m} \end{aligned}$$

$$D = 2.1 \text{ km}$$

The altitude of the clouds is 2.1 km.

**54.** A certain principal becomes Rs. 96800/= in 2 years if compounded annually at a certain rate of interest. The same principal becomes Rs. 97240/= in two years if compounded half yearly at the same rate of interest. The rate of interest is -

- (a) 8%                      (b)  $8\frac{1}{3}\%$                       (c) 10%                      (d)  $12\frac{1}{2}\%$

**Ans.** [c]  
**Sol.**

**Case-I**

$A = 96,800$   
 $n = 2$  yrs  
 $n = 1$   
 $R = R$   
 $P = P$

**Case-II**

$A = 97,240$   
 $n = 2$   
 $x = 2$   
 $R = R$   
 $P = P$

$$\begin{aligned} A &= P \left( 1 + \frac{R}{100x} \right)^{nx} \\ 96,800 &= P \left( 1 + \frac{R}{100} \right)^2 \\ 97,240 &= P \left( 1 + \frac{R}{200} \right)^4 \\ \frac{97240}{96800} &= \frac{\left( 1 + \frac{R}{200} \right)^4}{\left( 1 + \frac{R}{100} \right)^2} \\ &= \frac{(200 + R)^4}{(200)^4} \\ &= \frac{(200 + R)^4}{(100 + R)^2} \\ &= \frac{(200 + R)^4}{100^2} \\ &= \left[ \frac{(200 + R)^4}{(100 + R)^2} \right] \times \frac{100^2}{200^4} \\ 160727.3 &= \frac{(200 + R)^4}{(100 + R)^2} \Rightarrow R = 10\% \end{aligned}$$

**55.** Which properties of plastics make their disposal difficult : (I) PVC produces harmful combustion products, (II) polyalkenes are highly flammable; (III) polyalkenes are non-biodegradable -  
(a) I and II only                      (b) I and III only                      (c) II and III only                      (d) I, II, III

**Ans.** [c]



56. Suresh accidentally touched silencer of his two wheeler while parking and withdrew his leg immediately. Identify the correct order of the flow of message to the brain ?
- (a) Receptor → Sensory neuron → CNS → Motor neuron → Effectors  
 (b) Sensory neuron → CNS → Motor neuron → Effectors → Receptors  
 (c) CNS → Motor neuron → Effectors → Receptors → Sensory neuron  
 (d) Effectors → Receptors → Sensory neuron → Motor neuron

**Ans.** [a]

57. There are three bodies A, B and C. Body A when brought closer to B, attract. When body B is brought closer to C they repel. We can then conclude -
- (a) Body A and B should have opposite charges while Body C should have the same charge as B  
 (b) Body B and C should have same kind of charge while Body A may have opposite charge.  
 (c) Body A and B should have same charge while Body C may have opposite charge.  
 (d) Body C is neutral while Body A and B should have opposite charge

**Ans.** [a]

**Sol.** There are three bodies A, B and C. Body A when brought closer to B, attract, when body B is brought closer to C they repel. We can conclude that Body A and B should have opposite charges while Body C should have the same charge as B.

58. A pen costs Rs 13/= and a note book costs Rs. 35/=. Let m be the maximum number of items that can be bought for Rs 1000/= and n be the minimum number of items that can be bought for the same amount. Then m + n is -
- (a) 76 (b) 88 (c) 96 (d) 98

**Ans.** [a]

**Sol.** For maximum :  
 $13\text{pen} + 35\text{nb} = 1000$  (nb = note book)  
 $\text{pen} = 50$        $\text{nb} = 10$   
 $\Rightarrow 13 \times 50 + 35 \times 10 = 1000$   
 $\therefore m = 50 + 10 = 60$   
 For minimum :  
 $\text{pen} = 15, \text{nb} = 23$   
 $= 13 \times 15 + 35 \times 23$   
 $= 1000$   
 $\text{nb} = 23 + 15 = 38$   
 $m + n = 98$

59. When the pH of the environment of a protein is changed, it is said to be denatured. This is due to -
- (a) breakage of peptide bonds (b) breakage of disulfide links  
 (c) loss of tertiary structure (d) breakdown of R groups

**Ans.** [c]

60. If Brain is controlling unit of an organism, then at cellular level which cell organelle can be comparable to Brain ?
- (a) Chloroplast (b) Ribosome (c) Nucleus (d) Lysosome

**Ans.** [c]

61. Aldebaron, the brightest star in the constellation Taurus rises at local time 7 : 00 pm on 1<sup>st</sup> of October. On November 1<sup>st</sup> the star will rise at
- (a) 5 : 00 pm (b) 6 : 00 pm (c) 9 : 00 pm (d) 8 : 34 pm

**Ans.** [d]

**Sol.** The brightest star in the constellation Taurus rises at local time 7:00 pm on 1<sup>st</sup> October. On November 1<sup>st</sup> the star will rise at 8 : 34 pm.

