PHYSICAL OPTICS

PREVIOUS EAMCET BITS

(ENGINEERING PAPER)

1. In the Young's double slit experiment the intensities at two points P_1 and P_2 on the screen are respectively I_1 and I_2. If P_1 is located at the centre of bright fringe and P_2 is located at a distance equal to a quarter of fringe width from P_1, then I_1/ I_2 is **[EAMCET 2009 E]**

   1) 2 2) 1/2 3) 4 4) 16

   Ans: 1

Sol: If a is the amplitude of one of the interfering wave then intensity at any point is given as

$I = 4a^2 \cos^2\left(\frac{\phi}{2}\right)$ ……(1)

At bright fringe $\cos^2\left(\frac{\phi}{2}\right) = 1$

$\therefore\ I_1 = 4a^2$ ……..(1)

$I_2 = 4a^2 \cos^2\left(\frac{\pi}{4}\right) = 2a^2$ ……(2)

$\therefore$ (1) divided by (2)

$\frac{I_1}{I_2} = \frac{4a^2}{2a^2} = 2$

2. In Young's double slit experiment, the 10^{th} maximum of wavelength λ_1 is at a distance of y_1 from the central maximum. When the wavelength of the source is changed to λ_2 , 5^{th} maximum is at a distance of y_2 from its central maximum. The ratio (y_1 / y_2) is **[EAMCET 2009 E]**

   1) $\frac{2\lambda_1}{\lambda_2}$ 2) $\frac{2\lambda_2}{\lambda_1}$ 3) $\frac{\lambda_1}{2\lambda_2}$ 4) $\frac{\lambda_2}{2\lambda_1}$

   Ans: 1

Sol: The condition to form bright band at a point is to have a path difference of $x = n\lambda$

From the given problem

$y_1 = 10\lambda_1$……(1)

$y_2 = 5\lambda_2$ ……(2)

Dividing (1) and (2)

$\frac{y_1}{y_2} = \frac{2\lambda_1}{\lambda_2}$

3. Four light sources produce the following four waves : **[EAMCET 2009 E]**

   i) $y_1 = a\sin(\omega t + \phi)$ ii) $y_2 = a\sin 2\omega t$ iii) $y_3 = a'\sin(\omega t + \phi)$ 4) $y_4 = a'\sin(3\omega t + \phi)$

   Superposition of which two waves give rise to interference?

   1) (i) and (ii) 2) (ii) and (iii) 3) (i) and (iii) 4) (iii) and (iv)

   Ans : 3

Sol: For obtaining sustained interference pattern the sources should maintain same phase or constant phase difference i.e. the source should be coherent

4. In Fraunhoffer diffraction experiment, L is the distance between screen and the obstacle, b is the size of obstacle and λ is wavelength of incident light. The general condition for the applicability of Fraunhoffer diffraction is **[EAMCET 2008 E]**

1) $\frac{b^2}{L\lambda} >> 1$ 2) $\frac{b^2}{L\lambda} = 1$ 3) $\frac{b^2}{L\lambda} = << 1$ 4) $\frac{b^2}{L\lambda} \neq 1$

Ans: 3

Sol: 1) If $\frac{b^2}{L\lambda} >> 1$, the approximation of geometrical optics is applicable

2) If $\frac{b^2}{L\lambda} << 1$, Fraunhofer diffraction is observed

3) $\frac{b^2}{L\lambda} \approx 1$, Fresnel diffraction is observed

5. In Young's double slit experiment, first slit has width four times the width of the second slit. The ratio of the maximum intensity to the minimum intensity in the interference fringe system is **[EAMCET 2006 E]**

1) 2 : 1 2) 4 : 1 3) 9 : 1 4) 8 : 1

Ans: 3

Sol: As Intensity $\propto$ width of the slit

$\therefore I \propto a^2$ or $I \propto$ width of slit

$$\therefore \frac{I_{max}}{I_{min}} = \left[\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right]^2$$

$$= \left[\frac{\sqrt{w_1}+\sqrt{w_2}}{\sqrt{w_1}-\sqrt{w_2}}\right]^2$$

$$\frac{I_{max}}{I_{min}} = \left[\frac{\sqrt{4}+\sqrt{1}}{\sqrt{4}-\sqrt{1}}\right]^2 = \frac{9}{1}$$

6. A light ray of wavelength λ is passing through a pin hole of diameter 'D' and the effect is observed on a screen placed at a distance 'L' from the pin hole. The approximations of geometrical optics are applicable if **[EAMCET 2005 E]**

1) $D \leq 1$ 2) $\frac{L\lambda}{D^2} = 1$ 3) $\frac{L\lambda}{D^2} << 1$ 4) $\frac{L\lambda}{D^2} >> 1$

Ans: 3

Sol: 1) If $\frac{b^2}{L\lambda} >> 1$, the approximation of geometrical optics is applicable

2) If $\frac{b^2}{L\lambda} << 1$, Fraunhofer diffraction is observed

3) $\frac{b^2}{L\lambda} \approx 1$, Fresnel diffraction is observed

7. Consider the following statements A and B and identify the correct answer **[EAMCET 2004 E]**

A: Fresnel's diffraction pattern occurs when the source of light or the screen on which the diffraction pattern in seen or when both are at finite distance from the aperture.

