**Reflection and Refraction**

**Questions from a Conceptual Course**

**Category 1: Reflection and Plane Mirrors**

**Question 1:**

aa. Which of the following statements describes the distinction between reflection and refraction?

a. Refraction occurs at a boundary; reflection happens in a medium.

b. Refraction involves a change in light’s direction; reflection does not.

c. Reflection occurs with light rays; refraction occurs with light waves.

d. Light crosses a boundary when it refracts; light stays in one medium when it reflects.

**Question 2:**

aa. How is the angle of incidence for light approaching a mirror defined?

a. It is the angle between the approaching light ray and the normal line.

b. It is the angle between the approaching light ray and the mirror surface.

c. It is the angle between the reflecting light ray and the normal line.

d. It is the angle between the reflecting light ray and the mirror surface.

**Question 3:**

aa. How is the angle of reflection for light approaching a mirror defined?

a. It is the angle between the approaching light ray and the normal line.

b. It is the angle between the approaching light ray and the mirror surface.

c. It is the angle between the reflecting light ray and the normal line.

d. It is the angle between the reflecting light ray and the mirror surface.

**X**

**Y**

**Z**

**A**

**B**

**C**

**D**

**Questions 4-8:**

The diagram at the right shows light reflecting off a surface. Three lines (X, Y and Z) and four angles (A, B, C and D) are labeled. Use the diagram in answering the next several questions.

aa. The incident ray is denoted by \_\_\_\_\_.

a. line X b. line Y

c. line Z

aa. The reflected ray is denoted by \_\_\_\_\_.

a. line X b. line Y

c. line Z

aa. The normal line is denoted by \_\_\_\_\_.

a. line X b. line Y

c. line Z

aa. The angle of incidence is angle \_\_\_\_.

aa. The angle of reflection is angle \_\_\_\_.

**Question 9:**

**A**

**B**

**C**

**D**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle A were 40°, then the angle of reflection would be \_\_\_\_\_°.

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 10:**

**A**

**B**

**C**

**D**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle A were 50°, then the angle of reflection would be \_\_\_\_\_°.

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 11:**

**A**

**B**

**C**

**D**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle B were 40°, then the angle of reflection would be \_\_\_\_\_°.

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 12:**

**A**

**B**

**C**

**D**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle B were 50°, then the angle of reflection would be \_\_\_\_\_°.

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 13:**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle C were 40°, then the angle of incidence would be \_\_\_\_\_°.

**A**

**B**

**C**

**D**

a. 40 b. 50

c. Impossible to tell with just this information.

**A**

**B**

**C**

**D**

**Question 14:**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle C were 50°, then the angle of incidence would be \_\_\_\_\_°.

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 15:**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle D were 40°, then the angle of incidence would be \_\_\_\_\_°.

**A**

**B**

**C**

**D**

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 16:**

aa. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle D were 50°, then the angle of incidence would be \_\_\_\_\_°.

**A**

**B**

**C**

**D**

a. 40 b. 50

c. Impossible to tell with just this information.

**Question 17:**

aa. A six-foot tall man stands in front of the mirror and views his image. Which statement describes the amount of mirror that the man needs to view his entire image?

a. The man needs more mirror to view his image when he is close and less when far away.

b. The man needs less mirror to view his image when he is close and more when far away.

c. The man needs three feet of mirror; it doesn’t matter whether he is close or far away.

d. The man needs six feet of mirror; it doesn’t matter whether he is close or far away.

**Question 18:**

aa. How much distance along a plane mirror would be required for a person to view his/her entire image in the mirror?

a. She needs an amount of mirror equal to her height.

b. She needs an amount of mirror equal to one-half her height.

c. The amount of mirror varies with the distance from it; more is needed when close.

d. The amount of mirror varies with the distance from it; more is needed when far away.

