1. We can solve this problem by using similar triangles several times or by using reflections to turn the path into a line segment. Using reflections, the equation of line OA is \( y = \frac{4x}{5} \), when \( x = 16 \), \( y = \frac{64}{5} \), so point A is \((16, \frac{64}{5})\). Since point B is \((16, 12)\), the length AB is 4/5. Thus the length CD is also 4/5 and point C is \((0, \frac{16}{5})\).

2. If one leg of right triangle has length 15 and the lengths of the hypotenuse \( a \) and other leg \( b \) are integers, we need to find all of the integer solutions to the equation
\[
a^2 - b^2 = 15^2 = 225 \Rightarrow (a - b)(a + b) = 15^2.
\]
Thus, since \( a + b > a - b \) we know that \( a + b \) is either 25, 45, 75 or 225 and, correspondingly, \( a - b \) is 9, 5, 3 or 1.
Solving the four systems of equations gives the four ordered pairs \((17, 8), (25, 20), (39, 36)\) and \((113, 112)\) for \((a, b)\).

3. If we think of the five dice as being in order then there are \(6^5 = 7776\) possible ways that the dice could be rolled. Of these, there are \(6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 = 120\) ways to roll the dice so that no number is repeated. Hence the probability that at least two of the dice will have the same number is
\[
1 - \frac{720}{7776} = 1 - \frac{5}{54} = \frac{49}{54}.
\]

4. Let \( A = x + x^2 + x^3 + x^4 \). Then, since \( x^5 = 1 \), we know \( xA = x^2 + x^3 + x^4 + x^5 = x^2 + x^3 + x^4 + 1 = A + 1 - x \). Solving \( xA = A + 1 - x \) gives \( A = \frac{1 - x}{x - 1} = -1 \).

5. Let \( a = x + y \) then \( x^2 + y^2 + x + y = 8 \) becomes \( a^2 + a - 2b = 8 \). Solving we get \( b = 5 - a \) and \( a^2 + a - 18 = 0 \). Solving this equation we obtain either \( a = 3 \) and \( b = 2 \), or \( a = -6 \) and \( b = 11 \). The second pair gives nonreal values for \( x \) and \( y \). The first pair gives \( x = 2 \) and \( y = 1 \) or \( x = 1 \) and \( y = 2 \).

6. If \( x \) is the number of steps from second to third base then \( 18 - 7 + 3 - 5 + 11 - 4 = \frac{x}{2} \). Thus \( x/2 = 16 \) and \( x = 32 \) steps.

7. Let \( \theta = \angle CAB \), then \( \theta = \tan^{-1}(1/2) \), so \( \angle DAB = 5^\circ + \tan^{-1}(1/2) \) and
\[
DB = 200 \tan(5^\circ + \tan^{-1}(1/2)) \text{ feet.}
\]
\[
DC = 200 \tan(5^\circ + \tan^{-1}(1/2)) - 100 \approx 22.87 \text{ feet.}
\]
To the nearest foot the height of the antenna is 23 feet.

8. The centers of the five spheres form a pyramid. Each of the triangular faces of the pyramid is an equilateral triangle with side length 4 feet. The altitude of each of these triangular faces is \( 2\sqrt{3} \) feet. The apex of the pyramid is therefore \( \sqrt{(2\sqrt{3})^2 - 2^2} = \sqrt{8} = 2\sqrt{2} \) feet above the base of the pyramid, and the top of the fifth sphere is \( 4 + 2\sqrt{2} \) feet above the level surface.