

# ICSE Solved Paper 2022 Semester-1 PHYSICS

## Class-X

(Maximum Marks : 40)

(Time allowed : One hour)

Candidates are allowed additional 15 minutes for only reading the paper. They must NOT start writing during this time.

You will not be allowed to write during the first 10 minutes.

This time is to be spent in reading the question paper.

All questions are compulsory.

The marks intended for questions are given in brackets [ ].

Select the correct option for each of the following questions.

1. The deviation produced by an equilateral prism does not depend on [1]

- (a) the angle of incidence.
- (b) the size of the prism.
- (c) the material of the prism.
- (d) the colour of light used.

Ans. Option (b) is correct.

Explanation:  $\delta = i + e - A$

$i$  depends on material of medium and colour of light.

$A$  is the angle of prism.

So, deviation ( $\delta$ ) does not depend on the size of prism.

2. The refractive index of a diamond is 2.4. It means that [1]

- (a) the speed of light in vacuum is equal to 2.4 times the speed of light in diamond.
- (b) the speed of light in the diamond is 2.4 times the speed of light in a vacuum.
- (c) the speed of light in a vacuum is 2.4 times the speed of light in the diamond.
- (d) the wavelength of light in diamond is 2.4 times the wavelength of light in vacuum.

Ans. Option (c) is correct.

Explanation:  $\mu = c/v$   
Or,  $2.4 = c/v$   
 $\therefore c = 2.4 v$

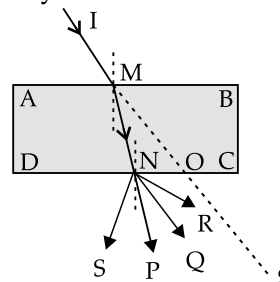
3. An object of height 10 cm is placed in front of a concave lens of focal length 20 cm at a distance 25 cm from the lens. Is it possible to capture this image on a screen? Select a correct option from the following [1]

- (a) Yes, as the image formed will be real.
- (b) Yes, as the image formed will be erect.
- (c) No, as the image formed will be virtual.
- (d) No, as the image formed will be inverted.

Ans. Option (c) is correct.

Explanation: Concave lens always produces virtual image.

4. A ray of light IM is incident on a glass slab ABCD as shown in the figure below. The emergent ray for this incident ray is [1]



- (a) NQ
- (b) NR
- (c) NP
- (d) NS

Ans. Option (a) is correct.

Explanation: The emergent ray will be parallel to the incident ray.

5. The colour of white light which is deviated least by a prism is [1]

- (a) green
- (b) yellow
- (c) red
- (d) violet

Ans. Option (c) is correct.

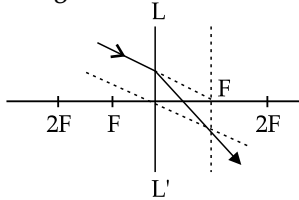
Explanation: Red deviates least since its wavelength is the largest.

6. The wavelength range of visible light is [1]

- (a) 40 nm to 80 nm
- (b) 4000 nm to 8000 nm
- (c) 4 nm to 8 nm
- (d) 400 nm to 800 nm

Ans. Option (d) is correct.

7. Observe the diagram which shows the path of an incident ray through an optical plane LL' of a lens. The focal length of the lens is 20 cm.



- (i) If an object is placed at a distance of 30 cm in front of this lens, then [1]
  - (a) the image will be virtual
  - (b) the image will be diminished and inverted.
  - (c) the image will be diminished.
  - (d) the image will be real and magnified.
- (ii) This type of lens can be used [1]
  - (a) to correct hypermetropia.
  - (b) to correct myopia.
  - (c) to diverge light.
  - (d) in the front door peepholes.
- (iii) An object is placed in front of this lens at a distance of 60 cm. Then the image distance from the lens with proper sign convention is [1]
  - (a) +60 cm                      (b) +30 cm
  - (c) -30 cm                      (d) +15 cm
- (iv) An object is placed in front of this lens at a distance of 60 cm. Then the magnification of the image is [1]
  - (a) 0.25                          (b) 1.25
  - (c) -0.5                          (d) 1

Ans. (i) Option (d) is correct.

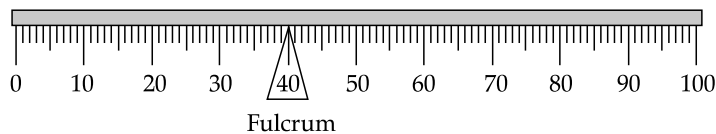
*Explanation:* The lens is convex. If an object is placed in front of a convex lens between F and 2F, a real, inverted and magnified image is formed.