62. In the xy-plane let **A** be the point (5, 0) and **L** be the line  $y = \frac{x}{3}$ . The number of points **P** on the line **L** such that triangle OAP is isosceles is (**O** being the origin)
- (a) 1                                      (b) 2                                      (c) 3                                      (d) infinitely many

**Ans.** [c]

**Sol.**  $\Delta$  OAP can be isosceles

If  $OA = AP$

or  $OP = AP$

or  $OA = OP$

(i)  $OA = AP$

$$\Rightarrow \sqrt{(x-5)^2 + \left(\frac{x}{3}\right)^2} = 5$$

$$\Rightarrow x = 0, \frac{9}{10}$$

$$y = 0, \frac{3}{10}$$

$$P_1 \rightarrow \left(\frac{9}{10}, \frac{3}{10}\right)$$

(ii)  $OP = AP$

$$\Rightarrow \sqrt{x^2 + \frac{x^2}{9}} = \sqrt{(x-5)^2 + \frac{x^2}{9}}$$

$$\Rightarrow x = \frac{5}{2}$$

$$\Rightarrow y = \frac{5}{6}$$

$$P_2 \rightarrow \left(\frac{5}{2}, \frac{5}{6}\right)$$

(iii)  $OA = OP$

$$5^2 = x^2 + \frac{x^2}{9}$$

$$\Rightarrow x = \pm \frac{15}{\sqrt{10}}$$

$$y = \pm \frac{5}{\sqrt{10}}$$

$$P_3 \rightarrow \left(\frac{15}{\sqrt{10}}, \frac{5}{\sqrt{10}}\right)$$

63. For the reaction,  $2A + B \rightarrow C$  which relationship is correct ?

- (a)  $\Delta[A] = \Delta[C]$                       (b)  $-\Delta[A] = \Delta[C]$                       (c)  $-2\Delta[A] = \Delta[C]$                       (d)  $-\Delta[A] = 2\Delta[C]$

**Ans.** [c]

**Sol.** Decrease in concentration of reactant = Increase in concentration of products

(-)

(+)

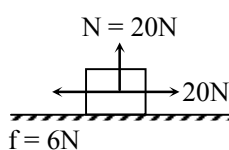
64. In some societies, "Women were solely held responsible for giving birth to female baby" assuming no role for men. But scientific advancement has proved men equally responsible for the birth of either sex. Armed with this information which of the following would be the most appropriate scenario for the birth of female child ?
- (a) Ovum with X chromosome and Sperm with Y chromosome is FEMALE
  - (b) Ovum with Y chromosome and Sperm with Y chromosome is MALE
  - (c) Ovum with X chromosome and Sperm with X chromosome is FEMALE
  - (d) Ovum with Y chromosome and Sperm without chromosome is FEMAL

Ans. [c]

65. A block of mass 2 kg placed on a floor experiences an external force in horizontal direction of 20N, frictional force of 6N and normal force of 20N. The body travels a distance of 10m under the combined effect of all these force. If initially body is at rest then what is the kinetic energy of the body at the end of 4m ?
- (a) 140J
  - (b) 260 J
  - (c) 60J
  - (d) 460 J

Ans. [c]

Sol.



Work done during 0 to 4m

$$W_f = -6 \times 4 = -24 \text{ J}$$

$$W_{\text{ext}} = 20 \times 4 = 80 \text{ J}$$

$$W_f + W_{\text{ext}} = \Delta K = K - 0 = 80 - 24 = 56 \text{ J}$$

The kinetic energy of the body at the end of 4m is 56 J.

66. If  $x^3 = a + 1$  and  $x + (b/x) = a$ , then x equals-

- (a)  $\frac{a(b+1)}{a^2 - b}$
- (b)  $\frac{ab+1}{a^2 - b}$
- (c)  $\frac{ab+a+1}{a^2 - b}$
- (d)  $\frac{ab-a-1}{a^2 - b}$

Ans. [c]

Sol.  $x^3 = a + 1$                        $x = ?$

$$x + \frac{b}{x} = a$$

Put  $a = 7$

$$\Rightarrow x^3 = 8 \Rightarrow x = 2$$

$$2 + \frac{b}{2} = 7 \Rightarrow b = 10$$

From options :  $\frac{ab+a+1}{a^2 - b} = \frac{7 \times 10 + 7 + 1}{49 - 10} = \frac{78}{39} = 2$

