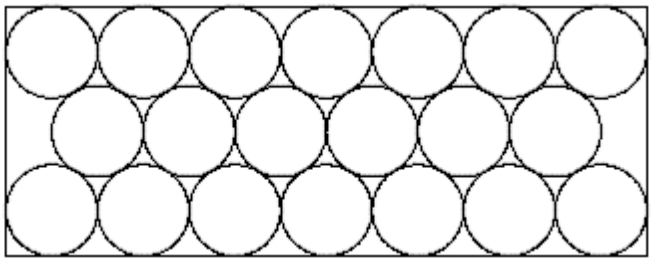
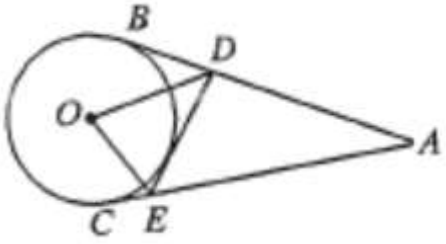
Assign 18 Math Challengers: Challenging Circle geometry Problems:

1. The diagram shows twenty congruent circles arranged in three rows and enclosed in a rectangle. The circles are tangent to one another and to the sides of the rectangle as shown in the diagram. The ratio of the longer dimension of the rectangle to the shorter dimension can be written as $\frac{1}{2}\left(\sqrt{p}-q\right)$, where "p" and "q" positive integers. Find "p" and "q"

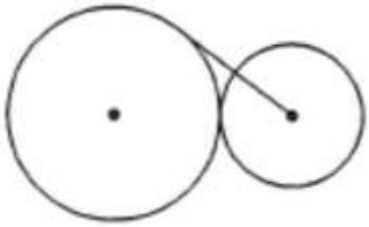


2. In the diagram, AB, AC and DE are tangents to the circle. If $\angle A = 20°$, what is the value of



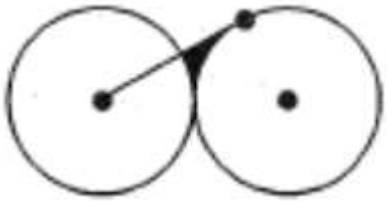
$\angle DOE$?

3. Two circles are externally tangent as shown. A tangent line is drawn to the larger circle from the centre of the smaller circle. The lines has a length of 2. If the larger circle has a diameter of 3, what is the radius of the smaller circle?

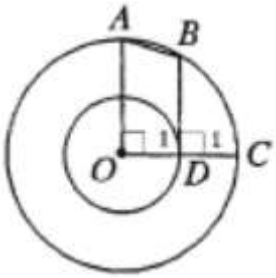


4. The perimeter of triangle APM is 152, and angle $\angle PAM = 90°$ A circle of radius 19 with center "O" on AP is drawn so that it is tangent to $\overline{AM}$ and $\overline{PM}$. Given that OP=m/n, where "m" and "n" are relatively prime positive integers, find the value of "m+n"

5. Two externally tangent circles are congruent. A line is drawn from the center of one circle and is tangent to the other. If the length of this line segment is 12, what is the area of the shaded region as shown? Note: it is the area bounded between the tangent and the two circles:



6. Two concentric circles have "O" as their common center". The smaller circle has a radius of 1 and the larger circle has a radius of 2. Both AO and BD are perpendicular to OC. What is $\angle BAO$?



7. Circles "C1" and "C2" intersect at two points, one of which is (9,6), and the product of their radii is 68. The x-axis and the line y=mx, where m>0, are tangent to both circles. It is given that "m" can be written in the form of $\frac{a\sqrt{b}}{c}$, where "a", "b", and "c" are positive integers, "b" is not divisible by the square of any prime, and "a" and "c" are relatively prime. Find $a+b+c$.

8. Triangle ABC is isosceles with AC=BC and $\angle ACB = 106°$. Point "M" is in the interior of the triangle so that $\angle MAC = 7°$ and $\angle MCA = 23°$. Find the number of degrees of $\angle CMB$. (Challenge)

9. In the diagram (Not Drawn to scale) CD is a diameter of circle "O". If arc ED is a $50°$ arc, and $\angle EAD = 50°$, what is $\angle DAB$? {Note: All points which look collinear, are collinear} (Challenge)