socrative
by MasteryConnect

Name: Solutions Date: _____

Quiz name: AP Physics 2 - Test 08 - Ray Optics Pt. 1

1. An object is located 0.20 meters from a converging lens which has a focal length of 0.15 meters. Relative to the object, the image formed by the lens will be:

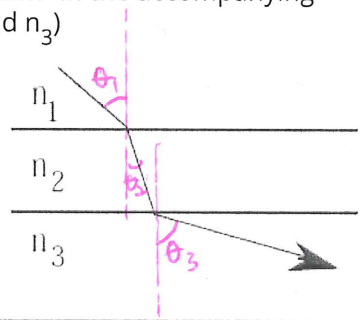
(A) virtual, inverted, smaller
(B) real, inverted, smaller.
(C) real, inverted, larger
(D) virtual, upright, larger

Look @ Ray tracing worksheet Problem #3

2. A beam of light passes from medium 1 to medium 2 to medium 3 as shown in the accompanying figure. What is true about the respective indices of refraction (n_1, n_2, and n_3)

(A) $n_1 > n_2 > n_3$
(B) $n_1 > n_3 > n_2$
(C) $n_2 > n_3 > n_1$
(D) $n_2 > n_1 > n_3$

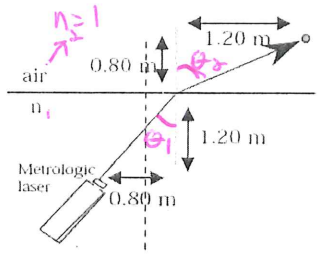
$\theta_3 > \theta_1 > \theta_2$
so
$n_3 < n_1 < n_2$



3. A laser is embedded in a material of index of refraction n. The laser beam emerges from the material and hits a target. See the accompanying figure for the position parameters of the laser and target. The value of n is:

(A) 1.4
(B) 1.5
(C) 2.1
(D) 3.5

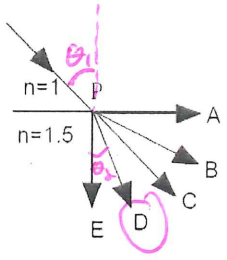
$\theta_1 = \tan^{-1}\left(\frac{0.8}{1.2}\right) = 33.69^\circ$
$\theta_2 = \tan^{-1}\left(\frac{1.2}{0.8}\right) = 56.3^\circ$
$n_1 \sin\theta_1 = n_2 \sin\theta_2$
$n_1 = \frac{n_2 \sin\theta_2}{\sin\theta_1} = \frac{(1)\sin(56.3)}{\sin(33.7)} = 1.5$



4. A beam of light is directed toward point P on a boundary as shown to the right. Which segment best represents the refracted ray?

(A) PA
(B) PB
(C) PC
(D) PD
(E) PE

enters a larger index, so refraction angle decreases



5. 2 Correct Answers: Which of the following are possible for the images formed by the lens in the accompanying figure? Select two answers.

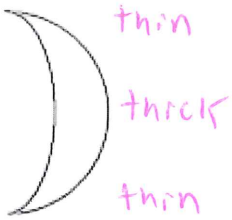
(A) Real and inverted

(B) Real and smaller in size

(C) Real and upright

(D) Virtual and smaller in size

This acts like a convex lens. Check ray tracing Problems 1-6.



6. A narrow beam of monochromatic light enters a lens parallel to the optic axis, as shown in the accompanying diagram. Which arrow best represents the direction of the light after leaving the lens?

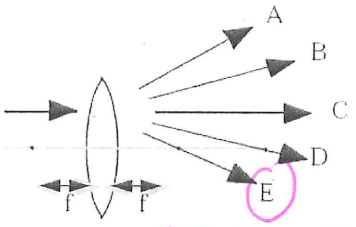
(A) A

(B) B

(C) C

(D) D

(E) E



goes through focal point.

7. Which diagram best represents what happens to a ray of light entering air from water? Air is at the top in all diagrams.

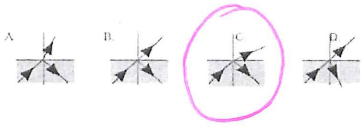
(A) A

(B) B

(C) C

(D) D

it goes to a lower index by entering the air from water. So the refraction angle increases.



8. A beam of light traveling in glass (n_g = 1.5) strikes a boundary with air (n_a = 1.0) at point P. The angle of incidence is 60° as shown in the diagram. Which ray would best indicate the beam's path after point P?

