Name Date

Answers

Science Links 10 Workbook Answers

Unit 4 Light and Applications of Optics

Using Your Appendices, page 108

1. So other people can understand what the diagram represents. Examples may vary.
2. The lines are not straight and the wheel labels are reversed.
3. Drawings will vary. Drawings should be clear, accurate, and have labels.

Topic 4.1 What is light and how is it produced?

Reading Check, page 111

1. Incandescence is the light that hot objects emit. Luminescence is the light that unheated objects emit.
2. wavelength

Cloze Activity, page 112

1. energy
2. incandescence
3. luminescence
4. energy
5. chemiluminescence
6. incandescent
7. wave
8. wavelength
9. electromagnetic waves
10. electromagnetic spectrum
11. wavelength
12. visible light

Comprehension, page 113

1. Technology that produces incandescence uses heat to produce the light. Technology that produces luminescence does not use heat.
2. Both technologies transfer a form of energy into light energy.
3. **a)** incandescence
   b) luminescence

c) incandescence
d) incandescence or luminescence
e) luminescence
f) luminescence
g) incandescence
h) luminescence
i) luminescence
j) incandescence
k) incandescence
l) incandescence
m) luminescence
n) incandescence
o) incandescence
p) luminescence
q) luminescence

Interpreting Illustrations, page 114

1. Students should label a length equal to the distance between adjacent peaks.
2. **a)** 2
   b) 3
   c) 1
   d) 4
3. radio waves: 5
   X rays: 1
   visible: 3
   infrared: 4
   ultraviolet: 2
4. They are the only waves with that specific wavelength and the only waves that we can see.

Assessment, page 115

1. E
2. D
3. B
4. A
5. C

6. Answers may vary. For example:
   a) fire, incandescent light bulb
   b) computer monitor, glow stick
7. Diagrams should be similar to the wave diagram on page 111 of the workbook.
8. The distance from peak to peak in a wave.
9. red light

Topic 4.2 How does light interact with objects to give them colour?

Reading Check, page 117

1. reflection, absorption, and transmission
2. A transparent object transmits all or most light with no change in direction.
   A translucent object transmits some light and scatters it in different directions.
   An opaque object reflects or absorbs light.
3. An object's colour is determined by the colours that it absorbs, reflects, or transmits.

Cloze Activity, page 118

1. reflection
2. transmission
3. absorption
4. ray
5. transparent
6. opaque
7. translucent
8. reflect, absorb
9. transparent, translucent
10. transparent
11. translucent
12. opaque

Comprehension, page 119

1. **a)** White light is reflected to the eye.
   b) All light is absorbed by the black print, so no light reflects to the eye.

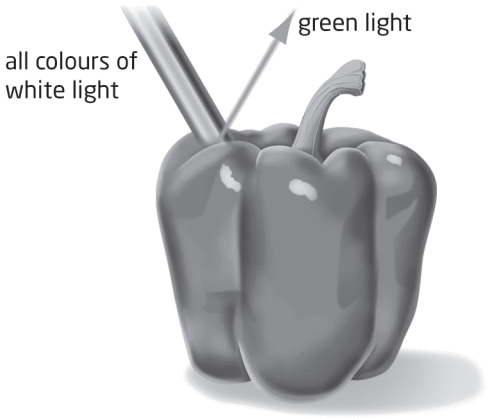
2. a) absorption, reflection
b) absorption
c) reflection, transmission
d) reflection, transmission

3. a) opaque
b) opaque
c) opaque
d) translucent
e) transparent
f) transparent
g) transparent
h) translucent

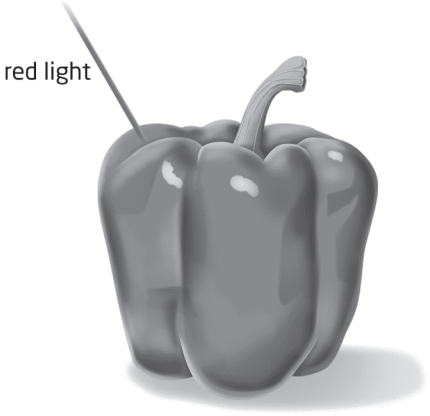
Illustrating Concepts, page 120

1. a) opaque

b)



2. The pepper would be black because the light would not be reflected.



3. a) Diagrams should show light rays passing through in a straight line. All colours of light enter the window and only yellow light leaves.
b) yellow

4. **a)** Diagrams should show some light rays passing through the window, but bending in different directions. All colours of light enter the window and only yellow light leaves.
   b) yellow

Assessment, page 121

1. D
2. G
3. A
4. C
5. F
6. E
7. B
8. **a)** The black print absorbs all the white light, so no light (black) is reflected to the eye.
   b) Diagrams should resemble the diagram on page 119 of the workbook.
9. **a)** An opaque object's colour is determined by the colours that it **absorbs** and **reflects**.
   b) When a transparent object has a certain colour, it **transmits** and **reflects** that colour and **absorbs** all other colours.

