Section 11.2 Review
Partial Refraction and Total Internal Reflection

Multiple Choice ANSWERS

For each question below, select the best answer.

1. If a ray of light is incident on an air-to-glass boundary at an angle, which phenomenon will be observed?
   a. total reflection
   b. total refraction
   c. partial reflection and partial refraction
   d. partial reflection and total refraction
   e. total reflection and partial refraction

2. For total internal reflection to occur in an optical fibre, how must the speed of light in the optical fibre differ from the speed of light in the cladding?
   a. The speed of light must be faster in the optical fibre than in the cladding.
   b. The speed of light must be slower in the optical fibre than in the cladding.
   c. The speed of light must be the same in both the optical fibre and the cladding.
   d. The light in the optical fibre must start off slowly, and then reach its final speed in the cladding.
   e. The light in the optical fibre must start off fast, and then slow to its final speed in the cladding.

3. When light passes from one medium into a different one, the amount of reflection compared with the amount of refraction depends on what?
   a. the angle of incidence
   b. the indices of refraction of the two media
   c. the angle of refraction
   d. A and B
   e. A and C

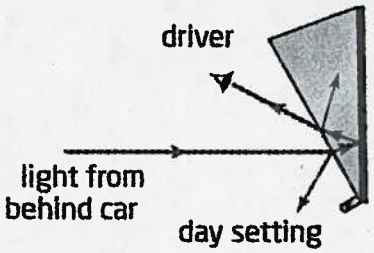
4. When light travels from air into water, and the angle of incidence is nearly zero, what happens to most of the light?
   a. It is refracted.
   b. It is reflected.
   c. It is dispersed.
   d. It is absorbed.
   e. It is lost.

5. As the angle of incidence increases for light travelling from air to water, what is *true* about the light?
   a. More and more light is refracted.
   b. More and more light is reflected.
   c. More and more light is dispersed.
   d. More and more light is absorbed.
   e. More and more light is lost.

6. When the Sun is directly above a pond, what happens to most of the light encountering the pond?
   a. It is refracted.
   b. It is reflected.
   c. It is dispersed.
   d. It is absorbed.
   e. It is lost.

7. You are standing by a pond at sunset. What happens to most of the light encountering the pond?
   a. It is refracted.
   b. It is reflected.
   c. It is dispersed.
   d. It is absorbed.
   e. It is lost.

8. The diagram below shows the setting of a rearview mirror in a car. In this setting, most of the light is going *into* the driver's eyes. At what time of day would the driver usually have the mirror at this setting?



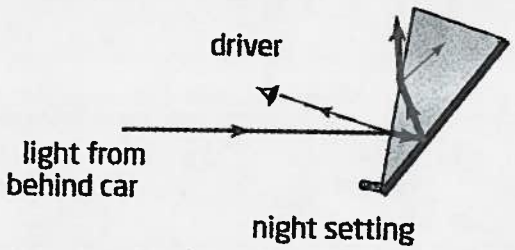
   a. midnight
   b. daytime
   c. evening
   d. nighttime
   e. not enough information given

Section 11.2 Review
Partial Refraction and Total Internal Reflection

Multiple Choice ANSWERS

For each question below, select the best answer.

9. The following diagram shows the setting of a rearview mirror in a car. In this setting, most of the light is going *away* from the driver's eyes. At what time of the day should the driver have the mirror at this setting?



a. 8:00 A.M.
b. daytime
c. noon
d. nighttime
e. not enough information given

10. When is a critical angle possible?
a. when light travels from a medium in which its speed is fast to a medium in which its speed is slow
b. when light travels from a medium in which its speed is slow to a medium in which its speed is fast
c. when light stays in the same medium
d. when light reflects
e. when light does not reflect

11. What is the critical angle?
a. the angle of incidence for which the angle of refraction is 0°
b. the angle of incidence for which the angle of refraction is 90°
c. the angle of refraction for which the angle of incidence is 0°
d. the angle of refraction for which the angle of incidence is 90°
e. 90°

12. When light passes from water into air, its critical angle is about 49°. What is *true* about all the light rays that have an angle of incidence greater than this angle?
a. They will be absorbed.
b. They will be totally reflected.
c. They will be partially reflected and partially refracted.
d. They will be totally refracted.
e. They will be lost.

