

FIITJEE

INDIAN OLYMPIAD QUALIFIER IN JUNIOR SCIENCE (IOQJS)

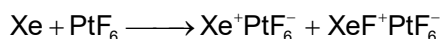
PART – 2 ANSWER KEYS

- | | | | | | | | |
|----|---|-----|---|-----|---|-----|---|
| 1. | D | 2. | B | 3. | C | 4. | D |
| 5. | C | 6. | A | 7. | C | 8. | C |
| 9. | B | 10. | C | 11. | D | 12. | C |

FIITJEE

HINTS AND SOLUTIONS

1. D



The ionization potential of O_2 is lower than that of xenon as its electron is lost from antibonding molecular orbitals.

∴ Option(B) is incorrect

Second ionization potential of any element is higher than the first ionization potential.

∴ Option(A) is incorrect

Option(C) is incorrect because Xe forms ionic bond with PtF_6 ion not with fluoride ion.

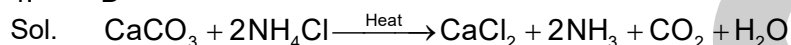
2. B

Sol. If anything dissolves into water, density will increase.

3. C

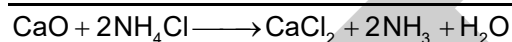
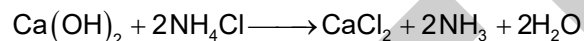
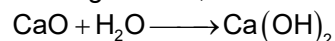
Sol. Heating increases the random motion of electrons in a metal. The electrons collide with the kernels(positive metal ions). So, they can't carry current effectively. In case of molten NaCl, heating decreases the viscosity and increases the velocity of ions. So conductivity increases.

4. D



Heating of above mixture produces NH_3 , CO_2 and H_2O . So more number of raw materials are formed in the above reaction

Heating of CaO , NH_4Cl and H_2O produces the following



∴ Option(D) is correct, because maximum number of materials used in the reaction are formed..

In reaction(C) only NH_3 and H_2O are formed.

5. C

Sol. Aluminium foil does not allow molecules of air to pass through it. Hence, it prevent convection.

As Aluminium foil has poor transmittivity, therefore heat loss through radiation is also prevented.

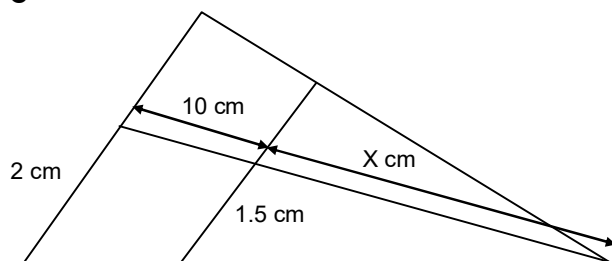
6. A

Sol. As the observer & source (train) both are stationary, therefore there is No Doppler effect and hence frequency remains the same.

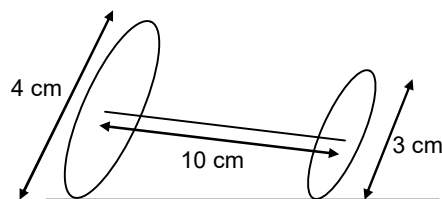
Flow of wind changes the velocity of sound.

7. C

Sol.



$$\frac{1.5}{x} = \frac{2}{10+x}$$



$$\Rightarrow 15 + 1.5x = 2x$$

$$\Rightarrow 15 = 0.5x$$

$$\Rightarrow x = 30 \text{ cm}$$

Taking the velocity of centre of bigger wheel as v cm/s.

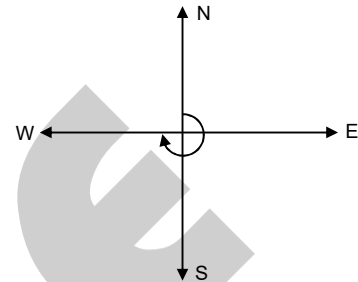
$$w_1 = \frac{v}{2} \qquad w = \frac{v}{40}$$

$$\Rightarrow \frac{w_1}{w} = \frac{v/2}{v/40} = 20$$

As the ratio is 20, it means in one complete revolution of cart, the wheel rotates 20 times. As we need to turn

the toy cart by $\left(\frac{3}{4}\right)^{\text{th}}$ of rotation, therefore wheels will

perform $\frac{3}{4} \times 20 = 15$ rotations.



