

Wave Optics — NEET Physics PYQ (2008-2020)

Class 12 Physics · 20 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2020 · Q138

1. The Brewsters angle i_b for an interface should be :

- (A) $0^\circ < i_b < 30^\circ$
- (B) $30^\circ < i_b < 45^\circ$
- (C) $45^\circ < i_b < 90^\circ$
- (D) $i_b = 90^\circ$

NEET 2020 · Q165

2. In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent sources is doubled, then the fringe width becomes :

- (A) double
- (B) half
- (C) four times
- (D) one-fourth

NEET 2020 · Q168

3. Assume that light of wavelength 600 nm is coming from a star. The limit of resolution of telescope whose objective has a diameter of 2 m is :

- (A) 3.66×10^{-7} rad
- (B) 1.83×10^{-7} rad
- (C) 7.32×10^{-7} rad
- (D) 6.00×10^{-7} rad

NEET 2019 · Q5

4. In a double slit experiment, when light of wavelength 400 nm was used, the angular width of the first minima formed on a screen placed 1 m away, was found to be 0.2° . What will be the angular width of the first minima, if the entire experimental apparatus is immersed in water? ($\mu_{\text{water}} = 4/3$)

- (A) 0.266°
- (B) 0.15°
- (C) 0.05°
- (D) 0.1°

NEET 2018 · Q8

5. Unpolarised light is incident from air on a plane surface of a material of refractive index ' μ '. At a particular angle of incidence ' i ', it is found that the reflected and refracted rays are perpendicular to each other. Which of the following options is correct for this situation?

- (A) $i = \sin^{-1}(1/\mu)$
- (B) Reflected light is polarised with its electric vector perpendicular to the plane of incidence
- (C) Reflected light is polarised with its electric vector parallel to the plane of incidence
- (D) $i = \tan^{-1}(1/\mu)$

NEET 2018 · Q9

6. In Young's double slit experiment the separation d between the slits is 2 mm, the wavelength λ of the light used is 5896 Å and distance D between the screen and slits is 100 cm. It is found that the angular width of the fringes is 0.20° . To increase the fringe angular width to 0.21° (with same λ and D) the separation between the slits needs to be changed to

- (A) 2.1 mm
- (B) 1.9 mm
- (C) 1.8 mm
- (D) 1.7 mm

NEET 2017 (Gujarati paper) · Q154

7. Two coherent sources of intensity ratio α interfere. The value of $(I_{\max} - I_{\min})/(I_{\max} + I_{\min})$ is:

- (A) $2\sqrt{\alpha}/(1 + \alpha)$
- (B) $(1 + \alpha)/(2\sqrt{\alpha})$
- (C) $(1 - \alpha)/(1 + \alpha)$
- (D) $2\sqrt{\alpha/(1 + \alpha)}$

NEET 2017 (Gujarati paper) · Q166

8. Due to Doppler effect, the shift in wavelength observed is $0.1 \text{ \AA}$, for a star producing a wavelength $6000 \text{ \AA}$. The velocity of recession of the star will be:

- (A) 2.5 km s^{-1}
- (B) 10 km s^{-1}
- (C) 5 km s^{-1}
- (D) 20 km s^{-1}

NEET 2017 (Gujarati paper) · Q173

9. A parallel beam of light of wavelength λ is incident normally on a single slit of width d . Diffraction bands are obtained on a screen placed at a distance D from the slit. The second dark band from the central bright band will be at a distance given by:

- (A) $\lambda d D$
- (B) $\lambda D/(2d)$
- (C) $2\lambda d/D$
- (D) $2\lambda D/d$

NEET 2016 Phase 2 · Q36

10. The interference pattern is obtained with two coherent light sources of intensity ratio n . In the interference pattern, the ratio $(I_{\max} - I_{\min})/(I_{\max} + I_{\min})$ will be

- (A) $\sqrt{n}/(n + 1)$
- (B) $2\sqrt{n}/(n + 1)$
- (C) $\sqrt{n}/(n + 1)^2$
- (D) $2\sqrt{n}/(n + 1)^2$

NEET 2016 Phase 2 · Q38

11. A linear aperture whose width is 0.02 cm is placed immediately in front of a lens of focal length 60 cm . The aperture is illuminated normally by a parallel beam of wavelength $5 \times 10^{-5} \text{ cm}$. The distance of the first dark band of the diffraction pattern from the centre of the screen is

- (A) 0.10 cm
- (B) 0.25 cm
- (C) 0.20 cm
- (D) 0.15 cm

NEET 2016 Phase 1 · Q6

12. In a diffraction pattern due to a single slit of width 'a', the first minimum is observed at an angle 30° when light of wavelength $5000 \text{ \AA}$ is incident on the slit. The first secondary maximum is observed at an angle of:

- (A) $\sin^{-1}(1/4)$
- (B) $\sin^{-1}(2/3)$
- (C) $\sin^{-1}(1/2)$
- (D) $\sin^{-1}(3/4)$

13. The intensity at the maximum in a Young's double slit experiment is I_0 . Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance $D = 10 d$?