Topic 4.3 How can you mix colours to make different colours?

Reading Check, pages 122–123

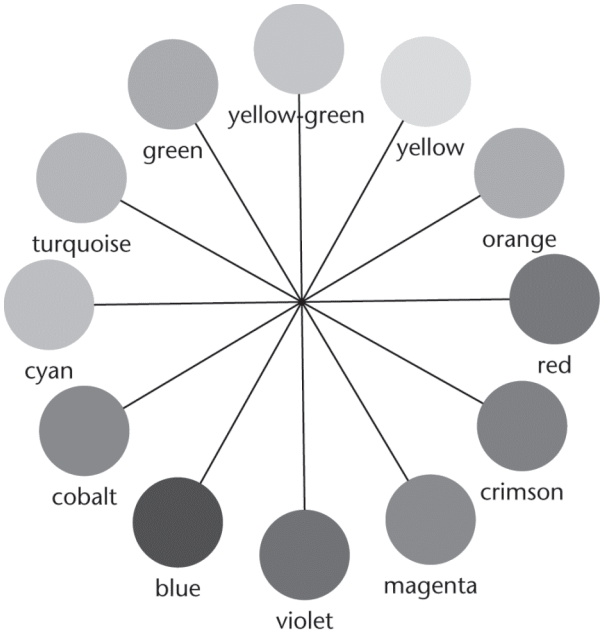
1. red, blue, green
2. cyan, magenta, yellow
3. red and cyan, blue and yellow, green and magenta
4. cyan, magenta, yellow
5. red, blue, green
6. on opposite sides

Comprehension, page 124

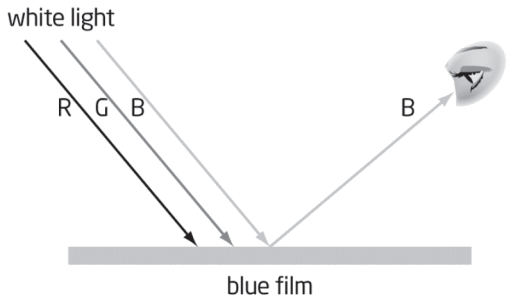
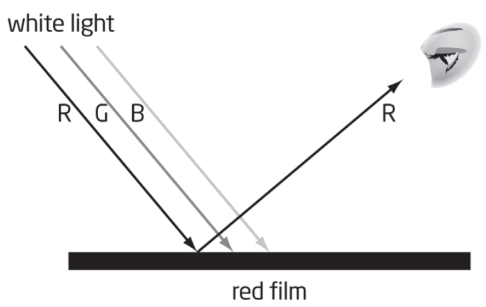
1. **a)** The additive primary colours are **red**, **blue**, and **green**. These colours are the same as the subtractive **secondary** colours.
   b) The subtractive primary colours are **cyan**, **magenta**, and **yellow**. These colours are the same as the additive **secondary** colours.
2. **a)** magenta
   b) cyan
   c) white

d) white
e) magenta
f) cyan
g) black
h) black

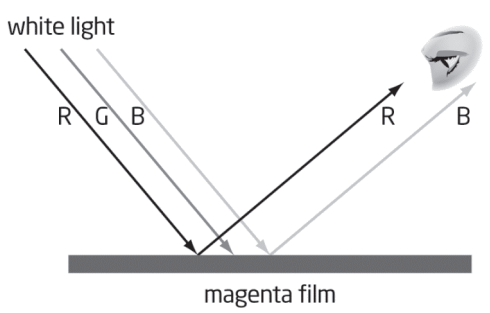
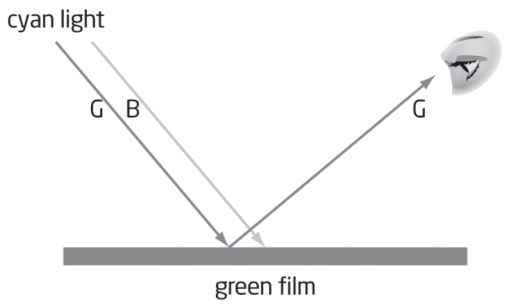
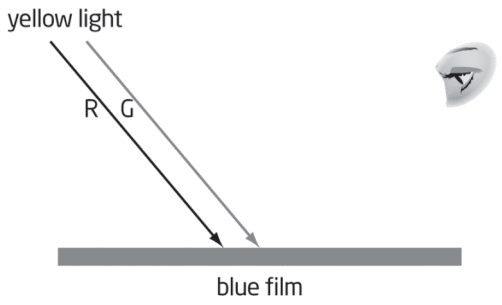
3.