67. An electrochemical cell constructed for the reaction:  $\text{Cu}^{2+}_{(\text{aq})} + \text{M}_{(\text{s})} \rightarrow \text{Cu}_{(\text{s})} + \text{M}^{2+}_{(\text{aq})}$  has an  $E^\circ = 0.75\text{V}$ . The standard reduction potential for  $\text{Cu}^{2+}_{(\text{aq})}$  is 0.34V. What is the standard reduction potential for  $\text{M}^{2+}_{(\text{aq})}$  ?
- (a) 1.09V
  - (b) 0.410V
  - (c) - 0.410V
  - (d) - 1.09V

Ans. [c]

Sol.  $E^\circ_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$

$$0.75 = 0.34 - x$$

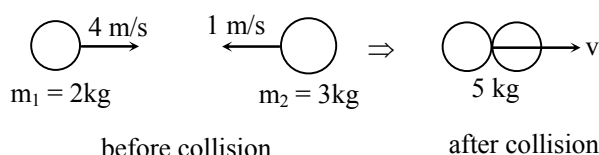
$$x = - 0.410\text{V}$$

68. Which one of the following is said to produce seeds exposed and they are called naked seed plant  
 (a) Deodar & Pinus (b) Marsilea & Nostoc  
 (c) Maize & Garden pea plant (d) Spirogyra & Funaria

Ans. [a]

69. A body of mass 2 kg moving in the positive X-direction with a speed  $4 \text{ ms}^{-1}$  collides head on with an another body of mass 3 kg moving in the negative X-direction with a speed of  $1 \text{ ms}^{-1}$ . During collision a loud sound is heard and they both start moving together. The sound energy cannot be greater than-  
 (a) 12J (b) 14J (c) 15J (d) 17.5J

Ans. [c]  
 Sol.



Using conservation of momentums

$$m_1v_1 + m_2v_2 = m_1v_1 + m_2v_2$$

$$2 \times 4 - 3 \times 1 = 5v$$

$$8 - 3 = 5v$$

$$5 = 5v$$

$$v = 1 \text{ m/sec}$$

Final kinetic energy

$$k_f = \frac{1}{2} \times 5 \times 1 = 2.5 \text{ J}$$

Initial kinetic energy

$$k_i = \frac{1}{2} \times 2 \times 10 + \frac{1}{2} \times 3 \times 1$$

$$k_i = 16 + 1.5 = 17.55$$

$$\text{Sound} = k_i - k_f = 17.5 - 2.5$$

$$\text{Sound} = 15 \text{ J}$$

The sound energy cannot be greater than 15 J.

70. Let a, b, c be positive real numbers such that  $abc \neq 1$ ,  $(ab)^2 = (bc)^4 = (ca)^x = abc$ . Then x equals.  
 (a) 1 (b) 2 (c) 3 (d) 4

Ans. [b]

Sol.

$$a^2b^2 = b^4c^4 = c^x \cdot a^x = abc$$

$$a^2b^2 - abc = 0$$

$$\Rightarrow ab(ab - c) = 0$$

$$\Rightarrow a \cdot b = 0 \text{ or } ab = c$$

$$\Rightarrow a = \frac{c}{b}$$

$$\therefore b^4c^4 = c^x \cdot \left(\frac{c}{b}\right)^x$$

$$b^4c^4 = c^{2x} \cdot b^{-x}$$

$$\Rightarrow 2x = 4 \text{ or } x = -4$$

$$\Rightarrow x = 2$$

71. Which radiation is the easiest to shield ?  
 (a) alpha (b) beta (c) gamma (d) neutron

Ans. [a]

Sol. Alpha radiations are having high ionization potential & low penetration power.

72. Identify the correct order of sequence from exterior to interior.  
 (a) Cell → Nucleus → Chromosome → DNA → Protein  
 (b) Nucleus → Cell → Chromosome → DNA → Protein  
 (c) Cell → Nucleus → DNA → Chromosome → Protein  
 (d) Cell → Nucleus → Protein → DNA → Chromosome

Ans. [a]

73. In nuclear reactor, the electrons and protons are moving in opposite direction across a small hole in 2 second. If number of electron and protons are  $2 \times 10^{16}$  each, the current through the hole is given by-  
 (a) 1.6 mA (b) 0 mA (c) 6.4 mA (d) 3.2 mA

Ans. [a]

Sol.  $u = 2 \times 10^{16}$   
 $t = 2$  second

$$I = \frac{Q}{t}$$

$$I = \frac{ne}{t} = \frac{2 \times 10^{16} \times 1.6 \times 10^{-19}}{2} = \frac{2 \times 1.6}{2} \times 10^{-3}$$

$$I = 1.6 \times 10^{-3} \text{ Amperer}$$

$$\boxed{I = 1.6 \text{ mA}}$$

The current through the hole is 1.6 mA.

