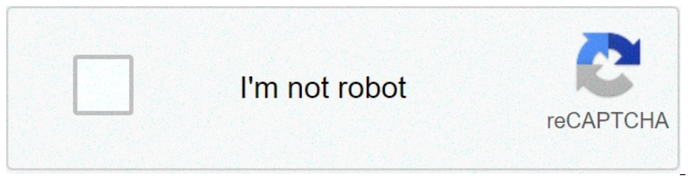

Continue

Geometric optics problems and solutions pdf

Optics questions with solutions and explanations at the bottom of the page. These questions may be used to practice for the SAT physics test. The questions are about reflection, refraction, critical angle, lenses, reflectors, light rays propagating through different mediums, refractive index of materials, ..etc.Which of the following is true about light?I) It is an electromagnetic waveII) It does not propagates in vacuumIII) Its maximum speed is approximately 3×108 m/sA) I onlyB) I and II onlyC) I and III onlyD) III onlyE) I, II and IIIThe speed of light in a certain material is 50% of its speed in vacuum. What is the refractive index of this material?A) 1.5B) 0.5C) 6.0D) 2.0E) 1.5×108What is the critical angle ic at the interface glass-cladding of an optical fiber whose core has a refractive index equal to 1.5 and cladding with a refractive index 1.45?A) 15°B) 105°C) 86°D) 83°E) 75°Which of the following is true about light with a single wavelength?I) It can be refractedII) It cannot be dispersedIII) It can be reflectedA) I, II and IIIB) I and II onlyC) II and III onlyD) I and III onlyE) NoneA ray of light is incident in medium (1) where light has speed s1 onto the interface with medium (2) where light has speed s2. If s1 > s2, then at the interfaceA) the ray will refract away from the normal to the interfaceB) the ray will refract toward from the normal to the interfaceC) the ray will follow a straight path from medium (1) to medium (2)D) the angle of reflection is greater than the angle of incidenceE) the angle of reflection is not equal to the angle of incidenceParallel rays of light strikes a convex lens. Which of the following diagrams shows what happens to the rays when they strike the lens? An object of height 10 cm is placed 50 cm in front of a bi-convex lens with a focal length of 20 cm. Which of the following is true about the image?I) The image is virtualII) The image is situated on the opposite side as the objectIII) The image is invertedA) I onlyB) I and II onlyC) II and III onlyD) II onlyE) III onlyAn object of height 5 cm is placed 25 cm in front of a bi-convex lens with a focal length of 10 cm. What is the height of the image?A) 2.5 cmB) 12.5 cmC) 6.8 cmD) 3.4 cmE) 7.4 cmAn optical fiber is made up of a core of refractive index 1.6 and a cladding of refractive index 1.5. What is the maximum angle that the light rays can make with the axis of the optical fiber so that light is totally reflected inside the optical fiber?A) 10°B) 15°C) 20°D) 70°E) 90°For an object in front of a plane mirror, which of the following about its images is(are) true?I) The image is realII) The image is uprightIII) The height of the image is twice the image of the objectA) I, II and IIIB) I and II onlyC) II onlyD) I and III onlyE) NoneSolutions to Above QuestionsLight is an electromagnetic wave that can propagate in vacuum with a maximum speed of approximately 3×108 m/s.Answer: Cv = 50% c (c speed of light in vacuum)Definition of refractive index n:n = c / v= c / 50% c = 2.0Answer: Dic = arcsin(1.45/1.5) = 75°Answer: ELight of any wavelength can be reflected and refracted. Light with a single wavelength cannot be dispersed.Answer: ASnell's lawn1 sin (i) = n2 sin (r)Use definition of refractive index: n = c / s (c speed of light in vacuum and s speed of light in the material)(c/s1) sin (i) = (c / s2) sin (r)sin (r) = (s2 / s1) sin (i)s2 / s1 icic = arcsin(1.5/1.6) = 70 °Let α be the angle made by the ray and the axis of the optical fiber. The relationship between α and i is:α = 90° - ii > ic90° - α > 70°α < 90° - 70°α < 20 °Answer: CThe image of the object in front of a plane mirror is virtual, upright and of the same height as the object.Answer: Creport this ad Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (B) $\frac{1}{15}=\frac{1}{v}-\frac{1}{10}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (A,B,C) Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. $(\mathrm{A})-\mathrm{pr},(\mathrm{B})-\mathrm{qst},(\mathrm{C})-\mathrm{prt},(\mathrm{D})-\mathrm{qs}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. 6 $\mathrm{m}=\frac{\mathrm{f}}{\mathrm{f}+\mathrm{u}}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. 