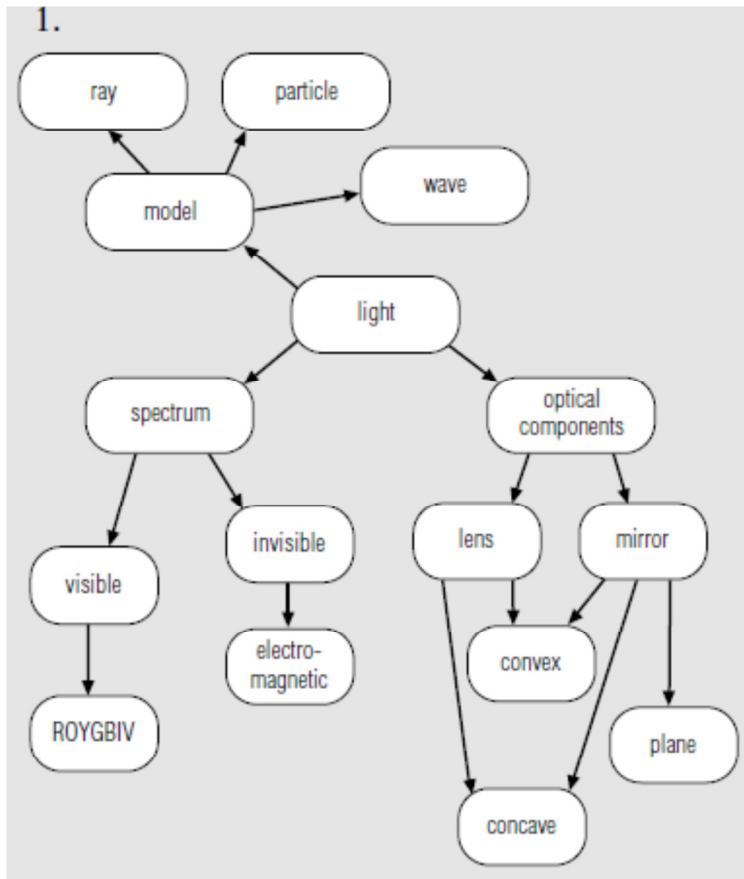


## UNIT 2 REVIEW ANSWERS, p. 236–237

Note: You may want to hand out BLM 2-38, LightConcept Map, for students to use in answering question 1.

### Visualizing Key Ideas



### Using Key Terms

2. (a) True

(b) False. The amplitude of a wave is the distance between the wave crest and the *equilibrium position*.

(c) True

(d) False. An opaque material does *not allow light to pass through*.

(e) False. In a mirror, the angle of incidence equals the angle of *reflection*.

(f) False. A *concave* mirror causes light rays to converge toward a focal point. Or: A convex mirror causes light rays to *diverge*.

(g) True

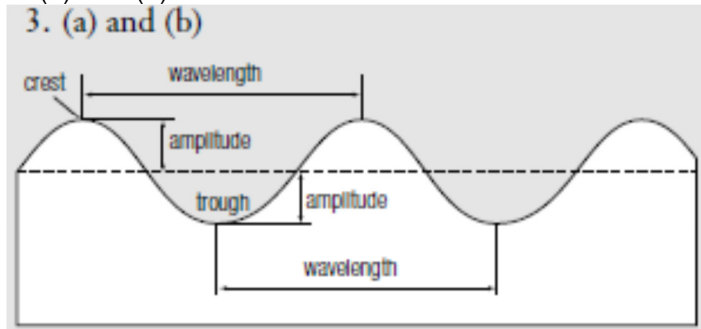
(h) False. Light passes through the eye in the following order: *cornea, pupil, lens, retina*.

(i) False. The blind spot occurs where the optic nerve *attaches to the retina*.

(j) False. A refracting telescope is made of a combination of *lenses*. Or: A *reflecting* telescope is made of a combination of lenses and mirrors.

