



PHYSICS

BOOKS - MHTCET PREVIOUS YEAR PAPERS AND PRACTICE PAPERS

WAVE THEORY OF LIGHT

Example

1. Define Snell's law of refraction. A ray of light is incident on a glass slab at angle of

incidence of 60° . If the angle of refraction be 32.7° , calculate the refractive index of glass.

(Given: $\sin 60^\circ = 0.866$ and $\sin 32.7^\circ = 0.540$).

A. $\sin^{-1}(0.5773)$

B. $\sin^{-1}(0.638)$

C. $\sin^{-1}(0.523)$

D. $\sin^{-1}(0.4387)$

Answer: A



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2. When a polaroid sheet is rotated between two crossed polaroids, the intensity of the transmitted will be maximum, when angle θ between pass axes is

A. $\frac{\pi}{2}$

B. $\frac{3\pi}{4}$

C. $\frac{\pi}{4}$

D. $\frac{2\pi}{3}$

Answer: C



3. Three identical polaroid sheets P_1 , P_2 and P_3 are oriented, so that the pass axis of P_2 and P_3 are inclined at angles of 60° and 90° respectively with respect to the pass axis of P_1 . A monochromatic source S of unpolarised light of intensity I is kept in front of the polaroid sheet P_1 as shown in the figure.



Determine the intensities of light as observed

by the observers O_1 , O_2 and O_3 as shown in the figure.

A. $I_0 \cos^2 \theta$, $\frac{I_0 \cos^2 \theta}{4}$ and 0

B. 0, $I_0 \cos^2 \theta$ and $\frac{I_0 \cos^2 \theta}{4}$

C. $I_0 \cos^2 \theta$, 0 and $\frac{I_0 \cos^2 \theta}{4}$

D. None of the above

Answer: A



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4. Two polaroid A and B are kept in crossed position. How should a third polaroid C be placed between them so that the intensity of polarized light transmitted by polaroid B reduces to $\frac{1}{8}$ th of the intensity of unpolarised light incident on A ?

A. 45°

B. 60°

C. 30°

D. 90°

Answer: A



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5. If a glass plate refractive index is 1.732 is to be used as a polariser, what would be the angle of refraction?

A. 30°

B. 60°

C. 45°

D. 35°

Answer: A



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6. What speed should a galaxy move with respect to us so that the sodium line at 589.0nm is observed at 589.6nm ?

A. 106km s^{-1}

B. 306km s^{-1}

C. 513km s^{-1}

D. 50km s^{-1}

Answer: B



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7. The spectral line for a given element in the light received from a distant star is shifted towards longer wavelength side by 0.032% . Deduce the velocity of star in the line of sight.

A. $9.6 \times 10^4 \text{ m s}^{-1}$

B. $11.6 \times 10^{-4} \text{ m s}^{-1}$

C. $12.6 \times 10^{-4} \text{ m s}^{-1}$

D. None of these

Answer: A



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Exercise 1

1. Wave theory of light is not initially accepted because

- A. it does not explain reflection and refraction processes
- B. it does not explain photoelectric effect
- C. it does not explain Doppler's effect
- D. it does not explain propagation of light through vacuum

Answer: D



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2. Young's experiment establishes that

A. light consists of waves

B. light consists of particles

C. light consists of neither particles nor waves

D. light consists of both particles and waves

Answer: A



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3. In geometrical optics, a ray of light is defined as

A. path of propagation of light

B. path of propagation of shadows

C. direction of formation of image

D. path of propagation of energy for

$$\lambda \rightarrow 0$$

Answer: D



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4. The phenomenon of interference is shown by

A. only longitudinal mechanical waves

B. only transverse mechanical waves

C. only electromagnetic waves

D. All of the above

Answer: D



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5. Select the correct option in the following.