3 $\frac{1}{f}=\frac{1}{u}+\frac{1}{v} \Rightarrow \frac{1}{10}=\frac{1}{u}+\frac{3}{25} \Rightarrow u=-50 \mathrm{m}$ $\frac{1}{\mathrm{f}}=\frac{1}{\mathrm{u}}+\frac{1}{\mathrm{v}} \Rightarrow \frac{1}{10}=\frac{1}{\mathrm{u}}+\frac{7}{50} \Rightarrow \mathrm{u}=-25 \mathrm{m}$ Speed $=\frac{25}{30} \times \frac{18}{5}=3$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. 6 $r=\frac{h}{\sqrt{\mu^{2}-1}}=\frac{8}{\sqrt{\left(\frac{5}{3}\right)^{2}-1}}=6 \mathrm{cm}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (C) When $\theta=0^{\circ},$ maximum light is transmitted. At $\theta>\theta_{\mathrm{C}}$ (critical angle), no further light is transmitted Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. 2 First refraction [Lens-air interface] $\frac{\mu_{2}}{v}-\frac{\mu_{1}}{u}=\frac{\mu_{2}-\mu_{1}}{R}$ where $\mu_{1}=1, \mathrm{u}=-24, \mu_{2}=\frac{7}{4}, \mathrm{R}=+6$ After solving v = 21 Now for second refraction [Lens-water interface] $\frac{4 / 3}{v_{2}}-\frac{7 / 4}{21}=0 \Rightarrow v_{2}=h=16 \mathrm{cm}$ So, from bottom $18-16=2 \Rightarrow \mathrm{x}=2$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (B) $\frac{1}{\mathrm{f}}=\frac{1}{\mathrm{f}_{1}}+\frac{1}{\mathrm{f}_{2}}$ $\frac{1}{\mathrm{f}}=\left(\frac{\mu_{1}-1}{\mathrm{R}_{1}}\right)+\left(\frac{\mu_{2}-1}{\mathrm{R}_{2}}\right) \Rightarrow \frac{1}{\mathrm{f}}=\frac{5}{14}+\frac{2}{14}$ f = 20 c.m. $\frac{1}{\mathrm{v}}-\frac{1}{\mathrm{u}}=\frac{1}{\mathrm{f}} \Rightarrow \frac{1}{\mathrm{v}}-\frac{1}{-40}=\frac{1}{20}=40 \mathrm{c.m}$ Paragraph for Questions 12 and 13 Most materials have the refractive index, n>1. So, when a light ray from air enters a naturally occurring material, then by Snell's law, $\frac{\sin \theta_{1}}{\sin \theta_{2}}=\frac{n_{2}}{n_{1}}$, it is understood that the refracted ray bends towards the normal. But it never emerges on the same side of the normal as the incident ray. According to electromagnetism, the refractive index of the medium is given by the relation, $n=\left(\frac{c}{v}\right)=\pm \sqrt{\varepsilon_{r} \mu_{r}}$, where c is the speed of electromagnetic waves in vacuum, v its speed in the medium, ε_{r} and μ_{r} are the relative permittivity and permeability of the medium respectively. In normal materials, both ε_{r} and μ_{r} are positive, implying positive n for the medium. When both ε_{r} and μ_{r} are negative, one must choose the negative root of n. Such negative refractive index materials can now be artificially prepared and are called meta-materials. They exhibit significantly different optical behaviour, without violating any physical laws. Since n is negative, it results in a change in the direction of propagation of the refracted light. However, similar to normal materials, the frequency of light remains unchanged upon refraction even in meta materials. Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (C) $_{1} \mu_{2}=\frac{\mu_{2}}{\mu_{1}}=\frac{\sin \mathrm{i}}{\sin \mathrm{r}}$ $\frac{(-)}{1}=\frac{\sin \mathrm{i}}{\sin \mathrm{r}}$ sini = sin(−r) Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (B) $\mu=\frac{\mathrm{c}}{\mathrm{v}} \Rightarrow \mathrm{v}=\frac{\mathrm{c}}{\mu}=\frac{\mathrm{c}}{\mathrm{n}}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (A) Here normal is along $\hat{j}$ Angle between incident ray and normal $\cos \theta=\frac{\frac{1}{2}(\hat{i}+\sqrt{3} \hat{j}) \cdot \hat{j}}{(1)(1)}=\frac{\sqrt{3}}{2} \Rightarrow \theta=30^{\circ}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (C) $\mathrm{m}=-\frac{1}{3}=\frac{\mathrm{v}}{\mathrm{u}}$ v = 8m u = – 24 m $\frac{1}{\mathrm{v}}-\frac{1}{\mathrm{u}}=\frac{1}{\mathrm{f}} \rightarrow \frac{1}{8}-\frac{1}{-24}=\frac{1}{\mathrm{f}} \Rightarrow \mathrm{f}=6 \mathrm{m}$ $\mathrm{f}=\frac{\mathrm{R}}{(\mu-1)}$ $\mu=\frac{\lambda_{\text {vaceum }}}{\lambda_{\text {medium }}}=\frac{3}{2}$ $6 \mathrm{m}=\left(\frac{\mathrm{R}}{3 / 2-1}\right) \Rightarrow \mathrm{R}=3 \mathrm{m}$ Download eSaral App for Video Lectures, Complete Revision, Study Material and much more...Sol. (D) (P) at prism surface ray moving towards normal so $\left(\mu_{2}>\mu_{1}\right)$at block surface ray moving away from normal so $\left(\mu_{3}