Explanations

1. (c) In reflection at an interface from rarer to denser medium, the change in phase of wave is π radian.

2. (b) Wavefront of a wave is perpendicular to the direction of motion of wave.

3. (c) Every point on a given wavefront act as a secondary source of light and emits secondary wavelets which travels in all directions with the speed of light in the medium a surface touching are these secondary wavelets tangentially in the forward direction, gives new wavefront at that instant of time.

Hence, secondary wavelets may be used to the new position of the wavefront.

4. (d) As, speed of light in vacuum is given as

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

$\Rightarrow \quad \mu_0 =$ constant value

$\Rightarrow \quad \varepsilon_0 =$ constant value

5. (c) As the parallel rays, will come from the source situated at infinity, hence the wavefront is planar and it is perpendicular to the rays.

6. (a) The colours seen in a soap bubble arise from interference of light reflecting off the front and back surfaces of the thin soap film. Depending on thickness of film, different colours interfere constructively and destructively.

7. (a) Fringe width, $\beta = \dfrac{D\lambda}{d}$

But, here $\theta = \dfrac{d}{D} \Rightarrow d = D\theta$

$\therefore \quad \beta = \dfrac{D\lambda}{D\theta} = \dfrac{\lambda}{\theta}$

8. (b) Given, $\lambda_1 = 12000$ Å , $\lambda_2 = 10000$ Å, $D = 2$ m

and $d = 2\text{ mm} = 2 \times 10^{-3}$ m

We have, $\dfrac{\lambda_1}{\lambda_2} = \dfrac{n_1}{n_2} = \dfrac{12000}{10000} = \dfrac{6}{5} \quad \left(\because x_n = \dfrac{n\lambda D}{d}\right)$

As, $x = \dfrac{n_1\lambda_1 D}{d} = \dfrac{5 \times 12000 \times 10^{-10} \times 2}{2 \times 10^{-3}}$

$= 5 \times 1.2 \times 10^4 \times 10^{-10} \times 10^3\text{m}$

$= 6 \times 10^{-3}\text{ m} = 6\text{ mm}$

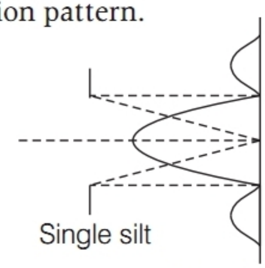
9. (c) In Young's double slit experiment, for maximum intensity (bright fringe), $x = m\dfrac{D\lambda}{d}$

where, m is the path difference, D is the distance between screen and coherent sources, d is the distance between coherent sources and λ is the wavelength. Putting $m = 0$, we get the position of the central bright fringe (which is called zero order fringe). Hence, at point O the path difference between two wavelets is zero. Hence, at O there is always a bright fringe. This is called the central fringe.

10. (c) Interference is the redistribution of light energy when light rays interfere with each other. The maximum intensity is the result of superimposing waves and minimum intensity is also the result of superimposing waves destructively. Hence, energy is conserved but distributed.

Hence, during phenomenon of interference energy is conserved but it is redistributed.

11. (d) The following diagram shows a single slit diffraction pattern.



As, it is clear from above diagram, in single slit diffraction, the central fringe has maximum intensity and has width double than other fringes.

12. (a) When the width of the slit become double i.e. $d = 2d$, then the central maxima on the diffraction pattern will become narrower and fainter.

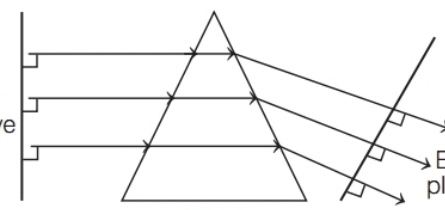
$\because$ Width of central maxima,

$$\beta = \frac{2D\lambda}{d}$$

As, we increase d to $2d$, β becomes $\beta/2$.

So, it becomes narrower and fainter.

13. (c) Since, the speed of light waves is less in glass, the lower portion of the incoming wavefront (which travels through the greatest thickness of glass) will get delayed resulting a tilt in the emerging wavefront as shown.



14. (c) $\phi = \dfrac{2\pi}{\lambda} \cdot \Delta x = \dfrac{2\pi}{\lambda} \times \dfrac{\lambda}{3} = \dfrac{2\pi}{3}$

and $I = 4I_0 \cos^2\left(\dfrac{\phi}{2}\right) = 4I_0 \times \dfrac{1}{4} = I_0$

Reason is not correct.

15. (a) As we know, fringe width, $\beta = \dfrac{\lambda D}{d}$

So, smaller the distance between the slits d, the larger will be fringe width β.

Thus, single fringe will cover whole screen and pattern will not be visible, i.e. no interference pattern is detected.

16. (c) If I_1 and I_2 are intensity of waves coming from two sources, then the maximum intensity,

$$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2 = (2\sqrt{I_0})^2 = 4I_0$$

$[\because I_1 = I_2 = I_0 \text{ (given)}]$

The minimum intensity observed at dark band is given by

$$I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2$$

If $I_1 = I_2 = I_0, I_{min} = 0$

If $I_1 \neq I_2, I_{min} \neq 0$

Therefore, intensity of dark band is not always zero.

17. (b) $I_{max} = 4I_0$ and $I_{min} = 0$

$$\therefore \frac{I_{max}}{I_{min}} = \text{infinite}$$

If width of one slit is slightly increased $I_{min} > 0$. Therefore, this ratio will be less than infinite.

18. (c) Diffraction determines the limitations of the concept of light rays.

A beam of width a travels a distance $\frac{a^2}{\lambda}$, called the Fresnel distance, before it starts to spread out due to diffraction.

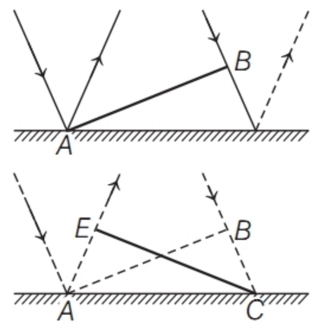
19. (i) (d) Huygens' original wave theory of light assumes that light propagates in the form of longitudinal mechanical wave.

(ii) (c) A wave normal is a line perpendicular to the wavefront. It gives the direction of a moving wave.

(iii) (a) When a source of light is linear in shape, such as a fine rectangular slit, the wavefront is cylindrical in shape.

(iv) (c) The secondary wavelets in the forwards direction at any instant gives the new position of the wavefront at that instant.

(v) (c) Figure shows AB as incident wavefront, so A and B are in same phase, i.e. $\phi = 0°$.



By the time B reaches C, secondary wavelet from A reaches E.

So, points C and E are same time intervals apart as they are in same phase, *i.e.* $\phi = 0°$.