1- Refractive index of glass is 1.52 and refractive index of water is 1.33, then the critical angle will be

(A) 60°

B) 45°

C) 30°

D) 15°

$$\sin \theta_c = \frac{n_2}{n_1} \to \text{water} \atop \to \text{glass}$$

$$\sin \theta_c = \left(\frac{1.33}{1.52}\right) \to \theta_c = \sin^{-1}\left(\frac{1.33}{1.52}\right)$$

$$\theta_c = 61° \approx 60°$$

2- Light of wavelength is 720 nm in air. It has a wavelength in glass (Refractive index of air n =1.5) equal to

A) 720 nm

(B) 480 nm

C) 1080 nm

D) 7201.5 nm

$$\lambda_2 = \frac{\lambda_1}{n_2}$$

$$= \frac{720}{1.5} = 480 \, nm$$

3- A cut diamond sparkles because of its:

A) Hardness

(B) High refractive index ✓

C) Emission of light by the diamond

D) Absorption of light by the diamond

4- If the critical angle for total internal reflection from a medium to air is 30°, the velocity of light in the medium is (Refractive index of air n = 1)

A) 3×10⁸ m/s

(B) 1.5×10⁸ m/s ✓

C) 6×10⁸ m/s

D) 2×10⁸ m/s

$$\sin \theta_c = \frac{n_2}{n_1} \to \text{for air } n_2 = 1 \atop n_1 \to ?$$

$$\therefore n_1 = \frac{n_2}{\sin \theta_c} = \frac{1}{\sin 30} = 2$$

$$V = \frac{C}{n_1} = \frac{3 \times 10^8}{2} = 1.5 \times 10^8 \, m/s$$

5- Total internal reflection of light is possible when light enters from

A) Air to glass

B) Vacuum to air

C) Air to water

(D) Water to air ✓

6- Critical angle is that angle of incidence in the denser medium for which the angle of refraction in rarer medium is

A) 0°

B) 57°

C) 90° ✓

D) 180°

7- When light travels from one medium to the other of which the refractive index is different, then which of the following will change

A) Frequency, wavelength and velocity

B) Frequency and wavelength

C) Frequency and velocity

D) Wavelength and velocity ✓

8- A light wave has a frequency of 4×10^{14} Hz and a wavelength of 5×10^{-7} meters in a medium. The refractive index of the medium is

A) 1.5

B) 1.33

C) 1.0

D) 0.66

$$f = 4 \times 10^{14} \, Hz \quad , \quad \lambda = 5 \times 10^{-7} \, m$$
$$V = f \cdot \lambda$$
$$V = 4 \times 10^{14} \, (5 \times 10^{-7}) = 2 \times 10^{8} \, m/s$$
$$\therefore n = \frac{c}{V} = \frac{3 \times 10^{8}}{2 \times 10^{8}} = 1.5$$

9- Light of different colours transmit through air

A) With the velocity of air

B) With different velocities

C) With the velocity of sound

D) Having the equal velocities ✓

10- The speed of light in air is 3×10^8 m/s. What will be its speed in diamond whose refractive index is 2.4

A) 3×10^8 m/s

B) 332 m/s

C) 1.25×10^8 m/s ✓

D) 7.2×10^8 m/s

$$V = \frac{c}{n} = \frac{3 \times 10^8}{2.4} = 1.25 \times 10^8 \, m/s$$

11- When light enters from air to water, then its

A) Frequency increases and speed decreases

B) Frequency is same but the wavelength is smaller in water than in air ✓

C) Frequency is same but the wavelength in water is greater than in air

D) Frequency decreases and wavelength is smaller in water than in air

12- Refractive index of glass is 1.52 and refractive index of water is 1.33. If the speed of light in glass is 2.00×10^8 m/s, the speed in water will be

A) 2.67×10^8 m/s

B) 2.25×10^8 m/s ✓

C) 1.78×10^8 m/s

D) 1.50×10^8 m/s

$$\frac{V_1}{V_2} = \frac{n_2}{n_1}$$

$$\frac{2 \times 10^8}{V_2} = \frac{1.33}{1.52} \Rightarrow V_2 = 2.28 \times 10^8 \ m/s$$

13- The refractive index of water and glass with respect to air is 1.3 and 1.5 respectively. Then the refractive index of glass with respect to water is

A) 2.6/1.5

B) 1.5/2.6

C) 1.3/1.5

D) 1.5/1.3 ✓

14- Which of the following statement is true

A) Velocity of light is constant in all media

B) Velocity of light in vacuum is maximum ✓

C) Velocity of light is same in all reference frames

D) Laws of nature have identical form in all reference frames

15- Stars are twinkling due to

A) Diffraction

B) Reflection

C) Refraction ✓

D) Scattering

16- When light travels from glass to air, the incident angle is θ_1 and the refracted angle is θ_2. The true relation is

A) $\theta_1 = \theta_2$

B) $\theta_1 < \theta_2$ ✓

C) $\theta_1 > \theta_2$

D) Not predictable

17- The lateral magnification M of the image due to a flat mirror is defined as

A) The ratio of the image height to the object height. ✓

B) The ratio of the object height to the image height.