**Question 19:**

aa. A six-foot tall man stands 5 feet from a mirror that is 4-feet long. Where is the image of the man located?

a. The image is located three feet behind the mirror.

b. The image is located five feet behind the mirror.

c. The image is located six feet behind the mirror.

d. The image is located on the surface of the mirror.

**Question 20:**

aa. A five-foot tall man stands 6 feet from a mirror that is 4-feet long. Where is the image of the man located?

a. The image is located three feet behind the mirror.

b. The image is located five feet behind the mirror.

c. The image is located six feet behind the mirror.

d. The image is located on the surface of the mirror.

**Question 21:**

aa. Five students - Al (A), Bo (B), Cy (C), Di (D) and Ed (E) are sitting in front of the plane mirror in the physics classroom. Their positions are shown in the diagram below, along with their mirror image. Obie (O) the observer is looking in the mirror for the images of these students.

**A**

**B**

**C**

**D**

**EE**

**O**

Which students can Obie see? Bubble in the bubbles for any student that Obie can see?

a. Al (A) b. Bo (B)

c. Cy (C) d. Di (D)

e. Ed (E)

**Question 22:**

aa. Five students - Al (A), Bo (B), Cy (C), Di (D) and Ed (E) are sitting in front of the plane mirror in the physics classroom. Their positions are shown in the diagram below, along with their mirror image. Obie (O) the observer is looking in the mirror for the images of these students.

**B**

**C**

**D**

**E**

**OE**

**A**

Which students can Obie see? Bubble in the bubbles for any student that Obie can see?

a. Al (A) b. Bo (B)

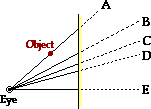
c. Cy (C) d. Di (D)

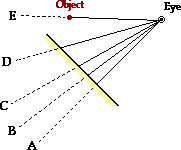
e. Ed (E)

**Question 23:**

aa. Consider the diagram at the right, Suzie is positioned in front of a mirror and viewing an object (a lit bulb) in the mirror. At which location must Suzie sight in order to view the image of the object?

**Question 24:**

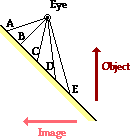
aa. Along which line of sight must the eye look in order to see the image of the object?



**Question 25:**

aa. Along which line of sight must the eye look in order to see the image of the object?

**Question 26:**

aa. An *arrow object* is positioned in front of a plane mirror as shown. Along which line of sight must the eye look in order to see the topmost part of the image (i.e., the arrowhead)?

**Question 27:**

aa. How is a real image different than a virtual image?

a. Real images are reduced in size; virtual images are magnified in size.

b. A real image is formed by reflection; a virtual image is formed by refraction.

c. A real image is located where light rays converge; virtual images form when light rays diverge.

**Question 28:**

aa. What do all real images (formed by mirrors) have in common?

a. They are magnified in size.

b. They are reduced in size.

c. They are located on the object's side of the mirror.

d. They are located behind the surface of a mirror.

**Question 29:**

aa. **TRUE** or **FALSE**:

A real image is formed in front of the mirror surface. A virtual image is formed on a mirror surface.

a. True b. False

**Question 30:**

aa. **TRUE** or **FALSE**:

A real image is formed in front of a mirror. A virtual image is formed behind a mirror.

a. True b. False

**Question 31:**

aa. **TRUE** or **FALSE**:

The image of an object as seen in a plane mirror is located upon the surface of the mirror.

a. True b. False

**Question 32:**

aa. **TRUE** or **FALSE**:

When a light ray undergoes diffuse reflection, the light ray does not follow the law of reflection.

a. True b. False

**Question 33:**

aa. **TRUE** or **FALSE**:

A real image is different than a virtual image in that a real image can be projected onto a screen.

a. True b. False

**Category 2: Refraction, Snell’s Law and Total Internal Reflection**

**Question 34:**

aa. When does refraction of light occur?

a. When light passes through a polarizing filter.

b. When light reaches a mirror or other reflecting surface.

c. When two light waves meet while moving along the same medium.

d. When light passes from one material to another material of a different density.