13. Under which condition can total internal reflection happen?
a. when light travels from a slow medium to a fast medium
b. when light travels from a fast medium to slow a medium
c. when light travels in the same medium
d. when light bends
e. when light travels through a vacuum

14. On which principle is fibre optics based?
a. refraction
b. polarization
c. dispersion
d. total internal reflection
e. reflection

15. A cladding-free fibre optics cable ($n = 1.50$) is submerged in water ($n = 1.33$). In which medium should the light be incident for total internal reflection to take place in the cable?
a. the water
b. the cable
c. the air
d. none of the above because the cable is not in air
e. not enough information given

cladding must have a lower index of refraction than the core for T.I.R to occur

16. Which phenomenon allows light in a retroreflector to change direction by 180°?
a. refraction
b. polarization
c. dispersion
d. total internal reflection
e. reflection

Section 11.2 Review
Partial Refraction and Total Internal Reflection

Written Answer ANSWERS

Answer the following questions in your notebook.

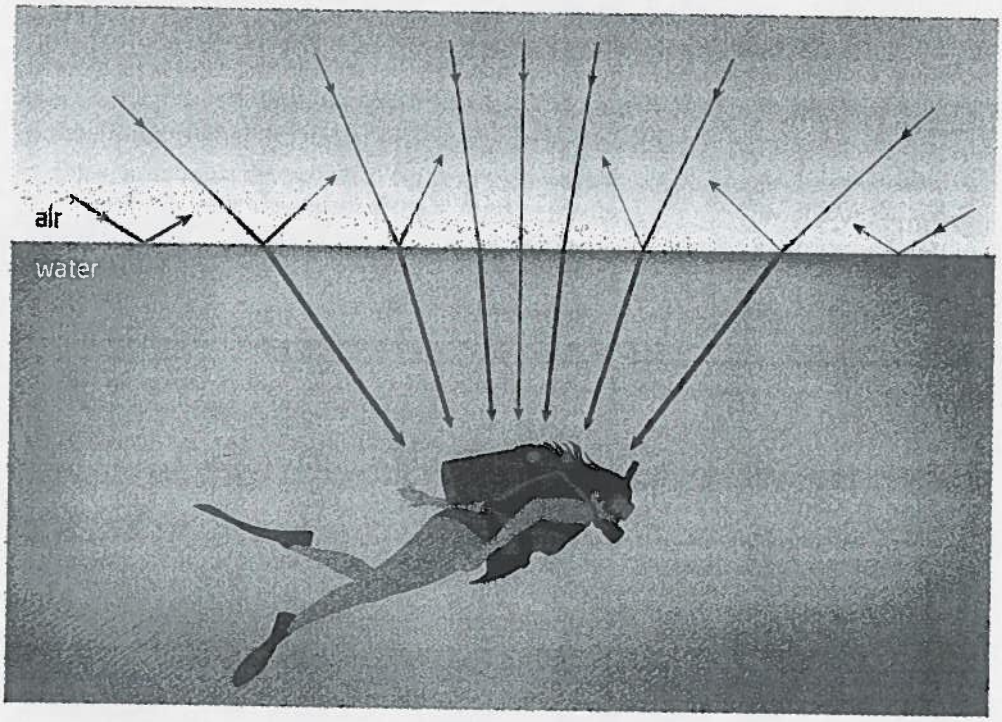
17. On what two factors does partial reflection depend?

$\angle i$, ① angle of incidence, ② indices of refraction, n

18. Why does the surface of water in a lake appear brighter at sunset than during the day?

$\angle i$ is greater late in the day ∴ more light is reflected

Use the following diagram to answer questions 19 and 20.



19. Explain why the swimmer would not be able to see any objects that are above the surface of the water and off to the side.