$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right) = 41.8^\circ$

(A) A

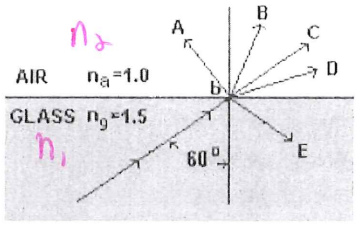
(B) B

(C) C

(D) D

(E) E

the incident angle is larger than the critical angle. So total internal reflection occurs. Always check for this when light is going from high index to low index.



9. 2 Correct Answers: A small light bulb is placed 20 cm to the right of a converging lens of focal length 10 cm.
Which of the following statements are true about the image of the bulb formed by the lens? Select two answers.

(A) It is virtual

(B) It is inverted

(C) It is one-half the size of the bulb

(D) It is 20 cm to the left of the lens

object located at 2f. Check ray tracing worksheet Problem #2.

10. An image is formed on a screen by a convergent lens. If the top half of the lens is then covered what will happen to the image?

(A) the image is dimmer but otherwise unchanged

(B) the image becomes half as big

(C) only the top half of the image is produced

by covering

(D) only the bottom half of the image is produced

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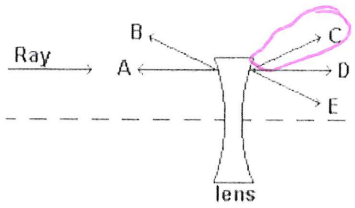
11. The index of refraction of this lens is greater than the index of refraction of the surrounding. After striking the lens shown in the diagram at right, the light ray will most likely follow which path?



(A) A
(B) B
(C) C
(D) D
(E) E

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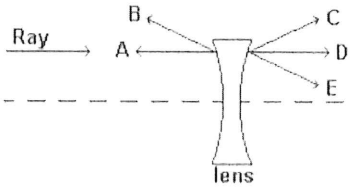
12. The index of refraction of this lens is less than the index of refraction of the surrounding. After striking the lens shown in the diagram at right, the light ray will most likely follow which path?



(A) A
(B) B
(C) C
(D) D
(E) E

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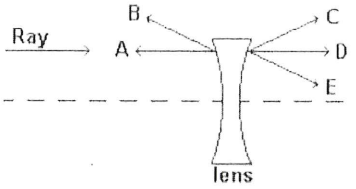
13. The index of refraction of this lens is equal to the index of refraction of the surrounding. After striking the lens shown in the diagram at right, the light ray will most likely follow which path?



(A) A
(B) B
(C) C
(D) D
(E) E

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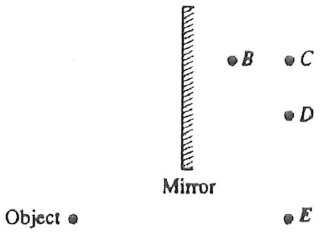
14. An object is placed near a plane mirror, as shown above. Which of the labeled points is the position of the image?



(A) B
(B) C
(C) D
(D) E

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15. A diverging lens produces an image of a real object. This image is

(A) virtual, larger than the object, and upright.
(B) virtual, smaller than the object, and upright.
(C) virtual, smaller than the object, and inverted.
(D) real, smaller than the object, and inverted.

check ray tracing worksheet Problems 7-9.

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16. When you use a magnifying glass, you hold the object which you are observing closer than one focal length to the lens, which is a convex lens. The image

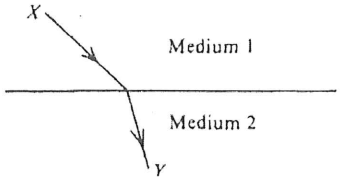
(A) is minified and virtual

(B) is magnified and virtual
(C) is minified and real
(D) in magnified and real

Check Ray tracing worksheet problem # 6

17. Light leaves a source at X and travels to Y along the path shown above. Which of the following statements is correct?

(A) The index of refraction is the same for the two media.
(B) Light travels faster in medium 2 than in medium 1.
(C) Light would arrive at Y in less time by taking a straight line path from X to Y than it does taking the path shown above.
(D) Light leaving a source at Y and traveling to X would follow the same path shown above, but in reverse.

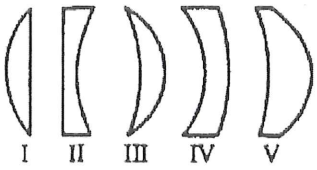


light paths are reversible

18. Assuming the indices of refraction of the lenses are greater than the surrounding, which three of the glass lenses above would cause parallel rays of light to converge?