8. **C**

Sol. In order to float,

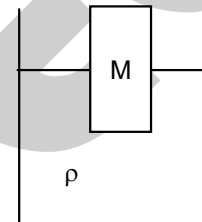
$$Mg = F_B$$

$$\Rightarrow Mg = \rho Vg$$

$$\Rightarrow V = \frac{M}{\rho}$$

Here, V is the submerged volume, which is independent of acceleration due to gravity, it solely depends upon mass of block and density of water.

\Rightarrow The block will still float with the water level in the cup remaining the same.



9. **B**

9. Mutation found in gene X of mice.

Heterozygous mouse = XY mate with female XX



50% of the pups will carry this mutation.

10. **C**

10. Most high endurance athletes use carbohydrate loading as a nutrition regimen prior to the event because carbohydrate loading is known to produce an increase in stored muscle glycogen which is known to prolong exercise, along with improve long-term performance.

11. **D**

11. the basis of given data

W \rightarrow are gymnosperms, X – are pteridophytes

Y \rightarrow are Angiosperms, Z – are Bryophytes

12. **C**

12. Gametes of tetraploid plants contains chromosomes 26

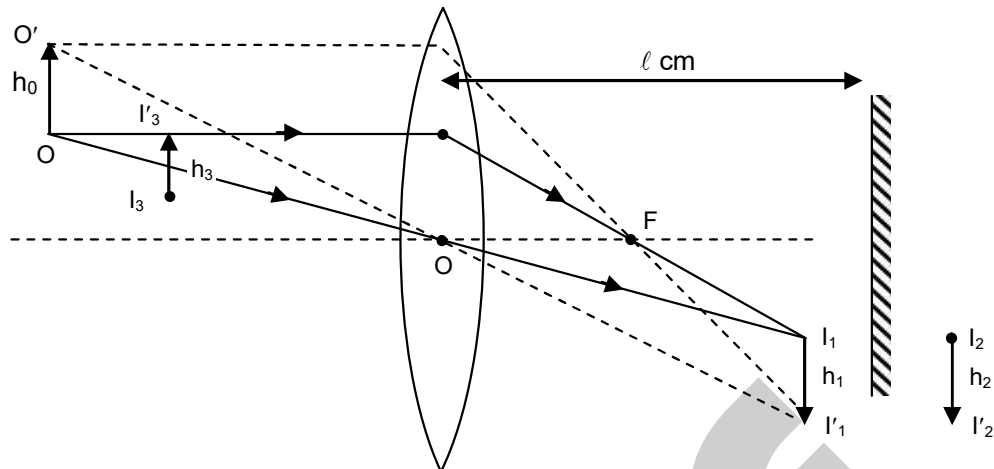
The number of chromatids during metaphase mitosis = 104