(ii) Option (a) is correct.

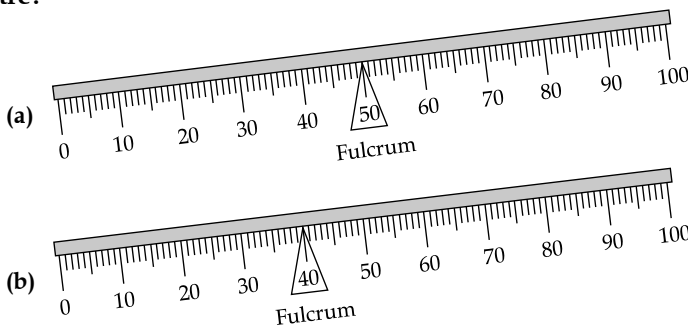
*Explanation:* In hypermetropia, the rays meet beyond the retina. Convex lens is used so that the rays meet in advance i.e., on the retina.

(iii) Option (b) is correct.

11. The diagram below shows the balanced position of a metre scale. [1]



Which one of the following diagrams shows the correct position of the scale when it is supported at the centre?



*Explanation:*  $1/v - 1/u = 1/f$   
 Or,  $1/v + 1/60 = 1/20$   
 Or,  $1/v = 1/30$   
 $\therefore v = +30 \text{ cm}$

(iv) Option (c) is correct.

*Explanation:* Magnification =  $v/u = 30/(-60) = -0.5$

8. The relation between CGS and S. I. unit of moment of force is [1]

- (a)  $1 \text{ Nm} = 10^5 \text{ dyne cm}$
- (b)  $1 \text{ Nm} = 10^5 \text{ dyne}$
- (c)  $1 \text{ Nm} = 10^7 \text{ dyne cm}$
- (d)  $1 \text{ dyne cm} = 10^7 \text{ Nm}$

Ans. Option (c) is correct.

*Explanation:*  
 SI unit of moment of force = Nm  
 CGS unit of moment of force = dyne cm  
 $1 \text{ Nm} = 1 \text{ N} \times 1 \text{ m}$   
 $= 10^5 \text{ dyne} \times 10^2 \text{ cm}$   
 $= 10^7 \text{ dyne cm}$

9. A coolie raises a load upwards against the force of gravity then the work done by the load is [1]

- (a) zero.
- (b) positive work.
- (c) negative work.
- (d) none of these.

Ans. Option (c) is correct.

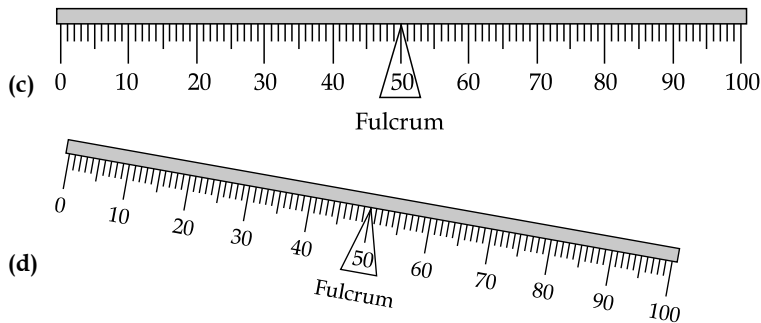
*Explanation:*  $W = Fs \cos \theta$   
 Here  $\theta = 180^\circ$   
 So, the work done =  $-Fs (\cos 180^\circ = -1)$

10. The energy change during photosynthesis in plants is

- (a) heat to chemical.
- (b) light to chemical.
- (c) chemical to light.
- (d) chemical to heat.

Ans. Option (b) is correct.

*Explanation:* During photosynthesis, plants convert solar energy into glucose. Hence, it is light to chemical energy conversion.



Ans. Option (a) is correct.

*Explanation:* When the fulcrum is shifted to 50, the mass of the left side becomes more than the mass of the right hand side. So, the left side of the scale will be tilted down.

12. A stone tied at the end of a string is whirled by hand in a horizontal circle with uniform speed.

(i) Name the force required for this circular motion [1]

- (a) Centrifugal force.
- (b) Centripetal force.
- (c) Force of gravity.
- (d) Frictional force.

(ii) What is the direction of the above-mentioned force? [1]

- (a) Towards the centre of the circular path.
- (b) Away from the centre of the circular path.
- (c) Normal to the radius at a point where the body is present on the circular path.
- (d) Direction of this force keeps on changing alternately towards and away from the centre.

Ans. (i) Option (b) is correct.

*Explanation:* When a stone is tied at one end of a string and whirled horizontally, the inward force exerted by the string on the stone is called tension. The tension of the string provides the necessary centripetal force for circular motion.