**Question 35:**

aa. Which statement describes what the refraction of light involves?

a. Refraction is the formation of a new wave having a different amplitude.

b. Refraction involves a change in direction of the path of light when crossing a boundary.

c. Refraction involves a change in direction of the path of light when reaching a reflecting surface.

**Question 36:**

aa. What is the cause of refraction?

a. The speeding up of a light wave.

b. The slowing down of a light wave.

c. The change in speed of a light wave.

**Question 37:**

aa. Light travels fastest in media that are \_\_\_\_\_.

a. less optically dense b. more optically dense

**Question 38:**

aa. Light travels slowest in media that are \_\_\_\_\_.

a. less optically dense b. more optically dense

**Question 39:**

aa. How does the optical density of the medium through which light travels related to the speed at which light travels?

a. Light travels slowest in the medium that is most optically dense.

b. Light travels fastest in the medium that is least optically dense.

c. The optical density of a medium has no affect upon the speed at which light travels.

**Question 40:**

aa. Light waves travel fastest in materials that have \_\_\_\_\_ index of refraction values.

a. low b. high

c. zero d. negative

**Question 41:**

aa. The higher the index of refraction value of a material, the \_\_\_\_\_ that light will travel in that material.

a. slower b. faster

**Question 42:**

aa. How is the index of refraction value of the medium through which light travels related to the speed at which light travels?

a. Light travels slowest in the materials with the highest index of refraction.

b. Light travels fastest in the materials with the highest index of refraction.

c. The index of refraction value has no affect upon the speed at which light travels.

**Question 43:**

aa. The speed of light is \_\_\_\_\_ in the most optically dense media; such media have a \_\_\_\_\_ index of refraction value.

a. slowest, low b. slowest, high

c. fastest, low d. fastest, high

**Question 44:**

aa. The speed of light is \_\_\_\_\_ in the least optically dense media; such media have a \_\_\_\_\_ index of refraction value.

a. slowest, low b. slowest, high

c. fastest, low d. fastest, high

**Question 45:**

aa. The higher the index of refraction value of a material, the \_\_\_\_\_ optically dense the material is and the \_\_\_\_\_ that light will travel in that material.

a. less, slower b. less, faster

c. more, slower d. more, faster

**Question 46:**

aa. The smaller the index of refraction value of a material, the \_\_\_\_\_ optically dense the material is and the \_\_\_\_\_ that light will travel in that material.

a. less, slower b. less, faster

c. more, slower d. more, faster

**Question 47:**

aa. Light travels faster in materials that have the \_\_\_\_\_ index of refraction value and are \_\_\_\_\_ optically dense.

a. highest, most b. highest, least

c. lowest, most d. lowest, least

**Question 48:**

aa. Light travels slower in materials that have the \_\_\_\_\_ index of refraction value and are \_\_\_\_\_ optically dense.

a. highest, most b. highest, least

c. lowest, most d. lowest, least

**Question 49:**

aa. Which two traits are characteristic of materials in which light travels relatively fast?

a. They have a low index of refraction value are very optically dense.

b. They have a high index of refraction value are very optically dense.

c. They have a low index of refraction value are NOT very optically dense.

d. They have a high index of refraction value are NOT very optically dense.

**Question 50:**

aa. When a light ray passes from a material in which it is traveling relatively slow into a material in which it travels faster, the light ray will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 51:**

aa. When a light ray passes from a material in which it is traveling relatively fast into a material in which it travels slower, the light ray will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 52:**

aa. When a light ray passes from one material into a less optically dense material, the light ray will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 53:**

aa. When a light ray passes from one material into a more optically dense material, the light ray will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 54:**

aa. When a light ray passes from a material with a low index of refraction into a material with a higher index of refraction, the light ray will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 55:**

aa. When a light ray passes from a material with a high index of refraction into a material with a lower index of refraction, the light ray will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 56:**