(A) I, II, and III
(B) I, III, and V
(C) I, IV, and V
(D) II, III, and IV

all lenses that are
top → thin
mid → thick
bottom → thin



19. If the object distance for a converging thin lens is more than twice the focal length of the lens, the image is

(A) virtual and erect
(B) larger than the object
(C) located inside the focal point
(D) located at a distance between f and 2f from the lens

Check ray tracing worksheet problem # 1

20. A physics student places an object 6.0 cm from a converging lens of focal length 9.0 cm. What is the magnitude of the magnification of the image produced?

s_o f

(A) 0.6
(B) 1.5
(C) 2.0
(D) 3.0

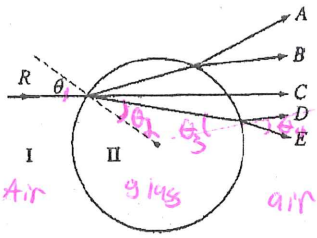
$\frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i}$ $\frac{1}{9} = \frac{1}{6} + \frac{1}{s_i}$ $\frac{1}{s_i} = \frac{1}{9} - \frac{1}{6}$ $s_i = -18\ cm$ $M = \frac{-s_i}{s_o} = 3$

21. A light ray R in medium I strikes a sphere of medium II with angle of incidence θ, as shown above. The figure shows five possible subsequent paths for the light ray.

$n_{air} = 1$ $n_{glass} = 1.5$

Which path is possible if medium I is air and medium II is glass?

(A) A
(B) B
(C) C
(D) D
(E) E



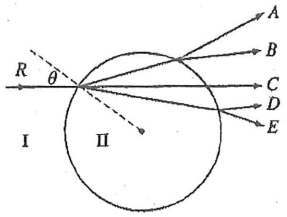
When light goes from low to high index, the angle of refraction is less than the angle of incidence. So this narrows it down to D and E.

When light goes from glass to air the angle of refraction is more than the angle of incidence.

So that eliminates D.

A light ray R in medium I strikes a sphere of medium II with angle of incidence θ, as shown above. The figure shows five possible subsequent paths for the light ray.

22. Which path is possible if medium I is glass and medium II is air?



(A) A
(B) B
(C) C
(D) D
(E) E

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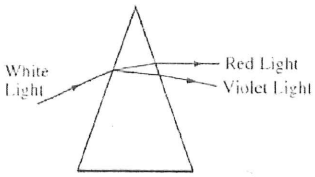
23. 2 Correct Answers: As shown, a beam of white light is separated into separate colors when it passes through a glass prism. Red light is refracted through a smaller angle than violet light because red light has a:



(A) slower speed in glass than violet light
(B) faster speed in glass than violet light
(C) slower speed in the incident beam than violet light
(D) lower index of refraction in glass than violet light

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24. When an object is placed in front of a plane mirror the image is:

(A) Upright, magnified and real
(B) Upright, the same size and virtual
(C) Inverted, demagnified and real
(D) Inverted, magnified and virtual
(E) Upright, magnified and virtual

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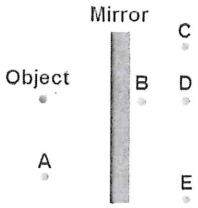
25. A point object is placed in front of a plane mirror. Which is the correct location of the image produced by the mirror?



(A) A
(B) B
(C) C
(D) D
(E) E

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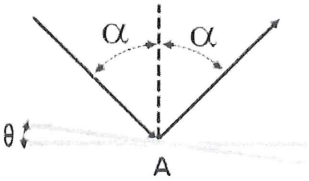
26. A narrow beam of light is incident on the surface of a plane mirror. The initial angle between the incident ray and reflected ray is 2α. If the mirror is turned around point A by the angle θ what is the change of the angle between two rays?



(A) θ
(B) 2θ
(C) 4θ
(D) θ/2
(E) θ/4

by changing the mirror's orientation by θ degrees, you also changed the angle of incidence by θ. However because of the Law of Reflection, the angle of reflection equals angle of incidence. So you added θ to the reflected angle as well. So in total you added 2θ.