A. Christian Huygens a contemporary of Newton established the wave theory of light by assuming that light waves were transverse

B. Maxwell provided the compelling theoretical evidence that light is transverse wave

C. Thomas Young experimentally proved the wave behaviour of light and Huygens

assumption

D. All the statements given above, correctly answers the question what is light

Answer: B



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6. According to Maxwell's electromagnetic theory, following phenomenon can be explained

I. propagation of light in vacuum

II. Interference of light

III. Polarisation of light

IV. Photoelectric effect

A. I, II and III

B. I, II and IV

C. I, III and IV

D. II, III and IV

Answer: C



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7. By corpuscular theory of light, the phenomenon which cannot be explained is

A. refraction

B. interference

C. diffraction

D. polarisation

Answer: A



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8. According to corpuscular theory of light, the different colours of light are due to

A. different electromagnetic waves

B. different force of attraction among the corpuscles

C. different size of the corpuscles

D. None of the above

Answer: C



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9. For a ray of light, which of the following statements holds true?

A. A ray is defined as the path of energy propagation

B. The wavelength for a ray of light in geometrical optics is assumed to be negligible, standing to zero

C. A ray of light travels in a straight line

D. All of the above

Answer: D



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10. Which of the following generates a plane wavefront?

A. α – rays

B. β – rays

C. γ – rays

D. None of these

Answer: D



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11. When a ray of light is incident normally on a surface, then

- A. total internal reflection takes place
- B. it passes undeviated
- C. it undergoes dispersion
- D. it gets absorbed by the surface

Answer: B



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12. A wavefront is.....of all the particales of a medium which are..... .

A. a surface imagined parallel and coplanar
with light rays

B. a surface around a source such that
each point of it is at a constant distance

from the source

- C. a surface which contains the plane of oscillations of electric field of light
- D. a surface which is created by medium particles oscillating in same phase

Answer: D



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13. Which of the following statement (s) is/are correct?

I. A point source emitting waves uniformly in all directions.

II. In spherical wave, the locus of point which have the same amplitude and vibrate in same phase are spheres.

III. At a small distance from the source, a small portion of sphere can be considered as plane wave.

A. Only I

B. Both I and II

C. Only III

D. All of these

Answer: B



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14. The idea of secondary wavelets for the propagation of a wave was first given by

A. Newton

B. Huygens

C. Maxwell

D. Fresnel

Answer: B



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15. A shortcoming of Huygen's model could not

A. explaining the absence of the backwave

- B. determine the shape of the wavefront
for a plane wave
- C. explain the point source emitting waves
uniformly in all directions
- D. All of the above

Answer: A



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16. Ray diverging from a point source from a wave front that is

A. cylindrical

B. spherical

C. plane

D. cubical

Answer: B



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17. Wavefront is the locus of all points, where the particles of the medium vibrate with the same

A. phase

B. amplitude

C. frequency

D. period

Answer: A



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18. Light waves travel in vacuum along the y -axis. Which of the following may represent the wavefront?

A. $y = \text{constant}$

B. $x = \text{constant}$

C. $z = \text{constane}$

D. $x + y + z = \text{constant}$

Answer: A



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19. A light wave travels through a medium carrying energy in three dimensional space.

Energy spread is described by

A. rays originating from the source

B. beam of light originating from source
consisting of a branch of rays

C. wavefronts originating from source
travelling in medium with speed of light

D. imagining light consisting of particles
moving through medium with speed of

light

Answer: C



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20. According to Huygens' principle, a wavefront propagates through a medium by

A. pushing medium particles

B. propagating through medium with speed of light

C. carrying particles of same phase along
with it

D. creating secondary wavelets which forms
a new wavefront

Answer: D



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21. In given figure, light passes from denser medium 1 to rarer medium 2.



When $i > i_0$ (critical angle of incidence). Then, wavefront EC is

- A. formed further deep in medium 2
- B. formed closer to surface line AC
- C. formed perpendicular to AC
- D. formed in medium 1 (on same side of AB)

Answer: D



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22. Figure shows behaviour of a wavefront when it passes through a prism.



Which of the following statement(s) is/are correct?