B: Diffracted light can be used to estimate the helical structure of nucleic acids.

1) A and B are true 2) A and B are false

3) A is true but B is false 4) A is false but B is true

Ans: 3

Sol: In Fresnels diffraction pattern the source and the screen are of finite distance.
Polarisation is used to estimate the helical structure of nucleic acid.

8. In Young's double slit experiment, an interference pattern is obtained on a screen by a light of wavelength 6000 A° coming from the coherent sources $S_1$and S_2. At certain point P on the screen third dark fringe is formed. Then the path difference $S_1P - S_2P$ in microns is **[EAMCET 2003 E]**

1) 0.75 2) 15 3) 3.0 4) 4.5

Ans: 2

Sol: The condition for dark fringe is

$\therefore$ path difference = $(2n + 1)\ \frac{\lambda}{2}$

$\therefore\ \Delta x = (2\times 2+1)\times\frac{6\times10^{-7}}{2}$

$=1.5\times10^{-6}\,m = 1.5$ micron

9. Consider the following statements A and B. Identify the correct choice in the given answers:

A : The refractive index of the extraordinary ray depends on the angle of incidence in the double refraction.

B: The vibration of light waves acquire one sided ness for both ordinary and extraordinary rays in double refraction **[EAMCET 2002 E]**

1) A and B are wrong 2) A and B are correct
3) A is correct B is wrong 4) A is wrong B is correct

Ans: 2

Sol: In double refraction method both ordinary and extra-ordinary ray are polarised.
The refractive index of the extra ordinary ray depends on the angle of incidence but the refractive index of the ordinary ray is independent of angle of incidence.

10. In Young's double slit interference experiment the wave-length of light used is 6000A°. If the path difference between waves reaching a point P on the screen is 1.5 microns, then at that point P. **[EAMCET 2002 E]**

1) Second bright band occurs 2) Second dark band occurs
3) Third dark band occurs 4) Third bright band occurs

Ans: 3

Sol: The condition for dark band is path difference $(2n-1)\frac{\lambda}{2}$

$(2n-1) = \frac{2\times1.5\times10^{-6}}{600\times10^{-10}} = 5$; n = 3

$\therefore$ Third dark band occurs

11. Light waves producing interference have their amplitudes in the ratio 3 : 2. The intensity ratio of maximum and minimum of interference fringes is **[EAMCET 2001 E]**

1) 36 : 1 2) 9 : 4 3) 25 : 1 4) 6 : 4

Ans: 3

Sol: $\frac{a_1}{a_2} = \frac{3}{2}$ [given]

$\frac{I_{max}}{I_{min}} = \left(\frac{a_1+a_2}{a_1-a_2}\right)^2 = \left(\frac{3+2}{3-2}\right)^2 = \frac{25}{1} = 25$

12. The difference in the number of wavelengths, when yellow light propagates through air and vacuum columns of the same thickness, is one. The thickness of the air column is: (Refractive index of air $\mu_a = 1.0003$; Wavelength of yellow light in vacuum = 6000A°) **[EAMCET 2001 E]**
1) 1.8 mm 2) 2 mm 3) 2 cm 4) 2.2 cm
Ans: 2

Sol:

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13. Four light sources produce the following four waves : **[EAMCET 2009 M]**
i) $y_1 = a\sin(\omega t + \phi_1)$ ii) $y_2 = a\sin(2\omega t)$
iii) $y_3 = a'\sin(\omega t + \phi_2)$ 4) $y_4 = a'\sin(3\omega t + \phi)$
Superposition of which two waves give rise to interference?
1) (i) and (ii) 2) (ii) and (iii) 3) (i) and (iii) 4) (iii) and (iv)
Ans: 3

Sol: The condition for interference is that two wave should have same phase or should maintain constant phase difference.

14. Two light beams produce interference pattern to give maxima and minima on the screen. If the intensities of the light beams are in the ratio of 9 : 4, then the ratio of intensities of maxima and minima is **[EAMCET 2009 M]**
1) 3 : 2 2) 5 :1 3) 25 : 1 4) 9 :1
Ans: 3

Sol: $\frac{I_1}{I_2} = \frac{9}{4}[\text{given}]$

$$\frac{I_1}{I_2} = \left(\frac{a_1}{a_2}\right)^2 = \frac{9}{4} \Rightarrow \frac{a_1}{a_2} = \frac{3}{2}$$

$$\therefore \frac{I_{max}}{I_{min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \left(\frac{3+2}{3-2}\right)^2 = \frac{25}{1} = 25$$

15. Wave theory cannot explains the phenomena of **[EAMCET 2008 M]**
A) Polarization B) Diffraction C) Compton effect D) Photoelectric effect
Which of the following is correct?
1) A and B 2) B and D 3) C and D 4) D and A
Ans: 3

Sol: Wave theory explains the phenomena of polarization and diffraction but the particle nature explains about Compton effect and photo electric effect.