### Checking Concepts

3. (a) and (b)



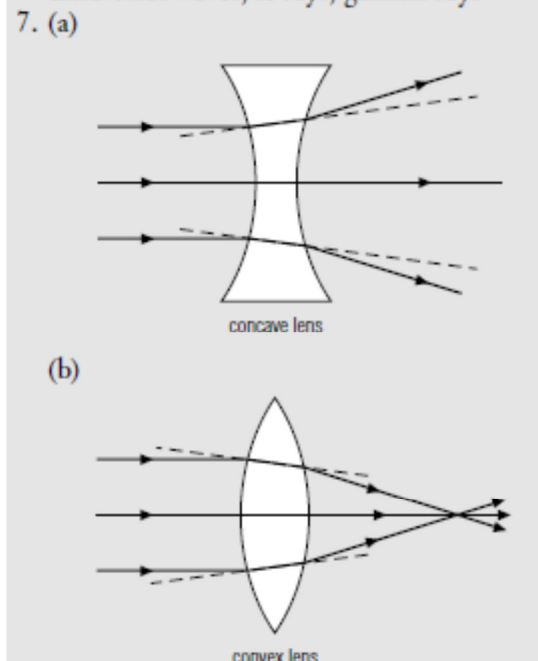
4. (a) The object is a prism.

(b) The prism causes the white light to separate into its component colours.

(c) Red, Orange, Yellow, Green, Blue, Indigo, Violet

5. An object that appears black absorbs all the light that falls on it, while an object that appears white reflects all the light.

6. Radio waves, infrared waves, visible light, ultraviolet waves, X rays, gamma rays



8. The wave front slows down when the light enters the glass. This causes the direction of the wave to change.

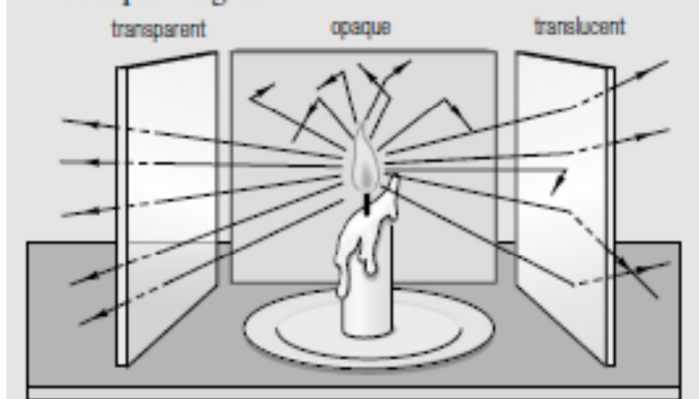
9. (a) Glass is denser than water.

(b) Light would be refracted more going from air into glass than from air into water.

10. (a) Reflection is a process in which light bounces off of a surface, while refraction is a process in which light passes through a surface into a transparent material of a different density.

(b) Both reflection and refraction cause the path of a light ray to be altered.

11. Sample diagram:

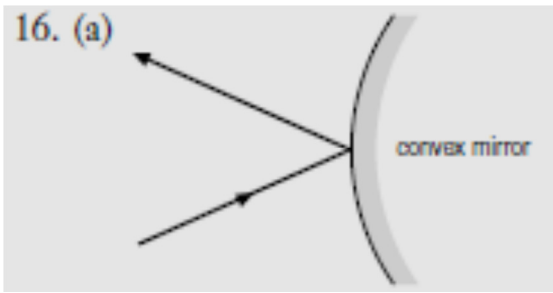


12. To determine the angle of reflection, draw the normal at the point on the surface where the light ray strikes. Determine the angle of incidence, which is the angle between the incident ray and the normal. The angle of incidence is also the angle of the reflection on the other side of the normal.

13. The focal point is the place where converging rays meet or from which light rays diverge. The focal length is the distance from the centre of a lens or mirror to the focal point.

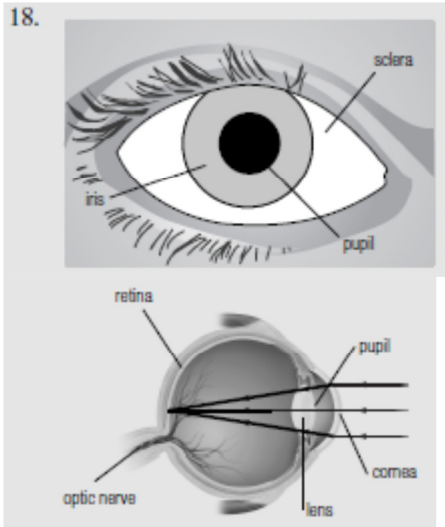
14. The thicker the convex lens, the shorter the focal length.