The number of chromatids during metaphase II meiosis = 52

- 13.1. S-1: Addition of solid NaOH slowly in water to form dilute solution.
S-2: Addition of above mixture to oil with stirring and heating
S-3: Addition of NaCl to the mixture in S-2 followed by cooling
- 13.2. Heating is done in step -2
Cooling is done in step-1 and step-3
Cooling in step-1 is required as the process of solution is exothermic. Cooling in step-3 is needed to separate soap from solution.
- 13.3. Apart from glycerol, NaOH and NaCl are left in the solution.
- 13.4. Answer is D. The boiling point of glycerol $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CH}_2\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$ is approximately three times than that of $\text{C}_2\text{H}_5\text{OH}$ due to more number of hydrogen bonds in glycerol. \therefore The boiling point is greater than 110°C .
- 13.5. The impurity present in the distilled glycerol is water.
- 13.6. $\begin{array}{c} \text{CH}_2\text{OCOC}_{17}\text{H}_{35} \\ | \\ \text{CHOCOC}_{17}\text{H}_{35} \\ | \\ \text{CH}_2\text{OCOC}_{17}\text{H}_{35} \end{array} + 3\text{NaOH} \longrightarrow 3\text{C}_{17}\text{H}_{35}\text{COONa} + \begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CH}_2\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$
- Moles of NaOH added = $\frac{50 \times 0.5}{1000} = 0.025$
- Moles of HCl consumed NaOH = $\frac{14 \times 0.5}{1000} = 0.007$
- \therefore Moles of NaOH reacted with oil = $0.025 - 0.007 = 0.018$
- \therefore Moles of NaOH required for 5 g oil = 0.018
- \therefore Moles of NaOH will be required for 1 Kg oil = $\frac{0.018}{5} \times 1000 = 3.6$
- \therefore Moles of glycerol formed = $\frac{1}{3} \times 3.6 = 1.2$ mole
- 13.7. 10% molecules of glycerol decomposed.
- \therefore Moles of glycerol decomposed = $1.2 \times \frac{10}{100} = 0.12$
- \therefore Moles of glycerol formed = $1.2 - 0.12 = 1.08$
- 14.1. The volatile nature of petrol and its insolubility in water prevent water from extinguishing it.
- 14.2. Paper stacks and stack of clothes can be extinguished by spraying water.
- 14.3. (a) Components(ii) and (iii) is reduced immediately by water spraying. Because water prevents O_2 to come in contact with the burning material and the heat of combustion also decreases.
- (b) (A), (B) are responsible for the role in Q.14.3 (a). since water has high latent heat of vapourisation, it can absorb more heat before changing to vapour.
- 14.4. Soda acid produces CO_2 gas which has higher density than oxygen. When CO_2 is sprayed, it forms a layer over fuel and prevents the flow of O_2 into the fire site.
- 14.5. Soda acid extinguisher can't extinguish petrol fire because the heat produced in petrol fire is so much intense that the extinguisher materials will be vapourised. It can't extinguish electric fire, because of electric shock. The shock can produce another fire.
- 14.6. CO_2 extinguisher can be used to extinguish electric fire by blocking the passage of O_2 the fire site. It can also be used for petrol fire.
- 14.7. (a) Oil fires are reduced by potassium carbonate or potassium acetate because oil is converted to potassium salt of fatty acid which is formed as an insoluble material. Which blocks the passage of O_2 into the fire site. \therefore The components(i) fuel and (ii) oxygen are reduced in this process.

(b) This extinguisher can extinguish paper stack and stack of clothes fire.

15.



(a) From the given above figure,

$$U_1 = -4 \text{ cm} \quad h_0 = 1.5 \text{ cm}$$

For image $I_1 I_1'$

$$\Rightarrow \frac{1}{V_1} - \frac{1}{U_1} = \frac{1}{f} \Rightarrow \frac{1}{V_1} - \frac{1}{-4} = \frac{1}{f} \Rightarrow V_1 = \frac{4f}{4-f}$$

$$\Rightarrow \frac{-h_1}{+1.5} = \frac{V_1}{U_1} \Rightarrow -\frac{h_1}{1.5} = \left(\frac{4f}{4-f}\right) \left(\frac{1}{-4}\right)$$

$$\Rightarrow h_1 = \frac{1.5f}{4-f}$$

For object $I_2 I_2'$, image is $I_3 I_3'$

$$\Rightarrow V_2 = +3 \text{ cm}, \quad h_3 = 0.75 \text{ cm}$$

$$\text{Applying lens formula } \frac{1}{V_2} - \frac{1}{U_2} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{+3} - \frac{1}{U_2} = \frac{1}{f} \Rightarrow U_2 = \frac{3f}{f-3}$$

$$\frac{0.75}{-h_2} = \frac{+3}{3f}(f-3)$$

$$\Rightarrow h_2 = \frac{0.75f}{3-f}$$

As $I_2 I_2'$ is the image of $I_1 I_1'$ & it is produced by plane mirror, hence size should be same.