(ii) Option (a) is correct.

*Explanation:* The direction of a centripetal force is towards the center of curvature, the same as the direction of centripetal acceleration.

13. A body of mass 200 g falls freely from a height of 15 m. [ $g = 10 \text{ ms}^{-2}$ ]

(i) When the body reaches 10 m above the ground, its potential energy will be [1]

- (a) 20000 J
- (b) 10 J
- (c) 10000 J
- (d) 20 J

(ii) The gain in kinetic energy of the body when it reaches 10 m above the ground is [1]

- (a) 20 J
- (b) 10 J
- (c) 30 J
- (d) 25 J

(iii) The total mechanical energy it will possess, when it is just about to strike the ground is [1]

- (a) 30000 J
- (b) 20000 J
- (c) 30 J
- (d) 20 J

(iv) The velocity in  $\text{ms}^{-1}$  with which the body will hit the ground is [1]

- (a) 30
- (b) 10
- (c)  $10\sqrt{3}$
- (d)  $10\sqrt{2}$

Ans. (i) Option (d) is correct.

*Explanation:*

$$P.E. = mgh = 200 \times 10^{-3} \times 10 \times 10 = 20 \text{ J}$$

(ii) Option (b) is correct.

*Explanation:* At 15 m height, total energy is potential.

$$\text{So, } T.E. = mgh = 200 \times 10^{-3} \times 10 \times 15 = 30 \text{ J}$$

At 10 m height, potential energy is 20 J.

So, the rest is kinetic energy.

$$\text{So, kinetic energy gain} = 30 - 20 = 10 \text{ J}$$

(iii) Option (c) is correct.

*Explanation:* The total energy of the system is conserved. When the body is just about to touch the ground, the total energy is kinetic. Hence, the total mechanical energy will be 30 J.

(iv) Option (c) is correct.

$$\text{Explanation: } \frac{1}{2}mv^2 = 30$$

$$\text{Or, } \frac{1}{2} \times 200 \times 10^{-3} \times v^2 = 30$$

$$\text{Or, } v^2 = 300$$

$$\therefore v = 10\sqrt{3} \text{ ms}^{-1}$$

14. A woman draws water from a well using a fixed pulley. The mass of the bucket and the water together is 10 kg. The force applied by the woman is 200 N. The mechanical advantage is ( $g = 10 \text{ m/s}^2$ ) [1]

- (a) 2
- (b) 20
- (c) 0.05
- (d) 0.5

Ans. Option (d) is correct.

*Explanation:*

$$\text{Load} = W = mg = 10 \times 10 = 100 \text{ N}$$

$$\text{Effort} = \text{Force applied} = 200 \text{ N}$$

$$\text{M.A.} = \text{Load} / \text{effort} = 100/200 = 0.5$$

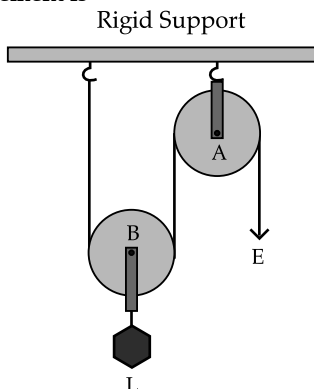
15. A single fixed pulley is used because [1]

- (a) it changes the direction of applied effort conveniently.
- (b) it multiplies speed.
- (c) it multiplies effort.
- (d) its efficiency is 100%.

Ans. Option (a) is correct.

*Explanation:* A single fixed pulley though does not reduce the effort but helps in changing the direction of effort applied.

16. In the diagram shown below, the velocity ratio of the arrangement is [1]



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

Ans. Option (b) is correct.

*Explanation:* If pulley B is moved by  $x$  distance downwards, then the rope moves  $2x$ . Hence, the velocity ratio of this arrangement is 2.

17. Which one of the following is the correct mathematical relation? [1]

- (a) Power = Force / Velocity  
(b) Power = Force  $\times$  Acceleration  
(c) Power = Force / Acceleration  
(d) Power = Force  $\times$  Velocity

Ans. Option (d) is correct.

*Explanation:*  $E = \frac{1}{2} mv^2$   
or,  $dE/dt = \frac{1}{2} m \times 2v \times (dv/dt)$   
or,  $P = m \times v \times a$   
 $\therefore P = F \times v$  (since,  $ma = F$ )

18. Select a correct option with respect to echo depth sounding: [1]

- (a) infrasonic waves are used.  
(b) the frequency of the waves used is between 20 Hz and 20,000 Hz.  
(c) ultrasonic waves are used.  
(d) supersonic waves are used.