I. Lower portion of wavefront (B') is delayed resulting in a tilt.

II. Time taken by light to reach A' from A is equal to the time taken to reach B' from B.

III. Speed of wavefront is same everywhere.

IV. A particle on wavefront A'B' is in phase with a particle on wavefront AB.

A. I and II

B. II and III

C. III and IV

D. I and III

Answer: A



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23. If a source of light is moving away from a stationary observer, then the frequency of light wave appears to change because of

A. Doppler's effect

B. interference

C. diffraction

D. None of these

Answer: A



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24. If a star is moving towards the earth, then the lines are shifted towards

A. red

B. infrared

C. blue

D. green

Answer: C



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25. It is believed that the universe is expanding and hence the distant stars are receding from us. Light from such a star will show

A. shift in frequency towards longer wavelengths

B. shift in frequency towards shorter wavelengths

C. no shift in frequency but decrease in intensity

D. a shift in frequency sometimes towards longer and sometimes towards shorter wavelengths

Answer: A



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26. In case of reflection of a wavefront from a reflecting surface,



- I. points A and E are in same phase.
- II. Points A and C are in same phase.
- III points A and B are in same phase.
- IV. Points C and E are in same phase.

Which of the following is correct?

A. I and II

B. II and III

C. III and IV

D. I and IV

Answer: C



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27. If AB is incident wavefront, then refracted wavefront is



A. 

B. 

C. 

D. 

Answer: B



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28. In the context of Doppler effect in light, the term red shift signifies

A. decrease in frequency

B. increase in frequency

C. decrease in intensity

D. increase in intensity

Answer: A



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29. If source and observer are moving towards each other with a velocity v_{radial} and c indicates velocity of light, then, fractional change in

frequency of light due to Doppler's effect will
be

A. $\frac{\Delta v}{v} = \frac{v_{\text{radial}}}{c}$

B. $\frac{\Delta v}{v} = \frac{-v_{\text{radial}}}{c}$

C. $\frac{\Delta v}{v} = \frac{c}{v_{\text{radial}}}$

D. $\frac{\Delta v}{v} = \frac{-c}{v_{\text{radial}}}$

Answer: B



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30. Monochromatic light of wavelength 589nm is incident from air on a water surface. Given, refractive index of water is 1.33.

Which of the following statement(s) is/are correct?

I. Frequency of reflected light and refracted light are same.

II. Wavelength of reflected light is more than that of refracted light.

III. Speed of reflected light is equal to that of refracted light.

IV. Intensity of reflected light is always more than that of refracted light.

A. I and III

B. II and IV

C. I and II

D. III and IV

Answer: C



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31. The critical angle of a certain medium is $\sin^{-1}\left(\frac{3}{5}\right)$. The polarizing angle of the medium is :

A. $\sin^{-1}\left(\frac{4}{5}\right)$

B. $\tan^{-1}\left(\frac{5}{3}\right)$

C. $\tan^{-1}\left(\frac{3}{4}\right)$

D. $\tan^{-1}\left(\frac{4}{3}\right)$

Answer: B



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32. When the angle of incidence on a material is 60° , the reflected light is completely polarised. The velocity of the refracted ray inside the materials is (in $\text{m//sec}^{(-1)}$)

A. 3×10^8

B. $\left(\frac{3}{\sqrt{2}}\right) \times 10^8$

C. $\sqrt{3} \times 10^8$

D. 0.5×10^8

Answer: C



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33. Two Nicols are oriented with their principal planes making an angle of 60° . The percentage of incident unpolarised light which passes through the system is

A. 50 %

B. 100 %

C. 12.5 %

D. 37.5 %

Answer: C



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34. Which of the following is a dichroic crystal?

A. Quartz

B. Tourmaline

C. Mica

D. Selenite

Answer: B



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35. The graph showing the dependence of intensity of transmitted light on the angle between polariser and analyser is

A. 

B. 

C. 

D. 

Answer: B



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36. Sound wave in air cannot be polarised because

A. their speed is small

B. they require medium

C. these are longitudinal

D. their speed is temperature dependent

Answer: C



37. In case of linearly polarised light, the magnitude of the electric field vector

A. does not change with time

B. varies periodically with time

C. increases and decreases linearly with time

D. is parallel to the direction of propagation

Answer: B



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38. Which of the following statement(s) is/are correct?

I. A polaroid consists of long chain molecules aligned in a particular direction.

II. Electric vectors along the direction of the aligned molecule in a polaroid gets absorbed.

III. An unpolarised light wave is incident on polaroid, then it will get linearly polarised.

A. Only I

B. Both II and III

C. Only III

D. All of the above

Answer: D



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39. Polaroids are used in

A. photographic cameras

B. 3D movies cameras

C. Both (a) and (b)

D. Neither (a) nor (b)

Answer: C



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40. Figure shows the process of



A. polarisation by scattering

B. polarisation of reflection

C. diffraction

D. None of the above

Answer: A



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41. Which of the following statement(s) is/are correct with reference to the figure given below?