- (A) I_0
- (B) $I_0/4$
- (C) $3I_0/4$
- (D) $I_0/2$

AIPMT 2015

14. In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maxima of single slit pattern?

- (A) 0.02 mm
- (B) 0.2 mm
- (C) 0.1 mm
- (D) 0.5 mm

AIPMT 2015

15. For a parallel beam of monochromatic light of wavelength ' λ ', diffraction is produced by a single slit whose width ' a ' is of the order of the wavelength of the light. If ' D ' is the distance of the screen from the slit, the width of the central maxima will be:

- (A) $2Da/\lambda$
- (B) $2D\lambda/a$
- (C) $D\lambda/a$
- (D) Da/λ

AIPMT 2014

16. A beam of light of $\lambda = 600$ nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between first dark fringes on either side of the central bright fringe is:

- (A) 1.2 mm
- (B) 2.4 cm
- (C) 2.4 mm
- (D) 1.2 cm

AIPMT 2014

17. In the Young's double-slit experiment, the intensity of light at a point on the screen where the path difference is λ is K , (λ being the wave length of light used). The intensity at a point where the path difference is $\lambda/4$, will be:

- (A) $K/4$
- (B) $K/2$
- (C) Zero
- (D) K

NEET 2013

18. In Young's double slit experiment, the slits are 2 mm apart and are illuminated by photons of two wavelengths $\lambda_1 = 12000 \text{ \AA}$ and $\lambda_2 = 10000 \text{ \AA}$. At what minimum distance from the common central bright fringe on the screen 2 m from the slit will a bright fringe from one interference pattern coincide with a bright fringe from the other?

- (A) 8 mm
- (B) 6 mm
- (C) 4 mm
- (D) 3 mm

NEET 2013

19. A parallel beam of fast moving electrons is incident normally on a narrow slit. A fluorescent screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statements is correct ?

- (A) Diffraction pattern is not observed on the screen in the case of electrons
- (B) The angular width of the central maximum of the diffraction pattern will increase
- (C) The angular width of the central maximum will decrease
- (D) The angular width of the central maximum will be unaffected

AIPMT 2008 Prelims · Q22

20. Two periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is

- (A) $2(I_1 + I_2)$
- (B) $I_1 + I_2$
- (C) $(\sqrt{I_1} + \sqrt{I_2})^2$
- (D) $(\sqrt{I_1} - \sqrt{I_2})^2$

Answer key and explanations

1. Answer: (C) $45^\circ < i_b < 90^\circ$

Brewster's law gives $\tan i_b = \mu$. For light going from a rarer to a denser medium $\mu > 1$, so $\tan i_b > 1$ and i_b lies between 45° and 90° . $i_b = 90^\circ$ would need an infinite refractive index.

2. Answer: (C) four times

Fringe width $\beta = \lambda D/d$. Doubling D and halving d multiplies β by $2 \times 2 = 4$. The two changes reinforce each other rather than cancelling.

3. Answer: (A) 3.66×10^{-7} rad

The angular limit of resolution is $\Delta\theta = 1.22\lambda/D = 1.22 \times 600 \times 10^{-9} / 2 = 3.66 \times 10^{-7}$ rad. Leaving out the factor 1.22 gives 3.0×10^{-7} , and using the radius instead of the diameter doubles the answer to 7.32×10^{-7} .

4. Answer: (B) 0.15°

Angular width $\propto \lambda$, and in water λ becomes λ/μ . New width $= 0.2^\circ \times 3/4 = 0.15^\circ$. Multiplying by $4/3$ (0.266°) wrongly assumes the wavelength increases in water.

5. Answer: (B) Reflected light is polarised with its electric vector perpendicular to the plane of incidence

This is Brewster's angle, $\tan i = \mu$, at which the reflected light is completely plane polarised with its electric vector perpendicular to the plane of incidence. The expression with $\tan^{-1}(1/\mu)$ inverts Brewster's law, and $\sin^{-1}(1/\mu)$ is the critical angle.

6. Answer: (B) 1.9 mm

Angular fringe width $\theta = \lambda/d$, so $\theta \propto 1/d$. $d' = d \times 0.20/0.21 = 2 \times 0.952 \approx 1.9$ mm. Increasing d to 2.1 mm would narrow the fringes instead.

7. Answer: (A) $2\sqrt{\alpha/(1 + \alpha)}$

Let $I_1 = \alpha I_2$. $I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$ and $I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$, so $I_{\max} - I_{\min} = 4\sqrt{I_1 I_2}$ and $I_{\max} + I_{\min} = 2(I_1 + I_2)$. The ratio is $2\sqrt{I_1 I_2}/(I_1 + I_2) = 2\sqrt{\alpha/(1 + \alpha)}$. The inverse form $(1 + \alpha)/(2\sqrt{\alpha})$ is always at least 1, which a ratio of this kind cannot be.