As $\angle i$ ↑, more of it is reflected ∴ the diver will be unable to see light from objects that are above & to the side

20. Explain why the swimmer would be able to see an object that is above the water and directly above her.

$\angle i$ is small & ∴ most of the light from the object penetrates the surface, refracts and reaches the diver.

21. How does total internal reflection occur?

$\angle i > \angle c$ (critical angle) which keeps all light in slower medium causing total internal reflection

22. Name three technologies that use total internal reflection.

binoculars, retroreflectors, optical fibres

23. What is the critical angle for light travelling from air to water?

No $\angle c$ b/c $n_{air} < n_{H_2O}$

24. How can you make light travel in circles?

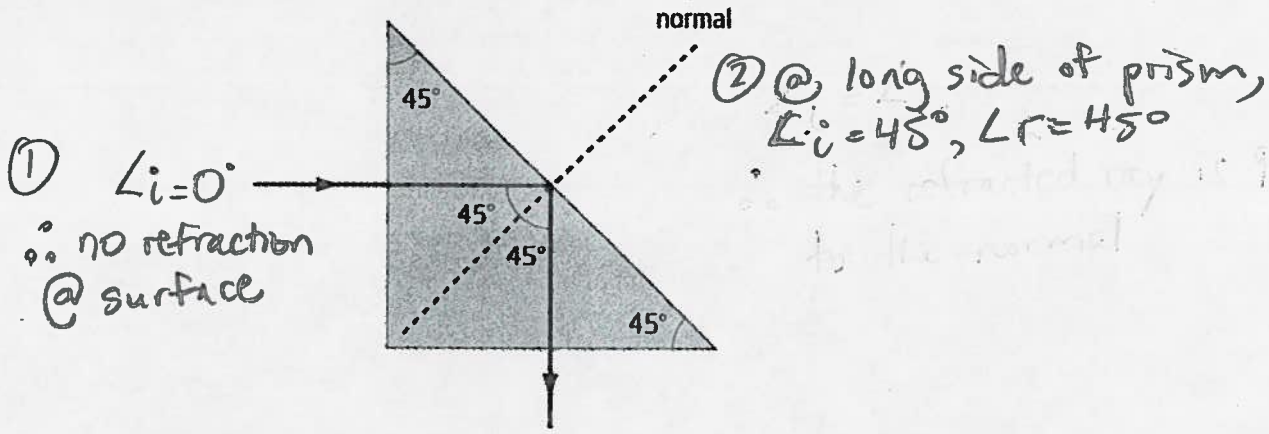
using total internal reflection

Section 11.2 Review
Partial Refraction and Total Internal Reflection

Written Answer ANSWERS

Answer the following questions in your notebook.

25. Describe how the ray of light changes direction in the following diagram.



26. How do retroreflectors apply the principle of total internal reflection to make it safer for a rider on a bicycle? car's headlights reflected by plastic prisms 180° back to the driver so that cyclists may be seen in the dark.

27. Name two uses of fibre optics technology.
telecommunications, endoscopy surgery

28. How does a rearview mirror work? They are wedge-shaped & silvered on the back. Light coming from behind the car hits the mirror @ a very small $\angle i$. ∴ most of the light is refracted & reaches silvered back of mirror, where it is reflected.

29. How are reflection and refraction used in a rearview mirror?
transparent glass wedge causes refraction to silvered back mirror where the light is reflected

30. How is reflection from the surface of a mirror different from reflection from the surface of water? All light is reflected off the surface of a mirror whereas some of the light is refracted through water ∴ not all light is reflected off the surface of the water

31. How is reflection from the surface of a mirror different from total internal reflection?
surface of mirror: one medium T.I.R: light travels from a slow medium to a faster mediu

32. For a swimmer, why does the light coming down from the air appear to come through a hole?
light from above that is off to the side of a swimmer creates a greater $\angle i$ and ∴ the majority of light off to the side is reflected and thus light directly above is not reflected but rather refracted to the swimmer which makes the light appear as though it is coming through a hole.