15. Light shining off a small metallic ball is an example of divergence. All the light rays that reflect off it move farther apart as they continue on their paths.



(b) A convex mirror is used because it shows a wider view of the scene.

17. The candle was moved from nearly two focal lengths away to slightly more than one focal length away from the lens.



19. At twilight, the cone cells do not receive enough light to give a colour image; however, the black and white detecting rod cells can produce a grey image.

20. (a) The cornea and the lens focus light in the eye.

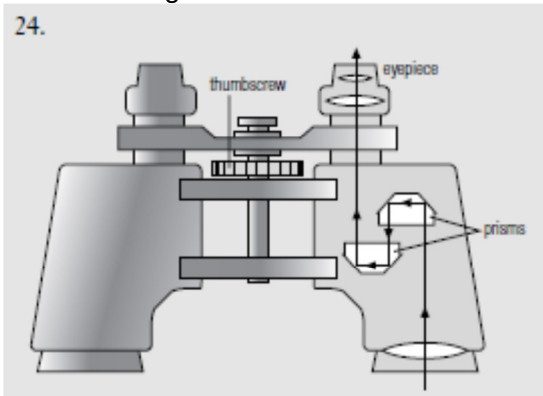
(b) The cornea does the most focussing.

21. When the eye focusses on a nearby object, the lens is very round. When the eye focusses on a distant object, the shape of the lens becomes flatter.

22. Four common defects in human vision include:

- Near-sightedness: the ability to see near objects clearly, but distant objects are fuzzy
- Far-sightedness: the ability to see distant objects clearly, but close objects are fuzzy
- Astigmatism: the inability to form a clear image or the tendency to form multiple blurry images
- Colour blindness: the ability to distinguish some colours but not others.

23. Refracting telescopes and microscopes both use two lenses. However, the lens in a telescope has a longer focal length than in a microscope because the objects viewed are far from the lens. In both devices an objective lens collects the light and focusses it into an image, which is magnified by the eyepiece lens.



25. Light from a laser is more concentrated than ordinary light from a bulb. This is because all the waves are the same wavelength and the crests and troughs are all lined up.

## Understanding Key Ideas

27. Light rays reflecting off a white wall with a rough surface bounce back in random directions, similar to the way light comes through a translucent material. The scattering of rays means that no image forms. In contrast, light reflecting off a mirror bounces back in a regular way, allowing an image to form.

28. Using the wave model, ultraviolet light has a shorter wavelength and higher frequency than infrared light.

29. Light moving as a wave through space is a disturbance in electric and magnetic fields, which can exist even in empty space. The wave transfers energy without causing any permanent displacement.

30. Students' answers may vary but may be similar to the following examples:

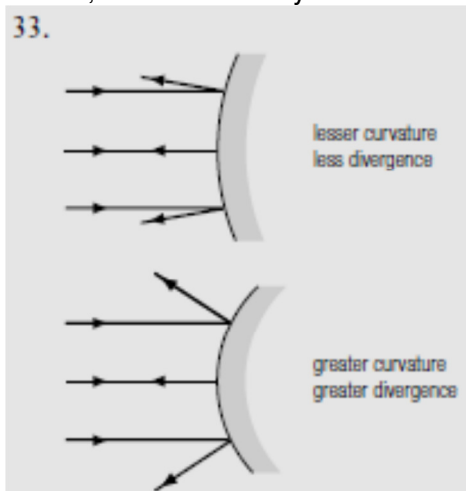
- X rays are absorbed better by bone than by tissue. This allows an image of a skeleton to be formed. Very sensitive X-ray procedures can also differentiate between different types of tissues.
- Radio waves are used in conjunction with strong magnets to make an image of different tissues and bones. The technique is called MRI or magnetic resonance imaging.