I. Dots and arrows indicate that both

polarisations are present in the incident and refracted waves.

II. The reflected light is not linearly polarised.

III. Transmitted intensity will be zero when the axis of the analyser is in the plane of the figure i.e. the plane of incidence.



A. Only I

B. Only II

C. Both I and III

D. Both I and II

Answer: C



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42. The Brewster angle for the glass air interface is 54.74° if a ray of light going from air to glass strikes at an angle of incidence 45° then the angle of refraction is

A. 60°

B. 30°

C. 25°

D. 54.74°

Answer: B



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43. Which of the following phenomenon is not common to sound and light waves ?

A. Interference

B. Diffraction

C. Polarisation

D. Reflection

Answer: C



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44. In case of linearly polarised light, the magnitude of the electric field vector

A. does not change with time

B. varies periodically with time

C. increases and decreases linearly with
time

D. is parallel to the direction of
propagation

Answer: B



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45. Light is incident on a glass surface at polarising angle of 57.5° . Then the angle

between the incident ray and the refracted ray
is

A. 57.5°

B. 115°

C. 65°

D. 205°

Answer: D



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46. When the angle of incidence is 60° on the surface of a glass slab, it is found that the reflected ray is completely polarised. The velocity of light in glass is

A. $\sqrt{2} \times 10^8 \text{ms}^{-1}$

B. $\sqrt{3} \times 10^8 \text{ms}^{-1}$

C. $2 \times 10^8 \text{ms}^{-1}$

D. $3 \times 10^8 \text{ms}^{-1}$

Answer: B



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47. Which of the following diagrams represent the variation of electric field vector with time for a circularly polarised light



Answer: B





48. A calcite crystal is placed over a dot on a piece of paper and rotated, on seeing through the calcite one will be see

- A. a single dot
- B. two stationary dots
- C. two rotating dots
- D. one dot rotating about the other

Answer: A



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49. For the study of the helical structure of nucleic acids, the property of electromagnetic radiation generally used is

A. reflection

B. interference

C. diffraction

D. polarisation

Answer: D



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50. When light passes through two polaroids P_1 and P_2 , then transmitted polarisation is the component parallel to the polaroid axis.

Which of the following is correct?

A. 

B. 

C. 

D. 

Answer: A



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51. Polarising angle for water is $53^{\circ} 4'$. If light is incident at this angle on the surface of water and reflected, the angle of refraction is

A. $30^{\circ} 4'$

B. $36^{\circ} 56'$

C. $37^{\circ} 5'$

D. $29^{\circ} 2'$

Answer: B



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Exercise 2 Miscellaneous Problems

1. Which phenomenon best supports the theory that matter has a wave nature?

A. Electron momentum

B. Electron diffraction

C. Photon momentum

D. Photon diffraction

Answer: B



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2. Which of the following cannot be polarised?

A. Ultraviolet rays

B. Ultrasonic waves

C. X-rays

D. Radio waves

Answer: B



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3. An optically active compound

A. rotates the plane polarised light

B. changing the direction of polarised light

C. do not allow plane polarised light to
pass through

D. None of the above

Answer: A



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4. If the polarizing angle of a piece of glass for green light is 54.74° , then the angle of minimum deviation for an equilateral prism made of same glass is :

[Given: $\tan 54.74^\circ = 1.414$]

A. 45°

B. 54.74°

C. 60°

D. 30°

Answer: D



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5. When unpolarised light beam is incident from air onto glass ($n = 1.5$) at the polarising angle

A. reflected beam is polarised 100 %

B. reflected and refracted beams are partially polarised

C. the reason for (a) is that almost all the light is reflected

D. All of the above

Answer: A



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6. When both the components of electric field of light waves are present such that one is stronger than the other and such light is viewed through a rotating analyser, one sees a maximum and a minimum of intensity but not complete darkness. This kind of light is called

