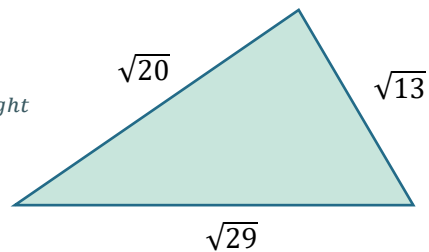Week 2 Seminar: Geometry puzzles

1. An ant starts at one vertex of a solid cube with side length 1. Calculate the distance of the shortest route the ant can take to the furthest vertex from the starting point.
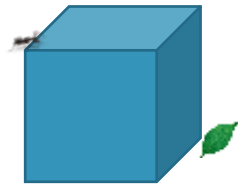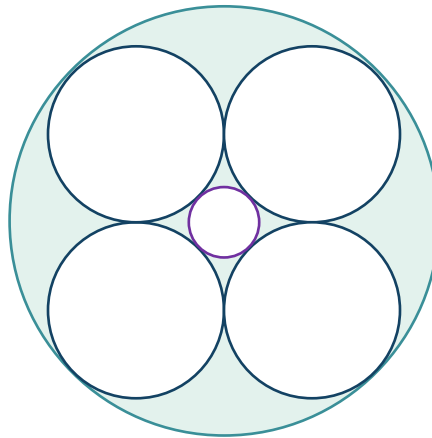

2. Find the area of this triangle:
   Hint: the area of a triangle is given by $\frac{1}{2}base \times height$
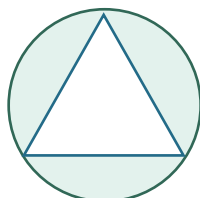

3. If the outer circle in the diagram below is a unit circle (i.e. radius 1), find the radius of the smallest circle.
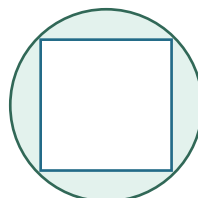

4. What is the volume of the largest cube that fits entirely within a sphere of unit volume?
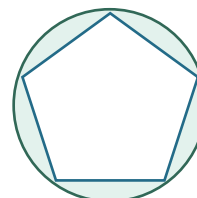   Hint: remember that the volume of a sphere is given by $\frac{4}{3}\pi r^3$

5. What is the area of an n-sided regular polygon inscribed within a circle of radius r?

$n = 3$ $n = 4$ $n = 5$

Week 2 Seminar: Geometry puzzles

6. A straight tree trunk has a circular cross section of radius n, where n is an integer. A second straight, circular tree trunk has radius m, where m is also an integer. Both tree trunks rest on the (level, horizontal) ground, adjacent and parallel to one another.
   a. Derive the general condition relating the radii of the two trunks that permits their centres to be an integer distance d apart when the circumferences touch.
   b. Give the three smallest solutions for n when $m = 1$.
   c. Give a general solution for n and m.