aa. When light passes from air (n=1.00) into water (n=1.33), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 57:**

aa. When light passes from air (n=1.00) into glass (n=1.50), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

a

**Question 58:**

a. When light passes from air (n=1.00) into flint glass (n=1.70), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 59:**

aa. When light passes from air (n=1.00) into zircon (n=2.10), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 60:**

aa. When light passes from air (n=1.00) into diamond (n=2.42), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 61:**

aa. When light passes from water (n=1.33) into air (n=1.00), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 62:**

aa. When light passes from glass (n=1.50) into air (n=1.00), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 63:**

aa. When light passes from flint glass (n=1.70) into air (n=1.00), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 64:**

aa. When light passes from zircon (n=2.10) into air (n=1.00), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 65:**

aa. When light passes from diamond (n=2.42) into air (n=1.00), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 66:**

aa. When light passes from water (n=1.33) into glass (n=1.50), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 67:**

aa. When light passes from water (n=1.33) into diamond (n=2.42), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 68:**

aa. When light passes from glass (n=1.50) into water (n=1.33), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 69:**

aa. When light passes from diamond (n=2.42) into water (n=1.33), the light will bend \_\_\_\_\_.

a. toward the normal line b. away from the normal line

c. in whichever direction it feels like

**Question 70:**

aa. Whenever light refracts at the boundary between two media, the angle that a light ray makes with the normal line will always be smallest in the medium \_\_\_\_\_.

a. where it travels slowest b. where it travels fastest

**Question 71:**

aa. Whenever light refracts at the boundary between two media, the angle that a light ray makes with the normal line will always be largest in the medium \_\_\_\_\_.

a. where it travels slowest b. where it travels fastest

**Question 72:**

aa. Whenever light refracts at the boundary between two media, the angle that a light ray makes with the normal line will always be smallest in the medium that is \_\_\_\_\_.

a. least optically dense b. most optically dense

**Question 73:**

aa. Whenever light refracts at the boundary between two media, the angle that a light ray makes with the normal line will always be largest in the medium that is \_\_\_\_\_.

a. least optically dense b. most optically dense

**Question 74:**

aa. Whenever light refracts at the boundary between two media, the angle that a light ray makes with the normal line will always be smallest in the medium that has the \_\_\_\_\_.

a. smaller index of refraction b. larger index of refraction

**Question 75:**

aa. Whenever light refracts at the boundary between two media, the angle that a light ray makes with the normal line will always be largest in the medium that has the \_\_\_\_\_.

a. smaller index of refraction b. larger index of refraction

**Question 76:**

aa. The diagram at the right shows a light ray passing across the boundary from \_\_\_\_\_.

Medium 1

Medium 2

a. a more dense to a less dense medium

b. a less dense to a more dense medium

c. Impossible to tell with this information.

**Question 77:**

aa. The diagram at the right shows a light ray passing across the boundary from \_\_\_\_\_.

Medium 1

Medium 2

a. a more dense to a less dense medium

b. a less dense to a more dense medium

c. Impossible to tell with this information.

**Question 78:**

aa. The diagram at the right shows a light ray passing across the boundary from a material where it travels relatively \_\_\_\_\_ into a material where it travels \_\_\_\_\_.

Medium 1

Medium 2

a. slow, faster

b. fast, slower

c. Impossible to tell with this information.

**Question 79:**

aa. The diagram at the right shows a light ray passing across the boundary from a material where it travels relatively \_\_\_\_\_ into a material where it travels \_\_\_\_\_.

Medium 1

Medium 2

a. slow, faster

b. fast, slower

c. Impossible to tell with this information.

**Question 80:**

aa. The diagram at the right shows a light ray passing across the boundary from a material with a relatively \_\_\_\_\_ index of refraction into a material with a \_\_\_\_\_ index of refraction.

Medium 1

Medium 2

a. low, higher

b. high, lower

c. Impossible to tell with this information.