Illustrating Concepts, page 125

	Colour(s) absorbed	Colour(s) reflected	Colour equation
a) 	red, green	blue	W – (R + G) = B
b) 	green, blue	red	W – (G + B) = R

Name Date

	Colour(s) absorbed	Colour(s) reflected	Colour equation
c) 	green	red, blue	W – G = M
d) 	blue	green	C – B = G
e) 	red, green	none	Y – B = K

Applying Concepts, page 126

1. red and blue
2. blue, then yellow, then red
3. Blue and yellow will produce white light, since yellow light is a combination of green and red.
4. yellow and red, then yellow, then yellow and red

Assessment, page 127

1. B
2. F
3. D
4. C
5. E

6. **a)** magenta
   b) cyan
   c) white
   d) magenta
   e) cyan
   f) black
   g) red
7. Combine two primary additive colours to get a primary subtractive colour. Combine two primary subtractive colours to get a primary additive colour.
8. **a)** Diagrams should show red and green light reflecting.
   b) W – B = Y

Topic 4.4 What is the law of reflection and how do mirrors form images?

Reading Check, page 128–129

1. The angle of incidence equals the angle of reflection.
2. location, orientation, size, and type
3. A plane mirror has a smooth, flat surface. A concave mirror caves inward at the centre. A convex mirror bulges outward at the centre.

Cloze Activity, page 130

1. incidence, reflection
2. incident ray
3. normal
4. normal
5. virtual
6. concave
7. convex
8. plane
9. principal axis
10. focal length
11. centre of curvature
12. virtual
13. real

Illustrating Concepts, pages 131

1. Diagrams should show an object 2 cm from a plane mirror and its image.
   Location: equal to object distance
   Orientation: upright
   Size: same as object
   Type: virtual
2. Diagrams should show an object 4 cm from a plane mirror and its image.
   Location: equal to object distance
   Orientation: upright
   Size: same as object
   Type: virtual
3. When the object's location changed, the image's location changed. All other image characteristics stayed the same.

Illustrating Concepts, pages 132

1. Diagrams should show an object 2 cm tall and 4 cm from the mirror, and its image.
   Location: longer than object distance
   Orientation: inverted
   Size: larger than original
   Type: real
2. The image in question 1 is real because the object is between the **focal point** and the **centre of curvature**. If it had been between the **mirror** and the **focal point**, it would have been a virtual image.

Illustrating Concepts, pages 133

1. Diagrams should show an object 6 cm tall and 5 cm from a convex mirror, and its image.
   Location: shorter than object distance
   Orientation: upright
   Size: smaller than original
   Type: virtual

Applying Knowledge, page 134

1. **a)** plane mirror
   b) convex mirror
   c) concave mirror; object is between focal point and centre of curvature
   d) concave mirror; object is between mirror and focal point

2. a) concave mirror; enlarge image
b) plane mirror; show actual size
c) convex mirror; enlarge field of view
d) concave mirror; focus the light
e) concave mirror; send light from the bulb out in parallel rays
f) convex mirror; enlarge field of view

Assessment, page 135

1. D
2. E
3. C
4. L
5. M
6. B
7. G
8. K
9. I
10. A
11. H
12. J
13. Diagrams should resemble the diagram on page 128 of the workbook.
14. location, orientation, size, and type

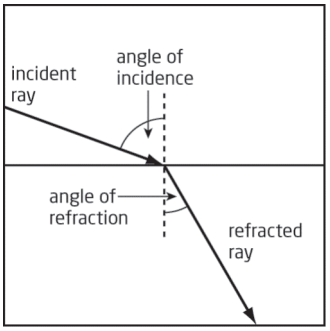
Topic 4.5 What is refraction and how can it be used?

Reading Check, page 136

1. Refraction occurs because light travels at different speeds in different media.
2. As it passes from a medium in which it travels slowly into a medium in which it travels quickly.
3. fibre optics communications

Illustrating Concepts, page 137

1.



2. a) Ray should bend toward the normal.

b) Ray should bend away from the normal.

c) Ray should bend away from the normal.

d) Ray should bend toward the normal.

3. a) From air to glass, the ray should bend toward the normal. From glass to air, the ray should bend away from the normal.

b) Any time the ray travels from air or water to glass, or from air to water, it should bend toward the normal. When the ray travels from glass to water or from glass to air, it should bend away from the normal.

