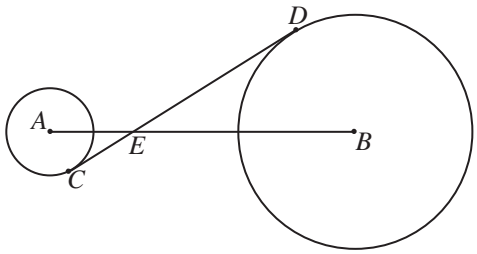
1. Spot's doghouse has a regular hexagonal base that measures one yard on each side. He is tethered to a vertex with a two-yard rope. What is the area, in square yards, of the region outside the doghouse that Spot can reach?

   (A) $\frac{2}{3}\pi$ **(B)** 2π **(C)** $\frac{5}{2}\pi$ **(D)** $\frac{8}{3}\pi$ **(E)** 3π

2. Odell and Kershaw run for 30 minutes on a circular track. Odell runs clockwise at 250 m/min and uses the inner lane with a radius of 50 meters. Kershaw runs counterclockwise at 300 m/min and uses the outer lane with a radius of 60 meters, starting on the same radial line as Odell. How many times after the start do they pass each other?

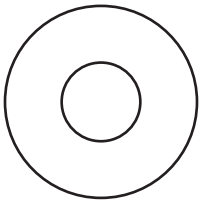
   (A) 29 **(B)** 42 **(C)** 45 **(D)** 47 **(E)** 50

3. Circles with centers A and B have radii 3 and 8, respectively. A common internal tangent touches the circles at C and D, as shown. Lines AB and CD intersect at E, and $AE = 5$. What is CD?



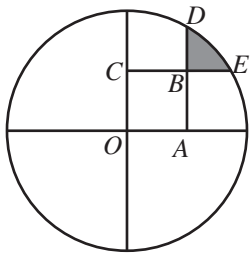
   (A) 13 **(B)** $\frac{44}{3}$ **(C)** $\sqrt{221}$ **(D)** $\sqrt{255}$ **(E)** $\frac{55}{3}$

4. Circles of diameter 1 inch and 3 inches have the same center. The smaller circle is painted red, and the portion outside the smaller circle and inside the larger circle is painted blue. What is the ratio of the blue-painted area to the red-painted area?



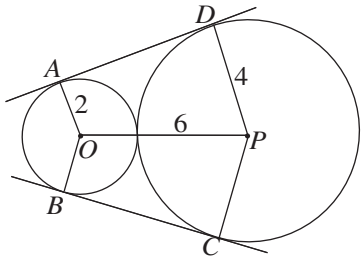
   (A) 2 **(B)** 3 **(C)** 6 **(D)** 8 **(E)** 9

5. A circle of radius 2 is centered at O. Square $OABC$ has side length 1. Sides $\overline{AB}$ and $\overline{CB}$ are extended past B to meet the circle at D and E, respectively. What is the area of the shaded region in the figure, which is bounded by $\overline{BD}$, $\overline{BE}$, and the minor arc connecting D and E?



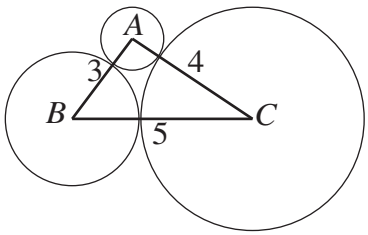
   (A) $\frac{\pi}{3} + 1 - \sqrt{3}$ **(B)** $\frac{\pi}{2}(2 - \sqrt{3})$ **(C)** $\pi(2 - \sqrt{3})$ **(D)** $\frac{\pi}{6} + \frac{\sqrt{3} - 1}{2}$ **(E)** $\frac{\pi}{3} - 1 + \sqrt{3}$

6. Circles with centers at O and P have radii 2 and 4, respectively, and are externally tangent. Points A and B on the circle with center O and points C and D on the circle with center P are such that $\overline{AD}$ and $\overline{BC}$ are common external tangents to the circles. What is the area of the concave hexagon $AOBCPD$?



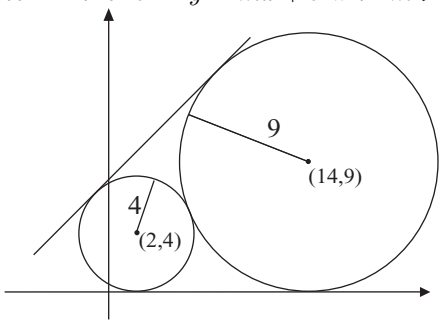
(A) $18\sqrt{3}$ **(B)** $24\sqrt{2}$ **(C)** 36 **(D)** $24\sqrt{3}$ **(E)** $32\sqrt{2}$

7. The vertices of a $3-4-5$ right triangle are the centers of three mutually externally tangent circles, as shown. What is the sum of the areas of these circles?



(A) 12π **(B)** $\dfrac{25\pi}{2}$ **(C)** 13π **(D)** $\dfrac{27\pi}{2}$ **(E)** 14π

8. Circles with centers $(2,4)$ and $(14,9)$ have radii 4 and 9, respectively. The equation of a common external tangent to the circles can be written in the form $y = mx + b$ with $m > 0$. What is b?



(A) $\dfrac{908}{119}$ **(B)** $\dfrac{909}{119}$ **(C)** $\dfrac{130}{17}$ **(D)** $\dfrac{911}{119}$ **(E)** $\dfrac{912}{119}$