DIRECTIONS: If the graph of the given equation is a circle, find its center and radius. If the equation has no graph, say so.

1. $x^2 + y^2 = -8y$
   
   $x^2 + (y + 4)^2 = 16$
   Center: (0, -4)
   Radius: 4

2. $x^2 + y^2 - 4x + 2y - 4 = 0$

   $(x - 2)^2 + (y + 1)^2 = 9$
   Center: (2, -1)
   Radius: 3

DIRECTIONS: Find the center and radius of each circle (Hint: First divide both sides by the coefficient of the second-degree terms).

3. $9x^2 + 9y^2 + 6x + 18y + 9 = 0$

   $\left(x + \frac{1}{3}\right)^2 + (y + 1)^2 = \frac{1}{9}$
   Center: (-\frac{1}{3}, -1)
   Radius: \frac{1}{3}

4. $3x^2 + 3y^2 - 6x + 24y + 24 = 0$

   $(x - 1)^2 + (y + 4)^2 = 9$
   Center: (1, -4)
   Radius: 3

DIRECTIONS: Find an equation of the circle (in standard form) that is described (Hint: It may be helpful to sketch a graph of the circle).

5. Center(0, 5); the circle passes through the point(0, 0).

   $x^2 + (y - 5)^2 = 25$

6. Center(-2, 0); the circle passes through the point(2, 0).

   $(x + 2)^2 + y^2 = 16$

7. A diameter of the circle has endpoints (2, 5) and (0, 3).

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

8. The center is in Quadrant II; the radius is 3; the circle is tangent to the $y$-axis at (0, 4).

   $(x + 3)^2 + (y - 4)^2 = 9$

9. The center is on the line $y - 4 = 0$; the circle is tangent to the $x$-axis at (-2, 0).

   $(x + 2)^2 + (y - 4)^2 = 16$

10. The center is on the line $x + y = 4$; the circle is tangent to both coordinate axes.

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

11. The circle is tangent to both coordinate axes and the line $x = -8$ (there are two answers).

    $(x + 4)^2 + (y - 4)^2 = 16$ or $(x + 4)^2 + (y + 4)^2 = 16$