

# Circles

It is quite easy to decide if two circles touch or overlap from their equations.

Consider the two circles

$$(x-2)^2 + (y+3)^2 = 49$$

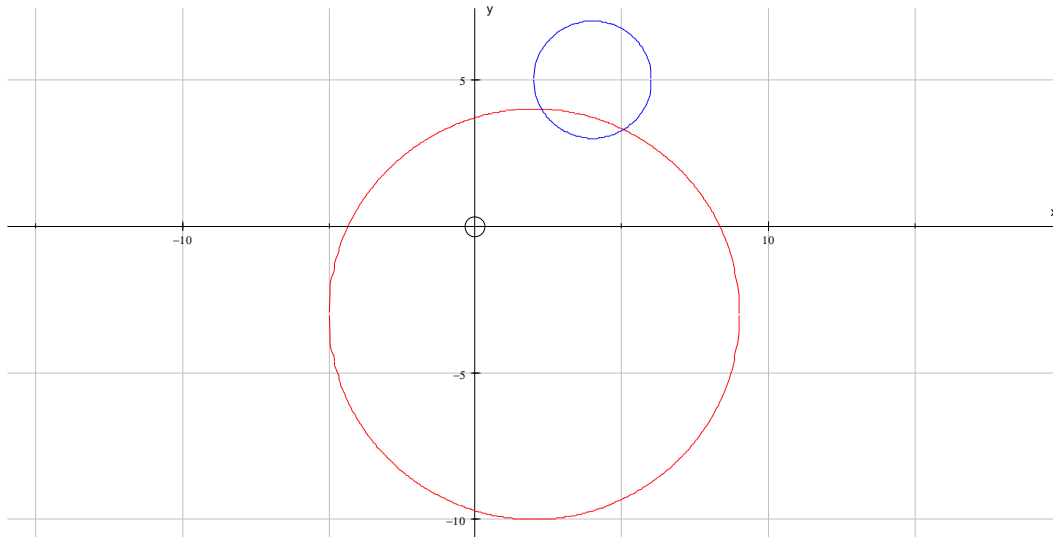
$$(x-4)^2 + (y-5)^2 = 4$$

Since their centres are at the points with coordinates  $(2, -3)$  and  $(4, 5)$  then the distance between their centres is

$$\sqrt{(4-2)^2 + (5-(-3))^2} = \sqrt{2^2 + 8^2} = \sqrt{68}$$

The radii of the two circles are 7 and 2.

Since  $7+2 > \sqrt{68}$  the two circles do cross, as can be seen below:



You should find that these circles do not cross:

$$(x-4)^2 + (y+1)^2 = 9$$

$$(x+1)^2 + (y-2)^2 = 4$$

These circles touch externally:

$$(x-2)^2 + (y-1)^2 = 9$$

$$(x-6)^2 + (y-4)^2 = 4$$

and these circles touch internally (i.e. one circle is inside the other):

$$(x-2)^2 + (y+3)^2 = 144$$

$$(x+4)^2 + (y-5)^2 = 4$$