$$\Rightarrow h_1 = h_2$$

$$\Rightarrow \frac{1.5f}{4-f} = \frac{0.75f}{3-f}$$

$$\Rightarrow 6 - 2f = 4 - f$$

$$\Rightarrow f = 2 \text{ cm}$$

For plane mirror,

Object distance = Image distance

$$V_1 = \frac{4 \times 2}{4-2} = 4 \text{ cm}$$

$$U_2 = \frac{3 \times 2}{2 - 3} = -6 \text{ cm}$$

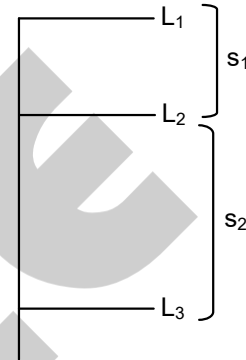
$$\Rightarrow \ell - V_1 = (-U_2) - \ell$$

$$\Rightarrow \ell - 4 = 6 - \ell \Rightarrow 2\ell = 10$$

$$\Rightarrow \ell = 5 \text{ cm}$$

(b) As the given object image pair gives a unique value of image position & object position, therefore it is NOT possible to have different values of ℓ & f satisfying the same relationship.

16. As Padma is having difficulty in synchronizing the dropping of magnet & starting the apps in both the smart phones simultaneously. Therefore she should fix one smart phone at L_2 & other smart phone at L_3 . The magnet should be dropped from L_1 . Now, she should start the app (magneto meter) in first smart phone fixed at L_2 . After a delay of time T_1 , she should start the app in second smart phone & after time T_2 from start, drop the magnet from L_1 . As all three events are taking place at different times, there will NOT be any problem of synchronization of all three events.



If the magnet reaches the level L_2 at time t_1 & Level L_3 at time t_2 , then the time taken to drop from L_1 to L_2 is $(t_1 - T_2)$ and the time taken to drop from level L_1 to level L_3 is $(t_2 - T_2 + T_1)$. Here time T_1 has to be added since the second app started late by time T_1 , therefore it has to be added.

$$s_1 = \frac{1}{2}g(t_1 - T_2)^2 \quad \Rightarrow \quad g = \frac{2s_1}{(t_1 - T_2)^2}$$

$$\& (s_2 + s_1) = \frac{1}{2}g(t_2 - T_2 + T_1)^2 \quad \Rightarrow \quad g = \frac{2(s_1 + s_2)}{(t_2 - T_2 + T_1)^2}$$

We can determine the value of g from both the equations & can take its average value to compensate any possible human errors.

Readings in the smart phone to be taken as soon as smart phone displays $259.2 \mu\text{T}$.

Possible sources of error:

- (1) Reaction time of Padma introduces a time lag between observing the event & actual occurrence of the event.
- (2) The error in measurement of time by smart phone depending upon the least count of watch inside smart phone.
- (3) the error in measurement of length s_1 and length s_2 since it has to be measured by some instrument & every instrument has some error.
- (4) The magnetic sensor inside the smart phone may introduce some error as the reading of smart phone magnetometer will remain more or less constant when the magnet is nearby to smart phone.

17.1. A

17.1 Intensity of colour is less in B because of antigen – antibody binding.

17.2 A

17.2 The best immune response is depicted by graph A.

17.3

X	Y	P	Q
i	ii	vi	v
iii	iv	viii	vii
			ix

18. Total absorption area of 1 microvilli = $2\pi\left(\frac{0.1}{2}\right) \times 1 + \pi\left(\frac{0.1}{2}\right)^2$ sq. unit

In case of diarrhea, length of 1 Microvilli = $\frac{34}{100} \times 1 \mu\text{m} = 0.34 \mu\text{m}$

Now total absorption area of 1 Microvilli = $2\pi\left(\frac{0.1}{2}\right) \times 0.34 + \pi\left(\frac{0.1}{2}\right)^2$

Decrease in absorption area = $2\pi\left(\frac{0.1}{2}\right) + \pi\left(\frac{0.1}{2}\right)^2 - \left(2\pi\left(\frac{0.1}{2}\right)(0.34) + \pi\left(\frac{0.1}{2}\right)^2\right)$
 $= 2\pi\left(\frac{0.1}{2}\right) \times 0.66$

Decrease % = $\frac{2\pi\left(\frac{0.1}{2}\right) \times 0.66}{2\pi\left(\frac{0.1}{2}\right) + \pi\left(\frac{0.1}{2}\right)^2} = 64.39\%$

- 19.1 A) B, 2015 – 2019
 B) A & B
 C) Pea plant
 D) D
 E) C, D

- 19.2 i) T
 ii) F
 iii) T
 iv) T