74. The sum  $1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \frac{1}{6} + \dots - \frac{1}{2012} + \frac{1}{2013}$  equals.

(a)  $\frac{1}{1006} + \frac{1}{1007} + \frac{1}{1008} + \dots + \frac{1}{2013}$

(b)  $\frac{1}{1007} + \frac{1}{1008} + \frac{1}{1009} + \dots + \frac{1}{2013}$

(c)  $\frac{1}{1006} + \frac{1}{1007} + \frac{1}{1008} + \dots + \frac{1}{2012}$

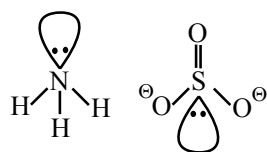
(d)  $\frac{1}{1007} + \frac{1}{1008} + \frac{1}{1009} + \dots + \frac{1}{2012}$

Ans. [b]

75. Which species below has the same general shape as  $\text{NH}_3$ ?  
 (a)  $\text{SO}_3^{2-}$  (b)  $\text{CO}_3^{2-}$  (c)  $\text{NO}_3^-$  (d)  $\text{SO}_3$

Ans. [a]

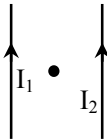
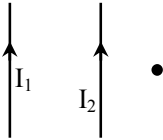
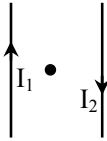
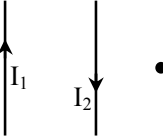
Sol.



76. After hearing to an influential lecture on "how to conserve environment by avoiding usage of plastic" ? Ghan Shyam resolved that he should also contribute towards protecting the environment from plastic menace. Can you suggest him the first step how should he go about doing this effectively
- (a) He should urge his parents to stop using plastic materials at home.
  - (b) He should write a letter to the local civic body against selling plastic materials around his locality
  - (c) He should practice minimising plastic usage himself.
  - (d) He should ask his teacher to advice people on his behalf to stop usage of plastics.

Ans. [c]

77. Two infinite wires are placed parallel to each other. They carry current  $I_1$  and  $I_2$  ( $I_2 = I_1$ ). The magnetic field is  $B_1$  and  $B_2$  respectively. Different situation are given in column 1. The comments on the direction and strength of magnetic field are given in column II. Match the following

Column 1		Column 2	
1.	The point <b>P</b> is at the mid point of the two conductors carrying current in same direction 	P.	$B_2 > B_1$ ; Thus $B_2 + B_1$ getting into the plane of the paper
2.	The Point <b>P</b> is on right side of second conductor carrying current in same direction 	Q.	$B_2 > B_1$ ; $B_2 - B_1$ coming out of the plane of the paper
3.	The point <b>P</b> is at the mid point of the two conductors carrying current in opposite direction. 	R.	$B_1 = -B_2$ ; $B_2 - B_1 = 0$
4.	The point <b>P</b> is at the right of the two conductors carrying current in opposite direction 	S.	$B_1 = B_2$ ; Thus $B_1 + B_2 = 2B$ getting into the plane of paper

(a) 

1	P
2	Q
3	R
4	S

(b) 

1	R
2	P
3	S
4	Q

(c) 

1	S
2	R
3	P
4	Q

(d) 

1	S
2	R
3	Q
4	P

Ans. [b]



$$\begin{aligned}
 \Rightarrow \quad 7r^2 &= 5h^2 \\
 A_4 &= \pi \cdot 4r \cdot \sqrt{h^2 + 16r^2} \\
 &= 4\pi r \cdot \sqrt{\frac{7}{5}r^2 + 16r^2} \\
 &= 4\pi r^2 \cdot \sqrt{\frac{87}{5}} \\
 A_0 &= \pi r \cdot \sqrt{\frac{7}{5}r^2 + r^2} \\
 &= \pi r^2 \cdot \sqrt{\frac{12}{5}} \\
 \frac{A_4}{A_0} &= 4 \cdot \frac{\sqrt{87}}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{12}} \\
 &= 4 \cdot \sqrt{\frac{87}{12}} = 10.77 \approx 11.
 \end{aligned}$$

79. The mass of 0.2 mole of Oxygen molecule is-  
 (a) 6.4 g                      (b) 3.2 g                      (c) 1.6 g                      (d) 2.75 g

Ans. [a]

Sol. Mole =  $\frac{\text{given gram}}{\text{molar mass}}$

$$0.2 = \frac{x}{32}$$

$$x = .2 \times 32$$

$$x = 6.4 \text{ g}$$

80. Wuchereria is an example of-  
 (a) Arthropoda                      (b) Annelida                      (c) Arthropoda                      (d) Nematoda

Ans. [d]