8. Answer: (C) 5 km s^{-1}

For $v \ll c$, $\Delta\lambda/\lambda = v/c$, so $v = c \times \Delta\lambda/\lambda = 3 \times 10^8 \times 0.1/6000 = 5 \times 10^3 \text{ m s}^{-1} = 5 \text{ km s}^{-1}$. Doubling the shift by mistake would give 10 km s^{-1} .

9. Answer: (D) $2\lambda D/d$

Single-slit minima occur at $d \sin \theta = n\lambda$. For $n = 2$ and small angles, $y = D \tan \theta \approx 2\lambda D/d$. The form $2\lambda d/D$ has the slit width and screen distance swapped and does not even have units of length.

10. Answer: (B) $2\sqrt{n/(n+1)}$

With $I_1 = nI_2$, $I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$ and $I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$. Their difference is $4\sqrt{I_1 I_2}$ and sum is $2(I_1 + I_2)$, so the ratio is $2\sqrt{I_1 I_2}/(I_1 + I_2) = 2\sqrt{n/(n+1)}$. Dropping the factor 2 gives $\sqrt{n/(n+1)}$.

11. Answer: (D) 0.15 cm

For single-slit diffraction the first minimum is at $\sin \theta = \lambda/a$, and on the focal plane $y = f\lambda/a = 60 \times 5 \times 10^{-5}/0.02 = 0.15$ cm. Using $2\lambda/a$ would give the width of the central maximum (0.30 cm), not the position of the first dark band.

12. Answer: (D) $\sin^{-1}(3/4)$

First minimum: $a \sin 30^\circ = \lambda$, so $\lambda/a = 1/2$. The first secondary maximum lies at $a \sin \theta \approx 3\lambda/2$, giving $\sin \theta = 3/2 \times 1/2 = 3/4$. $\sin^{-1}(1/2)$ is the first minimum itself, not a maximum.

13. Answer: (D) $I_0/2$

The point in front of a slit is at $y = d/2$, so path difference $= yd/D = (d/2)(d)/(10d) = d/20 = \lambda/4$, i.e. phase difference $\pi/2$. $I = I_0 \cos^2(\phi/2) = I_0 \cos^2(\pi/4) = I_0/2$. Using $I_0 \cos^2 \phi$ instead of $\cos^2(\phi/2)$ would wrongly give zero.

14. Answer: (B) 0.2 mm

Fringe width $\beta = \lambda D/d = 5 \times 10^{-7} \times 1/10^{-3} = 0.5$ mm. Ten fringes fill the central diffraction maximum: $2\lambda D/a = 10\beta = 5$ mm, so $a = 2 \times 5 \times 10^{-7} \times 1/(5 \times 10^{-3}) = 2 \times 10^{-4}$ m = 0.2 mm.

15. Answer: (B) $2D\lambda/a$

The first minima are at $\sin \theta \approx \lambda/a$ on either side, so the central maximum spans $2D\lambda/a$ on the screen. $D\lambda/a$ is only the half-width.

16. Answer: (C) 2.4 mm

First minima lie at $y = \pm \lambda D/a$, so their separation is $2\lambda D/a = 2 \times 600 \times 10^{-9} \times 2/10^{-3} = 2.4 \times 10^{-3}$ m = 2.4 mm. Forgetting the factor 2 gives 1.2 mm.

17. Answer: (B) $K/2$

Path difference λ is a maximum, so $K = I_{\max}$. Path difference $\lambda/4$ means phase difference $\pi/2$, so $I = I_{\max} \cos^2(\pi/4) = K/2$.

18. Answer: (B) 6 mm

Fringe width $\beta = \lambda D/d$: $\beta_1 = (12000 \times 10^{-10} \times 2)/(2 \times 10^{-3}) = 1.2$ mm and $\beta_2 = 1.0$ mm. Bright fringes coincide when $n_1(1.2) = n_2(1.0)$, first at $n_1 = 5$, $n_2 = 6$, i.e. 6 mm from the centre.

19. Answer: (C) The angular width of the central maximum will decrease

Faster electrons have a smaller de Broglie wavelength $\lambda = h/(mv)$. The angular width of the central maximum is about $2\lambda/a$, so it decreases. Electrons do show diffraction because of their wave nature.

20. Answer: (A) $2(I_1 + I_2)$

On superposition, $I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$ and $I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$. Adding them, the cross terms $\pm 2\sqrt{I_1 I_2}$ cancel, leaving $2(I_1 + I_2)$. $(\sqrt{I_1} + \sqrt{I_2})^2$ is only the maximum, not the sum.

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