Ans. Option (c) is correct.

19. Which one of the following diagnostic methods use reflection of sound? [1]

- (a) CT scan (b) Electrocardiogram  
(c) Echo cardiogram (d) MRI

Ans. Option (c) is correct.

20. A boy standing in front of a wall produces two whistles per second. He notices that the sound of his whistling coincides with the echo. The echo is heard only once when whistling is stopped. Calculate the distance between the boy and the wall. (The speed of sound in air = 320 m/s)

(i) The time in which the boy hears the echo is

- (a) 1 s (b) 0.5 s  
(c) 1.5 s (d) 2 s [1]

(ii) The distance at which the boy is standing from the wall [1]

- (a) 160 m (b) 240 m  
(c) 320 m (d) 80 m

(iii) If the speed of sound is increased by  $16 \text{ ms}^{-1}$  and the boy moves 4 m away from the wall then in how much time will he hear the echo of the first whistle? [1]

- (a) 0.525 s (b) 0.5 s  
(c) 0.48 s (d) 0.3 s

(iv) In which of the following timings of reflection of the whistle, the echo cannot be heard? [1]

- (a) 0.05 s (b) 0.12 s  
(c) 0.2 s (d) 0.11 s

Ans. (i) Option (b) is correct.

*Explanation:* Since, the sound of his whistling coincides with the echo, the reflected sound (i.e., the echo) returns to the boy in 0.5 s.

(ii) Option (d) is correct.

*Explanation:* Since, the sound of his whistling coincides with the echo, the reflected sound takes 0.5s time to return.

So,  $V = 2D/t$   
Or,  $320 = 2D/0.5$   
 $\therefore D = 80 \text{ m}$

(iii) Option (b) is correct.

*Explanation:*

Now velocity of sound =  $V = 320 + 16 = 336 \text{ m/s}$   
Present distance from wall =  $D = 80 + 4 = 84 \text{ m}$   
 $t = 2D/V = 2 \times 84 / 336 = 0.5 \text{ s}$

(iv) Option (a) is correct.

*Explanation:* To hear an echo time difference should be equal to or more than 0.1 s.

21. The ratio of velocities of light of wavelength 400 nm and 800 nm in a vacuum is [1]

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

Ans. Option (a) is correct.

*Explanation:* Velocity of light in vacuum is same for all wavelengths.

22. 1 joule = \_\_\_\_\_ erg [1]

(a)  $10^9$  (b)  $10^7$   
(c)  $10^5$  (d)  $10^6$

Ans. Option (b) is correct.

*Explanation:* 1 Joule = 1 Newton  $\times$  1 metre  
And 1 erg = 1 dyne  $\times$  1 cm  
1 Joule = 1 Newton  $\times$  1 metre  
Or, 1 Joule =  $10^5$  dynes  $\times$   $10^2$  cm  
 $\therefore$  1 Joule =  $10^7$  erg

23. A light body A and a heavy body B have the same momentum.

(i) Choose a correct statement from the given options. [1]

- (a) kinetic energy of body A and body B will be the same.
- (b) kinetic energy of body A is greater than kinetic energy of body B.
- (c) kinetic energy of body B is greater than kinetic energy of body A.
- (d) unless we know the velocity, we cannot find which body has greater kinetic energy.

(ii) If the ratio of kinetic energies of A and B is 5:2 then which one of the following gives the mass ratio of the bodies respectively? [1]

- (a) 5 : 2
- (b) 25 : 4
- (c) 2 : 5
- (d) 4 : 24

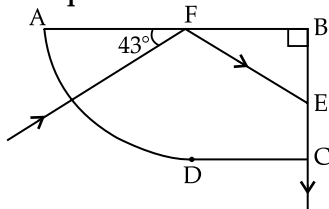
Ans. (i) Option (b) is correct.

*Explanation:*  $K.E. = \frac{1}{2}mv^2 = \frac{1}{2}p^2/2m$   
 $\therefore K.E. \propto 1/m$   
 Since  $m_B > m_A$   
 $K.E._A > K.E._B$

(ii) Option (c) is correct.

*Explanation:*  $K.E. \propto 1/m$   
 $\therefore K.E._A / K.E._B = m_B / m_A$   
 Or,  $5/2 = m_B / m_A$   
 $\therefore m_A / m_B = 2/5$

24. The diagram below shows a ray of light travelling from air into a glass material as shown below. Answer the questions that follow:



(i) The angle of incidence at the surface AB is [1]

- (a) 43°
- (b) 47°
- (c) 90°
- (d) 0°

(ii) Select a correct statement from the following. [1]

- (a) The speed of light at the curved surface AD does not change while entering the block.
- (b) The ray at the surface AD is not travelling along the radius of the curved part.
- (c) The ray at the surface AD is travelling along the radius of the curved part.
- (d) Light never refracts when it enters a curved surface.