16. In Young's double slit experiment using two identical slits, the intensity at a bright fringe on the screen is 1. If one of the slits is now closed, the intensity of the same bright fringe on the screen will be **[EAMCET 2008 M]**
1) 1 2) $\frac{1}{2}$ 3) $\frac{1}{4}$ 4) $\frac{1}{\sqrt{2}}$
Ans: 4

Sol: Let a is the amplitude of the interfering wave.
$\therefore I = (a_1 + a_2)^2 = (a + a)^2 = 4a^2$
If one slit is closed

$I_1 = (a)^2 = \frac{I}{4}$

17. The source is at some distance from an obstacle distance between obstacle and the point of observation is b and wavelength is λ. Then the average distance of n^{th} Fresnel zone will be at a distance ____- from the point of observation **[EAMCET 2007 M]**

1) $\frac{bn\lambda}{2}$ 2) $b-\frac{n\lambda}{2}$ 3) $b+\frac{n\lambda}{2}$ 4) $b-n\lambda$

Ans: 3

Sol: If the distance between obstacle and the point of observation is 'b' then the distance of n^{th} Fresnel Zone = $b+\frac{n\lambda}{2}$ from the point of observation.

18. Two coherent monochromatic light sources are located at two vertices of an equilateral triangle. If the intensity due to each of the sources independently is 1 Wm^{-2} at the third vertex. The resultant intensity due to both the sources at that point (i.e., at the third vertex) is (in Wm^{-2}) **[EAMCET 2006 M]**

1) Zero 2) $\sqrt{2}$ 3) 2 4) 4

Ans: 4

Sol: $I_1 = I_2 = 1 watt/m^2$

Phase angel $\theta = 0°$

Resultant intensity at the third vertex

$\therefore I = \left[\sqrt{I_1} + \sqrt{I_2}\right]^2 = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$

$\therefore I = 1+1+2\sqrt{1-1}\times 1 = 4$ watt / m^2

19. For the study of the helical structure of nucleic acids, the property of electromagnetic radiation, generally used is **[EAMCET 2005 M]**

1) Reflection 2) Interference 3) Diffraction 4) Polarization

Ans: 4

Sol: By using the property of polarisation helical structure of nucleic acids can be studied.

20. **Assertion (A) :** In Young's interference experiment the incident light used is white. When one slit is covered with red filter and the other with a blue filter, the phase difference at any point on the screen will continuously change producing uniform illumination .

Reason (R) : Two independent source of light would no longer act as coherent sources.

[EAMCET 2004 M]

1) Both A and R are true and R is the correct explanation of A
2) Both A and R are true and R is not the correct explanation of A
3) A is true but R is false
4) A is false but R is true

Ans: 1

Sol: The condition for interference is that two independent sources of light cannot act as coherent sources.

$\therefore$ Both A and R are true and R is the correct explanation of A

21. Consider the following statement A and B and identify the correct answer: **[EAMCET 2003 M]**

A : Polarized light can be used to study the helical structure of nucleic acids

B: Optic axis is a direction and not any particular line in the crystal

1) A and B are correct 2) A and B are wrong
3) A is correct and B is wrong 4) A is wrong and B is correct

Ans: 1

Sol: Both A and B are correct statements

22. When two coherent monochromatic light beams of intensities I and 4I aer super imposed, the ratio between maximum and minimum intensities in the resultant beam is **[EAMCET 2002 M]**

1) 9 : 1 2) 1 : 9 3) 4 : 1 4) 1 : 4

Ans: 1

Sol: $\frac{I_{max}}{I_{min}} = \left[\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right]^2$

$= \left[\frac{\sqrt{4I}+\sqrt{I}}{\sqrt{4I}-\sqrt{I}}\right]^2 = \frac{9}{1} = 9$

23. Consider the following two statements A and B and identify correct choice in the given answer.

A: When the light falls in two Polaroid sheets having their axis mutually perpendicular, it is completely extinguished.

B : When poly vinyl alcohol is subjected to a large strain the molecules get oriented parallel to the direction of strain and material becomes double refractive. **[EAMCET 2002 M]**

1) A and B are correct 2) Both A and B are wrong

3) A correct B wrong 4) A wrong B correct

Ans: 1

Sol: From the relation $I = \frac{I_0}{2}\cos^2\theta$, when $\theta = 90°$, $I = 0$

Both A and B are correct

24. A wavefront is an imaginary surface where **[EAMCET 2001 M]**

1) Phase is same for all points

2) Phase changes at constant rate at all points along the surface

3) Constant phase difference continuously changes between the points

4) Phase changes all over the surface

Ans: 1

Sol: Wave front is an imaginary surface where the phase is same for all points.

25. Both light and sound waves produce diffraction. It is more difficult to observe diffraction with light waves because **[EAMCET 2001 M]**

1) Light waves do not require medium 2) Wavelength of light waves is far smaller

3) Light waves are transverse waves 4) Speed of light is far greater

Ans: 2

Sol: As the wavelength of light waves is very les it is difficult to observe diffraction with light waves.