**Question 81:**

aa. The diagram at the right shows a light ray passing across the boundary from a material with a relatively \_\_\_\_\_ index of refraction into a material with a \_\_\_\_\_ index of refraction.

Medium 1

Medium 2

a. low, higher

b. high, lower

c. Impossible to tell with this information.

**Question 82:**

aa. Consider the diagram at the right. Which medium is air (n = 1.00) and which medium is water (n=1.33)?

Medium 1

Medium 2

a. Medium 1 = Air, Medium 2 = Water

b. Medium 1 = Water, Medium 2 = Air

c. Impossible to tell with this information.

**Question 83:**

aa. Consider the diagram at the right. Which medium is air (n = 1.00) and which medium is water (n=1.33)?

Medium 1

Medium 2

a. Medium 1 = Air, Medium 2 = Water

b. Medium 1 = Water, Medium 2 = Air

c. Impossible to tell with this information.

**Question 84:**

aa. Consider the diagram at the right. Which medium is air (n = 1.00) and which medium is glass (n=1.50)?

Medium 1

Medium 2

a. Medium 1 = Air, Medium 2 = Glass

b. Medium 1 = Glass, Medium 2 = Air

c. Impossible to tell with this information.

**Question 85:**

aa. Consider the diagram at the right. Which medium is air (n = 1.00) and which medium is glass (n=1.50)?

Medium 1

Medium 2

a. Medium 1 = Air, Medium 2 = Glass

b. Medium 1 = Glass, Medium 2 = Air

c. Impossible to tell with this information.

**Question 86:**

aa. Consider the diagram at the right. Which medium is water (n = 1.33) and which medium is glass (n=1.50)?

Medium 1

Medium 2

a. Medium 1 = Water, Medium 2 = Glass

b. Medium 1 = Glass, Medium 2 = Water

c. Impossible to tell with this information.

**Question 87:**

aa. Consider the diagram at the right. Which medium is water (n = 1.33) and which medium is glass (n=1.50)?

Medium 1

Medium 2

a. Medium 1 = Water, Medium 2 = Glass

b. Medium 1 = Glass, Medium 2 = Water

c. Impossible to tell with this information.

Material A

Material B

**Question 88:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The more optically dense material is \_\_\_\_\_.

a. material A

b. material B

c. Impossible to tell with this information.

**Question 89:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The more optically dense material is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 90:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The least optically dense material is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 91:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The least optically dense material is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 92:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The light is traveling fastest in \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 93:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The light is traveling fastest in \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 94:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The light is traveling slowest in \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 95:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The light is traveling slowest in \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 96:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The material with the highest index of refraction is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 97:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The material with the highest index of refraction is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 98:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The material with the lowest index of refraction is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 99:**

aa. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The material with the lowest index of refraction is \_\_\_\_\_.

Material A

Material B

a. material A

b. material B

c. Impossible to tell with this information.

**Question 100:**

aa. Consider the refraction diagrams below for the refraction of light at the boundaries separating materials A, B and C.

Material A

Material B

Material A

Material C

How does the speed at which light travels in these three materials compare to one another?

a. In order: light travels fastest in A, second fastest in B and slowest in C.

b. In order: light travels fastest in B, second fastest in A and slowest in C.

c. In order: light travels fastest in C, second fastest in B and slowest in A.

d. In order: light travels fastest in C, second fastest in A and slowest in B.

**Question 101:**

aa. Consider the refraction diagrams below for the refraction of light at the boundaries separating materials A, B and C.

Material A

Material B

Material C

Material B

How does the speed at which light travels in these three materials compare to one another?

a. In order: light travels fastest in A, second fastest in B and slowest in C.

b. In order: light travels fastest in B, second fastest in A and slowest in C.

c. In order: light travels fastest in C, second fastest in A and slowest in B.

d. In order: light travels fastest in C, second fastest in B and slowest in A.