SELF ASSESSMENT PAPER - 6

SOLUTIONS

I. Multiple Choice Questions **[1 × 4 = 4]**

1. Option (D) is correct.

Explanation: As we know that the velocity of wave is: $v = n\lambda$

When light ray goes from one medium to other medium, the frequency of light remains unchanged. So, $v \propto \lambda$ i.e., greater the wavelength, greater the speed.

And, the light of red colour is of highest wavelength and therefore of highest speed. So, after travelling through the slab, the red colour emerges first.

2. Option (D) is correct.

Explanation: Magnification

$$= m \propto \frac{1}{f_0 f_e}$$

So, magnifying power of a microscope depends on focal length of eyepiece and objective only.

3. Option (C) is correct.

Explanation: Wavefront is the locus of all points those are in same phase.

4. Option (D) is correct.

Explanation: Angular width

$$= 2\sin^{-1}\frac{\lambda}{d}$$

So, it is independent of D (distance between slit and screen).

II. Assertion and Reason **[1 × 2 = 2]**

1. Option (A) is correct.

Explanation: No interference pattern is detected when two coherent sources are too close to each other. The assertion is true.

Fringe width is proportional to 1/d. When d becomes too small, the fringe width becomes too large. So no pattern will be visible. So, the reason is also true. Reason also explains the assertion.

2. Option (A) is correct.

Explanation: If a medium has same refractive index at every point in all directions, then the wavefront obtained from a point source in such a medium is spherical since wave travels in all direction with same speed. Such a medium is known as isotropic medium. So, the assertion and reason both are true and the reason explains the assertion properly.

III. Competency Based Questions **[1 × 4 = 4]**

(i) Option (C) is correct.

Explanation: The optical fibre works on the principle of total internal reflection.

(ii) Option (A) is correct

Explanation: Single-mode fibre is used for long-distance transmission, while multimode fibre is used for shorter distances.

(iii) Option (C) is correct.

Explanation: Optical fibre is usually made of plastic or glass, so that light rays can travel continuously, bouncing off the optical fibre walls and can be transmitting end to end data.

(iv) Option (B) is correct.

Explanation: In graded index fibres, the refractive index of the optical fibre decreases as the radial distance from the fibre axis increases.

(v) Option (D) is correct.

Explanation: Light signals gets degrade over progressing distances due to absorption and scattering.

IV. Very Short Answer Type Question **[1 × 4 = 4]**

1. **(a)** Cylindrical wavefront is generated from a line source. **(b)** Spherical wavefront is generated from a near point source. Plane wavefront is generated from a far away point source.

2. For sustained interference, the source must be coherent and should emit the light of same frequency. In this problem, one hole is covered with red and other with blue, which has different frequency, so no interference takes place.

3. The focal length will be 2*f*.

V. Short Answer Type Question-I **[2 × 3 = 6]**

1.

$$\mu_{12} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}}$$

$$\mu_{12} = \frac{\mu_1}{\mu_2} = \frac{1.6}{\frac{4}{5}\sqrt{2}} = \frac{8}{4\sqrt{2}} = \sqrt{2}$$

$$\sqrt{2} = \frac{\sin\left(\frac{60°+\delta_m}{2}\right)}{\sin\frac{60°}{2}} = \frac{\sin\left(\frac{60°+\delta_m}{2}\right)}{\sin 30°}$$

$$\text{or, } \sin\left(\frac{60°+\delta_m}{2}\right) = \sqrt{2}.\frac{1}{2} = \frac{1}{\sqrt{2}} = \sin 45°$$

$$\text{or, } \frac{60°+\delta_m}{2} = 45°$$

$$\therefore \quad \delta_m = 30°$$

[CBSE Marking Scheme 2019]

2. Height of the needle,

$h = 4.5$ cm.

Object distance, $u = -12$ cm.

The focal length of the convex mirror,

$f = 15$ cm.

Applying mirror formula,

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

Or, $$\frac{1}{v}-\frac{1}{12}=\frac{1}{15}$$

$\therefore$ $$v = 6.7 \text{ cm}$$

Hence, the image of the needle is 6.7 cm away from the mirror. Also, it is on the other side of the mirror.

$$\text{Magnification} = m = \frac{h'}{h} = -\frac{v}{u}$$

Or, $$\frac{h'}{4.5} = -\frac{v}{u}$$

Or, $$\frac{h'}{4.5} = \frac{6.7}{12}$$

$\therefore$ $$h' = 2.5 \text{ cm}$$

$$\text{Magnification} = m = \frac{2.5}{4.5} = 0.56$$

3. Angular width,

$$2\theta = \frac{2\lambda}{d}$$

Given, $$\lambda = 6000 \text{ Å}$$

In case of new wavelength (assumed λ' here), angular width decreases by 30%

$$= \left(\frac{100-30}{100}\right) 2\theta$$

$$= 0.70\ (2\theta)$$

$$\frac{2\lambda'}{d} = 0.70 \times \left(\frac{2\lambda}{d}\right)$$

$\therefore$ $$\lambda' = 4200 \text{ Å}$$

VI. Short Answer Type Question-II [3 × 2 = 6]

1. (a) Both theories treat light as a wave in nature. However, as per the electromagnetic theory, light does not need any medium to propagate while for Huygens' wave theory, a medium is must. That is why, he assumed a hypothetical medium 'ether' through which light wave travels in vacuum.

(b) Angle between incident wavefront with the interface is called the incident angle of light wave.

2. (a) The instrument is called compound microscope because the focal length of objective lens is smaller than the focal length of eyepiece.

(b) Power of objective $= P_o = 100$ D

$$f_o = \frac{1}{100} \text{m} = 1\text{cm}$$

Power of eyepiece $= P_E = 40$ D

$\therefore$ $$f_E = \frac{1}{40} \text{m} = 2.5 \text{ cm}$$

Length of tube $= L = 20$ cm

D = Least distance of distinct vision

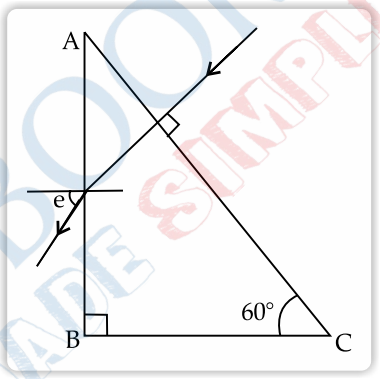
$= 25$ cm

$$\text{Angular magnification} = \frac{L}{f_o} \times \frac{D}{f_E}$$

$\therefore$ $$\text{Angular magnification} = \frac{20}{1} \times \frac{25}{2.5} = 200$$

VII. Long Answer Type Question [1 × 5 = 5]

1.



$$\angle C = 60°$$
$$\angle B = 90°$$
$$\angle A = 30°$$

$\therefore$ Angle of incidence at the face AB is 30°.

$$\frac{1}{\sqrt{3}} = \frac{\sin 30°}{\sin e}$$

or, $$\sin e = \sqrt{3}\ \sin 30°$$

$$= \sqrt{3} \times \frac{1}{2} = 0.87$$

$\therefore$ $$e = \sin^{-1} 0.87$$
$$= 60.46°$$

Now, the prism is immersed in a liquid of refractive index 1.3.

The refractive index of the surrounding medium is now greater than that of air but less than that of the medium of prism. Now, the angle of emergence will be less than 60.46°.

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