- A. polarised
- B. linearly polarised
- C. partially polarised
- D. None of these

Answer: C



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7. In the propagation of electromagnetic waves the angle between the direction of propagation and plane of polarisation is

A. 0°

B. 90°

C. 45°

D. 80°

Answer: A



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8. An unpolarised beam of intensity I_0 is incident on a pair of nicols making an angle of 60° with each other. The intensity of light emerging from the pair is

A. I_0

B. $I_0/2$

C. $I_0/4$

D. $I_0/8$

Answer: D



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9. A beam of unpolarised light is passed first through tourmaline crystal A and then through another tourmaline crystal B oriented so that its principal plane is parallel to that of A. The intensity of the emergent light is I . If A now rotated by 45° in a plane perpendicular

to the direction of the incident ray, the intensity of the emergent light will be

A. $2I_0$

B. $I_0/2$

C. $I_0/4$

D. $I_0/\sqrt{2}$

Answer: C



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10. If the plane of vibrations of the string is changed randomly in a very short intervals of time, it is known as

- A. polarised wave
- B. plane polarised wave
- C. unpolarised wave
- D. Both (a) and (b)

Answer: C



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11. According to Newton's corpuscular theory, the speed of light is

- A. same in all the media
- B. lesser in rarer medium
- C. lesser in denser medium
- D. independent of the medium

Answer: B



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12. A beam of natural light falls on a system of 5 polaroids, which are arranged in succession such that the pass axis of each polaroid is turned through 60° with respect to the preceding one. The fraction of the incident light intensity that passes through the system is :

A. $\frac{1}{64}$

B. $\frac{1}{32}$

C. $\frac{1}{256}$

D. $\frac{1}{512}$

Answer: D



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13. A ray of light is incident on a medium boundary at polarising angle such that its deviation is 24° , then angle of incidence is :

A. 24°

B. 57°

C. 66°

D. 90°

Answer: B



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14. Polarisation of light proves the -

A. light is a longitudinal wave

B. light is a transverse wave

C. light is not a wave

D. light travels with the velocity of

$$3 \times 10^8 \text{ms}^{-1}$$

Answer: B



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15. Unpolarized light is incident on a plane glass surface. What should be the angle of incidence so that the reflected and refracted rays are perpendicular to each other ?

A. 60°

B. 90°

C. 0°

D. 57°

Answer: D



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16. If the string always remains confined to the xy-plane, then it represents

A. a plane polarised wave

B. an unpolarised wave

C. linearly polarised wave

D. Both (a) and (c)

Answer: D



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17. Unpolarized light of intensity I_0 is incident on surface of a block of glass at Brewster's angle. In that case, which one of the following statements is true-

A. Reflected light is completely polarised

with intensity less than $\frac{I_0}{2}$

B. Transmitted light is completely polarised

with intensity less than $\frac{I_0}{2}$

C. Transmitted light is partially polarised

with intensity $\frac{I_0}{2}$

D. Reflected light is partially polarised with

intensity $\frac{I_0}{2}$

Answer: A



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18. A polarised light intensity I_0 is passed through another polariser whose pass axis makes an angle of 60° with the pass axis of the former, What is the intensity of emergent polarised light from second polarised?

A. $I = I_0$

B. $I = \frac{I_0}{6}$

C. $I = \frac{I_0}{5}$

D. $\frac{I_0}{4}$

Answer: D



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1. From Brewster's law, except for polished metallic surfaces, the polarising angle

A. depends on wavelength and is different for different colours

B. independent of wavelength and is different for different colours

C. independent of wavelength and is same for different colours

D. depends on wavelength and is same for different colours

Answer: A



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2. For the same angle of incidence the angles of refraction in media P, Q, R and S are 50° , 40° , 30° , 20° respectively the speed of light is minimum in medium

A. P

B. Q

C. R

D. S

Answer: D



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3. Light is incident at an angle i on a glass slab. The reflected ray is completely polarised . The angle of refraction is

A. $90^\circ - i$

B. $180^\circ - i$

C. $90^\circ + i$

D. i

Answer: A





4. When an unpolarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is

A. $\frac{1}{2}I_0$

B. $\frac{1}{4}I_0$

C. zero

D. I_0

Answer: A



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