Applying Knowledge, page 138

1. a) From air to glass, the ray should bend significantly toward the normal. From glass to water, the ray should bend slightly away from the normal.

b) Light bends toward the normal going from air to glass, then bends away from normal going from glass to water, but the final angle of refraction is still smaller than the original angle of incidence.

2. Shine a light through each liquid, one at a time, at the same angle of incidence. Compare the angles of refraction.

Assessment, page 139

1. E

2. F

3. C

4. A

5. Diagrams may vary. The angle of incidence in the ice should be greater than the angle of refraction in the water.

6. Light travels more quickly in Lucite because the angle of incidence in the Lucite is greater than the angle of refraction in the glass.

Topic 4.6 What are lenses and what are some of their applications?

Reading Check, pages 140–141

1. A lens is a thin, transparent piece of glass or plastic that has at least one curved side.
2. A converging (convex) lens makes light rays come together. A diverging (concave) lens makes light rays move apart.
3. The location and size of the object.
4. When the object is between the lens and a focal point.

Comprehension, page 142

1. There is a focal point on each side since the lens has two curved surfaces.
2. **a)**, **b)** Diagrams should resemble the converging lens diagram on page 140.
3. **a)** iii
   b) i
   c) ii
4.

Images Produced by a Converging Lens			
Object location	**Image orientation**	**Image size**	**Image type**
Between lens and focal point	upright	larger than object	virtual
Beyond focal point	inverted	varies	real

Illustrating Concepts, page 143

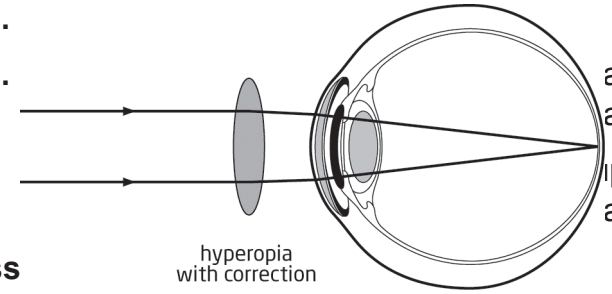
1. **a)** Location: between *F* and 2*F*, opposite side of lens
   Orientation: inverted
   Size: smaller than original
   Type: real
   b) Location: at 2*F*, opposite side of lens
   Orientation: inverted
   Size: same as original
   Type: real
   c) Location: beyond 2*F*, opposite side of lens
   Orientation: inverted
   Size: larger than original
   Type: real
   d) Location: beyond *F*, same side of lens
   Orientation: upright
   Size: larger than original
   Type: virtual

Name Date

Applying Knowledge, page 144

1.

2. arger than the object, and between F_1 and F_2.
age: inverted



pright, and larger than the object.
age: upright (compared to original)

Ass

1. A

2. B

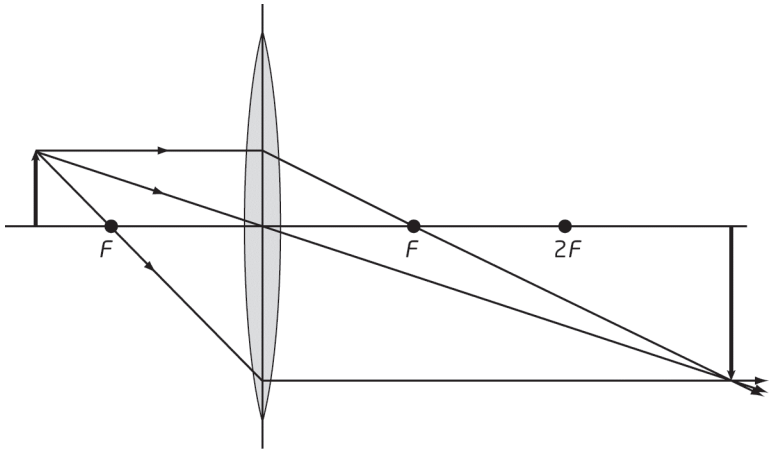
3. A

4. A

5. B

6. Toward the focal point.

7. a)



b) Size: 2 cm tall
Location: 6 cm from lens, opposite side of lens
Orientation: inverted
Type: virtual

8. Size: Increases as the object approaches the focal point, decreases after the object passes the focal point.

Orientation: Inverted as the object approaches the focal point, upright after the object passes the focal point.

9. Between the lens and the focal point.

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Literacy Test Preparation, page 147

1. A

2. C

3. A

4. D

5. Summaries should include information about the processes used to produce colours in fireworks, include a topic sentence, and be written in paragraph form.