

1. A sequence of concentric circles is drawn so that each has half the radius of the one preceding it. Find the ratio of the area of the first circle to that of the  $n$ th one (for an arbitrary natural number  $n$ ).

2. Let  $y = (x - a)^2 + (x - b)^2$ , where  $a$  and  $b$  are constants. Find the minimum value of  $y$  and the value of  $x$  at which the minimum occurs.

3. If three of the roots of  $x^4 + ax^2 + bx + c = 0$  are 1, 2, and 3, find the value of  $a + c$

4. The average (arithmetic mean) age of a group consisting of doctors and lawyers is 40. If the doctors average 35 and lawyers 50 years old, find the ratio of the number of doctors to the number of lawyers.

5. Two congruent  $30^\circ - 60^\circ - 90^\circ$  triangles are placed so that they overlap partly and their hypotenuses coincide. If the hypotenuse of each triangle is 12cm, find the area common to both triangles.

6. In  $\triangle ABC$  with right angle at  $C$ , altitude  $CH$  and median  $CM$  trisect the right angle. If the area of  $\triangle CHM$  is  $K$ , find the area of  $\triangle ABC$ , in terms of  $k$ .

7. If  $x$  is real and  $4y^2 + 4xy + x + 6 = 0$ . Find the complete set of values  $x$  for which  $y$  is real.

8. A parabolic arch has a height of 16 inches and a span of 40 inches. Find the height, in inches, of the arch at a point 5 inches from the center M.