1. **Section 4.3:** 1, 2, 3, 14, 18

1. See back of book.
2. \( \triangle ABC \sim \triangle ZXY \) by SSS similarity.

14. If the outermost square has side length \( x \), then the triangle in the upper left corner of that square is a 45-45-90 triangle with leg \( \frac{1}{2} x \), so the length of its hypotenuse is \( \frac{\sqrt{2}}{2} x \). The same ratio applies going from the middle square to the small square, so the side length of the small square is \( \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{2} x = \frac{1}{2} x \). Thus, the ratio is \( \frac{1}{\sqrt{2}} \).

18. (a) If \( \angle A \) is acute, then \( \triangle ABE \sim \triangle ACF \) (note typo) by AA since they both have a right angle and they share \( \angle A \). If \( \angle A \) is obtuse, the same criterion applies, but it applies with supplements to \( \angle A \) rather than \( \angle A \) itself. (If we have a right triangle, then \( A = E = F \).)

(b) Consider the third figure from Exercise 17. Take \( BC \) as the diameter of a circle. Since \( m\angle BEC = 90 \) and \( m\angle CFB = 90 \), both \( B \) and \( F \) lie on this circle. Note that \( \angle FCB \) and \( \angle FEB \) open onto the same angle, so \( \angle FCB \cong \angle FEB \). Similarly, \( \angle FBE \cong \angle FCE \). Now \( \angle AEB \) (a right angle) is exterior to \( \triangle BEC \), so \( 90 = m\angle AEF + m\angle FEB = m\angle AEB = m\angle ECB + m\angle EBC = m\angle ECF + m\angle FCB + m\angle EBC \). Thus \( m\angle AEF + m\angle FCB = m\angle ECF + m\angle FCB + m\angle EBC \) by substitution, so \( m\angle AEF = m\angle ECF + m\angle EBC = m\angle FBE + m\angle EBC = m\angle ABC \). Thus by Exercise 17, \( \triangle AFE \sim \triangle ACB \).

2. **Section 4.5:** 1, 3, 12, 15, 22

1. See back of book.

12. (a) \( m\angle 2 = 180 - 2\theta = m\angle 1 \) (by the Inscribed Angle Theorem). The complement of minor arc \( \overarc{DB} \) is a semicircle along with minor arc \( \overarc{BC} \). Thus, \( m\angle 3 = 180 - (90 + m\angle 1) = 2\theta - 90 \). Finally, \( m\angle 4 = 180 - m\angle 3 - \theta = 270 - 3\theta \).

(b) If \( m\angle 3 = 60 \), we get \( \theta = 75 \).

15. See back of book.

22. (a) This follows immediately from the Pythagorean Theorem.

(b) Let \( x = PO \). Then we wish to know for which values of \( x \) do we get \( x^2 - r^2 = k \). This will occur if \( x^2 = k + r^2 \), or \( x = \sqrt{k + r^2} \). Thus, the distance from \( P \) to \( O \) must be a constant, so the set of points desired is another circle centered at \( O \).
3. **Section 4.8: 4, 10**

4. We have \[ \frac{AF}{FB} \cdot \frac{BD}{DC} \cdot \frac{CE}{EA} = \frac{AX}{XB} \cdot \frac{BD}{DC} \cdot \frac{CE}{EA} \]. Thus \[ \frac{AF}{FB} = \frac{AX}{XB} \]. Assigning coordinates

\[ a, b, f, \text{ and } x \] in the obvious way, we find \[ \frac{f - a}{b - f} = \frac{x - a}{b - x} \], so \[ fb - f x - ab + ax = bx - ab - fx + fa \]. Thus \[ fb + ax = bx + fa \], giving \[ f(b - a) = x(b - a) \]. Therefore, \[ f = x \], so \[ F = X \].

10. See the page in my box. (Please don’t take it, though!)