C) The negative of the ratio of the image distance to the object distance

D) None of these

18- For a flat mirror, lateral magnification M = +1 for any image because:

A) The image height = the object height. ✓

B) The image height ≠ the object height.

C) The image height = the double of the object height.

D) The image height = the half of the object height.

19- A flat mirror reflects a pencil of light to form a real image. Then the pencil of light incident on the mirror is:

A) Parallel

B) Convergent ✓

C) Divergent

D) None of the above

20- A man runs towards flat mirror at a speed of 15m/s. What is the speed of his image:
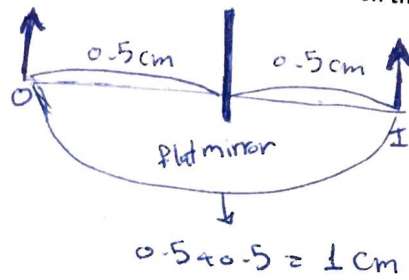
A) 7.5 m/s

B) 15 m/s ✓

C) 30 m/s

D) 45 m/s

21- An object is at a distance of 0.5 ~~m~~ cm in front of a flat mirror. Distance between the object and image is:

A) 0.5 cm

B) 0.25 cm

C) 1 cm ✓

D) 1.5 cm

(Handwritten diagram: arrows showing 0.5 cm on each side of a flat mirror, labeled O and I, "flat mirror")

$$0.5 + 0.5 = 1 \text{ cm}$$

22- A real image can be formed usually from:

A) flat mirror

B) concave mirror ✓

C) convex mirror

D) None of the above

23- An object having height 4cm and located at distance of 25 cm from convex mirror has a focal length of 10.0 cm. The formed image has height of:

A) 2.5 cm

B) 3.2 cm

C) 2 cm

D) 1.14 cm ✓

(Handwritten work:)

Convex mirror → $f = -10$ cm, $h = 4$ cm, $P = 25$ cm

$h' = ?$ $h' = M \cdot h$

$M = -\dfrac{q}{P} \rightarrow ?$

$\dfrac{1}{P} + \dfrac{1}{q} = \dfrac{1}{f} \Rightarrow \dfrac{1}{q} = \dfrac{-1}{10} - \dfrac{1}{25} \Rightarrow q = -7.14$ cm

$M = \dfrac{-(-7.14)}{25}$

$M = 0.28$

$\therefore h' = M \cdot h$

$= 0.28(4)$

$= 1.14$ cm

24- A spherical mirror has a focal length of 10.0 cm. For an object distance of 25.0 cm, the formed image will be:

A) upright and smaller than object

B) inverted and smaller than object ✓

C) upright and larger than object

D) inverted and larger than object

(Handwritten work:)

$\dfrac{1}{P} + \dfrac{1}{q} = \dfrac{1}{f} \Rightarrow \dfrac{1}{25} + \dfrac{1}{q} = \dfrac{1}{10}$

$\dfrac{1}{q} = \dfrac{5-2}{50} \Rightarrow q = 16.6$ cm

$M = -\dfrac{q}{P} = -\dfrac{16.6}{25}$

inverted $M = \ominus 0.6 < 1$ (smaller than object)

25- A concave mirror has a focal length of 15.0 cm. For an object distance of 20.0 cm, the formed image will be:

A) real and inverted ✓

B) virtual and inverted

C) real and upright

D) inverted and upright

(Handwritten work:)

$\dfrac{1}{P} + \dfrac{1}{q} = \dfrac{1}{f} \Rightarrow \dfrac{1}{20} + \dfrac{1}{q} = \dfrac{1}{15}$

$\dfrac{1}{q} = \dfrac{4 \times 1}{4 \times 15} - \dfrac{1 \times 3}{20 \times 3} \Rightarrow q = \dfrac{60}{4-3} = \oplus 60$ cm → real

$M = -\dfrac{q}{P} = -\dfrac{60}{20} = \ominus 3$ inverted

26- An object having height 4cm and located at distance of 25cm from convex mirror has a focal length of 10.0 cm. the image forms at distance of:

A) 6.9 cm

B) 5.5 cm

C) - 4.9 cm

D) – 7.14 cm ✓

$$P = 25 \text{ cm}$$

$$f = -10 \text{ cm} \quad (\text{for a convex mirror})$$

$$\frac{1}{P} + \frac{1}{q} = \frac{1}{f}$$

$$\frac{1}{25} + \frac{1}{q} = \frac{-1}{10}$$

$$\rightarrow \frac{1}{q} = \frac{5 \times -1}{5 \times 10} - \frac{1 \times 2}{25 \times 2} = \frac{-5 - 2}{50}$$

$$\frac{1}{q} = \frac{-7}{50} \Rightarrow q = -\frac{50}{7} = -7.14 \text{ cm}$$