31. Instruments that can cause light rays to converge are:

– those based on convex lenses, such as a simple magnifying glass, or more complex arrangements, such as refracting telescopes and microscopes.

– those based on concave lenses, such as the astronomical telescopes

32. The normal is an imaginary line that is perpendicular to the surface at the point where a light ray strikes it. In a mirror, the angle between the incident ray and the normal equals the angle of the reflected ray and the normal. For lenses, the refracted ray bends towards the normal.



34. A concave mirror can reflect light rays through a focal point. These rays can then diverge until they hit a screen, forming an image. Because the convex mirror causes light rays to diverge, no image is formed.

35. The denser the transparent material, the greater its ability to refract light.

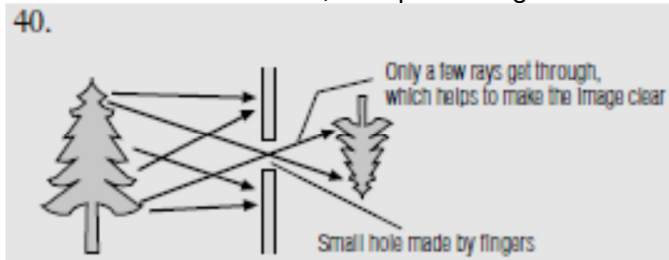
36. Students' answers may vary. Sample answer: The inability to detect red could cause a difficulty distinguishing between red and green traffic lights.

37. Very large lenses are extremely heavy and also absorb a lot of light. Very large mirrors do not have these problems to the same extent. This makes large mirrors more useful in astronomical telescopes than large lenses.

38. Colour vision is detected by three kinds of cone cells, each of which detects a different part of the visible spectrum. When the three colours are received by the brain, the brain constructs a colour image from them. Black and white is detected by rod cells, which are very sensitive to dim light but do not distinguish any differences between different colours.

## Thinking Critically

39. If no refraction occurs, the speed of light must be the same in both the water and the plastic.



41. (a) Green is denser than blue because the light is refracted away from the normal.

(b) The green material would make a better lens than the blue material because the green material causes greater refraction.

42. With half of the lens covered, almost all of the image would be formed, but it would be only about half as bright.

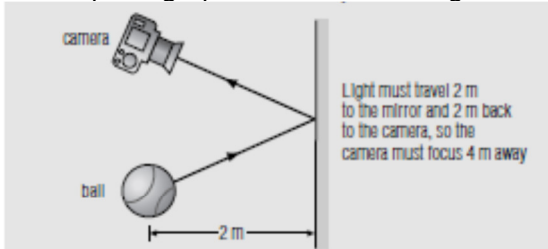
43. Most of the focussing is done by the cornea as light passes from the air into the cornea. If the cornea is covered by water, a lesser amount of refraction occurs and focussing does not happen correctly. Swimmers use a mask to hold air against their eyes.

44. (a) A telescope collects the light and focuses it onto a detector or into the eye of a viewer. To preserve the image, the mirror must be flat so that the light rays still travel in a regular way after reflection.

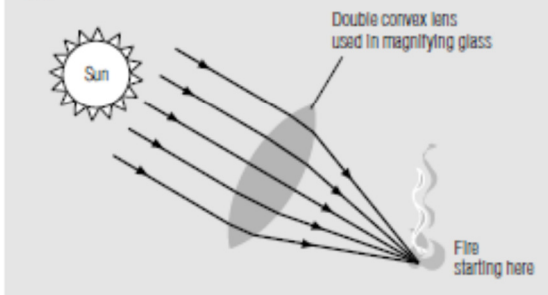
(b) A round mirror would cause reflected light rays to be scattered, which would prevent an image from forming.

45. Students' answers may vary, but could be similar to the following: Telescopes allow remote viewing of dangerous places such as volcanoes, as well as of wildlife. All astronomy is done with some sort of telescope.

46. To photograph the reflected image of an object that is 2 m in front of a mirror, the camera must focus 4 m away.



47.



### Developing Skills

48. (a) Frequency of middle C is  $524/2 \text{ s} = 262 \text{ Hz}$

(b) Frequency of A below middle C is  $660/3\text{s} = 220 \text{ Hz}$