(iii) The angle of incidence on the surface BC is [1]

- (a) 43°
- (b) 47°
- (c) 90°
- (d) 0°

(iv) The critical angle of this material of glass [1]

- (a) 47°
- (b) 43°
- (c) 42°
- (d) 45°

Ans. (i) Option (b) is correct.

*Explanation:* Angle of incidence is the angle between the incident ray and the normal.

Hence, Angle of incidence =  $90^\circ - 43^\circ = 47^\circ$

(ii) Option (c) is correct.

*Explanation:* Since, the ray is not deviated at AD surface then the ray travels along the radius of the curved part.

(iii) Option (a) is correct.

*Explanation:* Total internal reflection has occurred at F.

So,  $\angle EFB = 43^\circ$

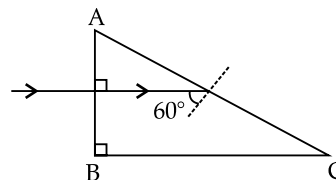
So,  $\angle FEB = 90^\circ - 43^\circ = 47^\circ$

So, the angle of incidence at BC surface =  $90^\circ - 47^\circ = 43^\circ$

(iv) Option (b) is correct.

*Explanation:* Since, for  $47^\circ$  angle of incidence total internal reflection has occurred at F, the critical angle is less than this. Also, at surface CB, the incident angle works as critical angle because refracted ray passes from the boundaries of these two media. Hence, the critical angle of the glass will be  $43^\circ$ .

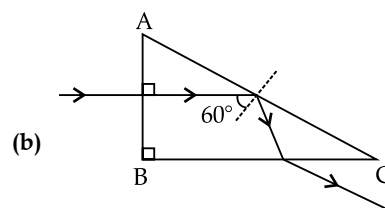
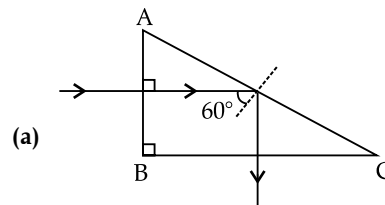
25. The diagram below shows the path of light passing through a right-angled prism of critical angle  $42^\circ$ .

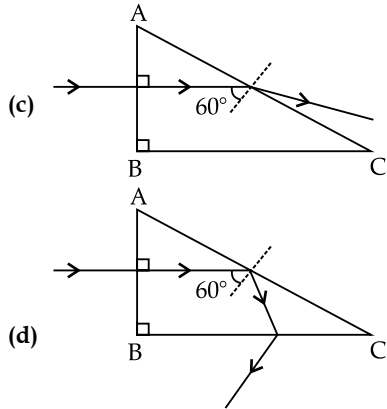


(i) The angle C of the prism is [1]

- (a) 45°
- (b) 60°
- (c) 90°
- (d) 30°

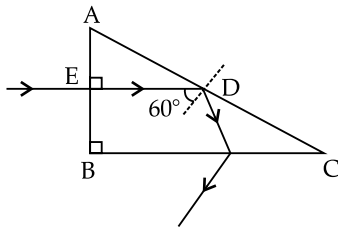
(ii) Which one of the following diagrams shows the correct path of this ray till it emerges out of the prism? [1]





Ans. (i) Option (d) is correct.

Explanation:



Since, angle of incidence  $>$  critical angle, total internal reflection will occur at  $D$ .

$$\angle ADE = 90^\circ - 60^\circ = 30^\circ$$

$\therefore \angle A = 60^\circ$   
Now in the triangle  $ABC$ ,

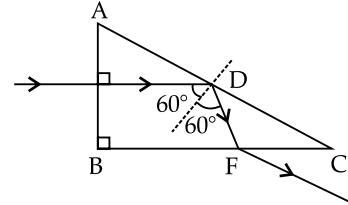
$$\angle A + \angle B + \angle C = 180^\circ$$

Or,  $60^\circ + 90^\circ + \angle C = 180^\circ$

$\therefore \angle C = 30^\circ$

(ii) Option (b) is correct.

Explanation:



Since, angle of incidence  $>$  critical angle, total internal reflection will occur at  $D$ .

So, the angle of reflection at  $D$  is  $60^\circ$ .

So, the angle of incidence at  $F = 120^\circ - 90^\circ = 30^\circ$

Since, angle of incidence  $<$  critical angle, regular refraction will take place.