27. An object is placed in front of a converging lens at a distance greater than 2F. The image produced by the lens is:

(A) Real, inverted and demagnified
(B) Real, inverted and magnified
(C) Virtual, upright and magnified
(D) Virtual, upright and demagnified
(E) Virtual, inverted and magnified

Check ray tracing worksheet
Problem # 1

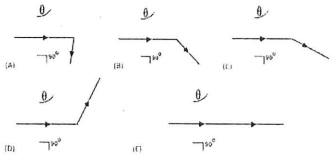
28. An object is placed in front of a converging lens at a distance less than F. The image produced by the lens is:

(A) Real, inverted and demagnified
(B) Real, inverted and magnified
(C) Virtual, upright and magnified
(D) Virtual, upright and demagnified
(E) Virtual, inverted and magnified

Check ray tracing worksheet
Problem # 6

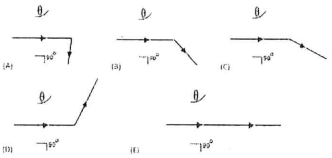
29. A light ray is incident on a glass prism with one angle of 90 □and the other angle θ. If θ is less than the critical angle for glass-air boundary, which of the following is correct for the emerging ray from the opposite face of the prism?

(A) A
(B) B
(C) C
(D) D
(E) E



30. A light ray is incident on a glass prism with one angle of 90 □and the other angle θ. If θ is greater than the critical angle for glass-air boundary, which of the following is correct for the emerging ray from the opposite face of the prism?

(A) A
(B) B
(C) C
(D) D
(E) E



31. An object is placed in front of a diverging lens at a distance between F and 2F. The image produced by the lens is:

(A) Real, inverted and demagnified
(B) Real, inverted and magnified
(C) Virtual, upright and magnified
(D) Virtual, upright and demagnified
(E) Virtual, inverted and magnified

Check ray tracing work sheet
Problem # 8

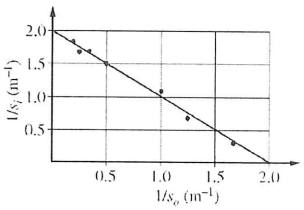
A group of students collected data using a lens. They varied the distance s_o of an object from the lens and measured the image distance s_i. The figure above is their graph of the inverse of the image distance as a function of the inverse of the object distance.

32. The focal length of the lens is approximately

the y- intercept is $\frac{1}{5}$

So $\frac{1}{5} = 2 \rightarrow$ $f = 0.5\ m$

(A) 0.5 m
(B) 1.0 m
(C) 2.0 m
(D) 4.0 m

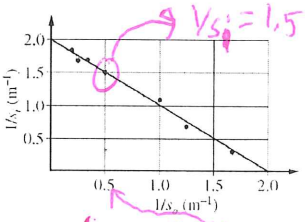


A group of students collected data using a lens. They varied the distance s_o of an object from the lens and measured the image distance s_i. The figure above is their graph of the inverse of the image distance as a function of the inverse of the object distance.

33. What is the magnitude of the image's magnification when the object is placed 2 m from the lens?

$|M| = \left|\frac{-s_i}{s_o}\right| = \left|\frac{-2/3}{2}\right| = \boxed{1/3}$

(A) 1/3
(B) 1
(C) 3
(D) The magnification is undefined because the image is an infinite distance from the lens.



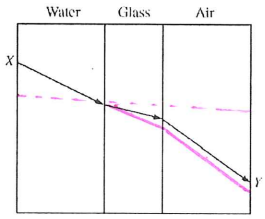
$1/s_i = 1.5$ so $s_i = \frac{2}{3}$

$s_o = 2 \rightarrow 1/s_o = 0.5$

A light ray enters a layer of water at point X, passes through a layer of glass, and exits through a layer of air at point Y, as shown in the figure. Where would the ray exit the layer of air if the glass was
34. replaced with a material of lower index of refraction? Assume no total internal reflection occurs.

(A) At a point above point Y
(B) At a point below point Y
(C) At point Y
(D) The location cannot be determined without knowing how much lower the index of refraction of the new material is.

by decreasing the index, you increase the angle of refraction.



35. Light travels fastest
(A) in a vacuum
(B) through water
(C) through glass
(D) through diamond
(E) through air

36. For all transparent materials, the index of refraction
(A) is less than 1
(B) is greater than 1
(C) is equal to 1
(D) could be any of the given answers, it all depends on optical density

A ray of light, which is traveling in air, is incident on a glass plate at a 45 degree angle. The angle of
37. refraction in the glass.

increase index → decrease angle

(A) is less than 45
(B) is greater than 45
(C) is equal to 45
(D) could be any of the above