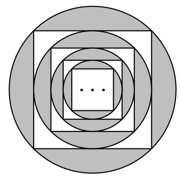
Directions: You may work to solve these problems in groups, but all written work must be your own. **Show your work**; See "Guidelines and advice" on the course webpage for more information.

1. An infinite series of nested circles and squares are drawn, all sharing a common center point. The outermost circle has radius 1. The space between each circle and the square it circumscribes is shaded. What is the total area of the shaded regions?



2. [S 1.5.1] A fly is resting on the front of a train that is hurtling forward at 60 kilometers per hour. On the same track, 300 kilometers straight ahead, another train is hurtling towards the first train at 60 kilometers per hour. At that moment, when the trains are 300 km apart, the fly takes off at 90 km per hour. He continually flies back and forth between the trains, flying just above the track and instantaneously turning around when he reaches a train. What is the total distance traveled by the fly before the two trains crash together, squishing the fly between them in the process? How did you figure this out? Try to generalize the situation to when the trains are initially d km apart, one train travels at a km/hr, the other at b km/hr, and the fly at c km/hr.

3. A geometric argument.

   (a) Let p, q, and r be three points in the plane that are not collinear (i.e. there is no single line containing all three points). Prove that there is a circle whose circumference contains p, q, and r.

   (b) Let T be a triangle in the plane. Show that the perpendicular bisectors of triangle all meet at a common point. *Hint: use part (a).*