Name: _____   Date: _____

Section 4.4 The Quadratic Relation
$y = a(x - h)^2 + k$

1. For each parabola
  i) identify the coordinates of the vertex
  ii) determine whether a is positive or negative

a)

b)

c)
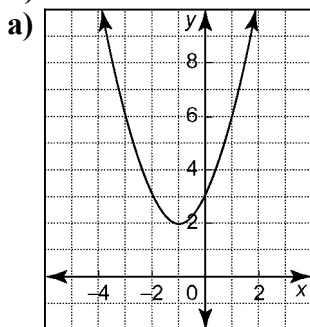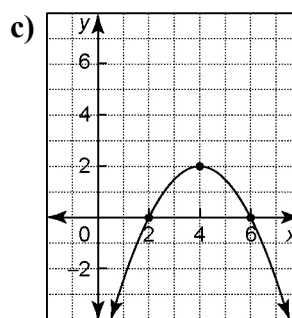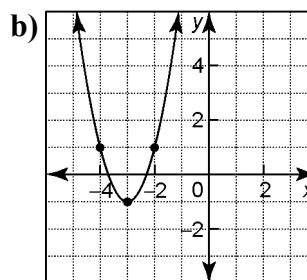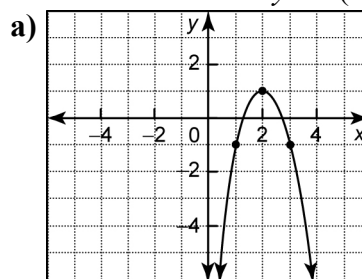
d)
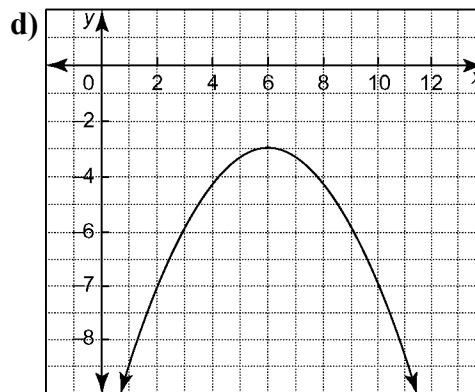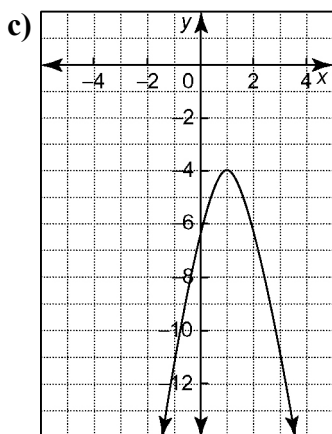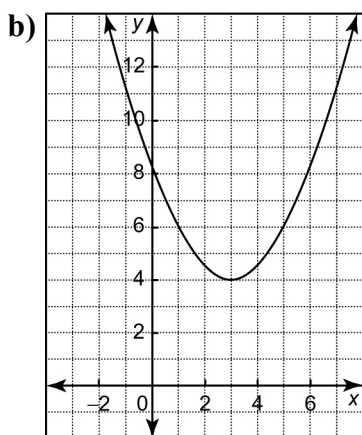
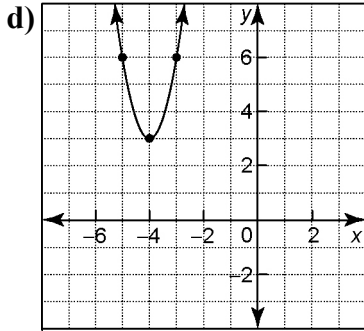**2.** Identify the coordinates of the vertex for each parabola, then write the equation of the relation in the form $y = a(x - h)^2 + k$.

a)

b)

c)

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d)

3. For each relation
- identify the coordinates of the vertex
- determine if the parabola opens upward or downward
- determine whether the parabola is vertically stretched or vertically compressed
- sketch the graph

a) $y = 3(x - 2)^2 + 4$
b) $y = -0.3(x + 1)^2 - 3$
c) $y = -2(x - 3)^2 + 1$
d) $y = 3.5(x + 5)^2 + 2$
e) $y = -0.5(x - 3)^2 - 2$
f) $y = 4x^2 + 1$

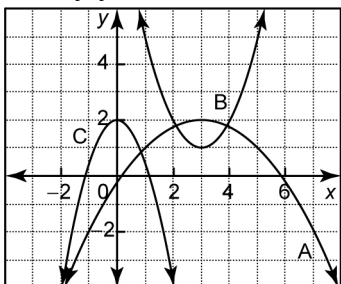**4.** Graph each quadratic relation.
a) $y = 2(x - 3)^2 + 1$
b) $y = 0.5(x + 4)^2 - 5$
c) $y = -4(x - 8)^2 + 1$
d) $y = -0.3(x + 1)^2 + 2$

5. An architect has designed a building with a roof that has a cross section in the shape of a parabolic arch. The shape of the arch can be modelled by the relation $y = -0.25(x - 3)^2 + 2$. Which graph represents the shape of the arch? Justify your answer.

6. A flare is launched into the air. The path of the flare can be modelled by the relation $h = -0.1(d - 10)^2 + 25$, where h is the height of the flare and d is the horizontal distance of the flare from where it was fired, both in metres.
a) What is the vertex of the relation, and what do these coordinates represent?
b) From what initial height was the flare fired?
c) Graph of the path of the flare for $d = 0$ to $d = 26$.

7. A baseball is hit in the air. Its path can be modelled by the relation $h = -2(d - 4)^2 + 33$, where h is the height of the ball and d is the horizontal distance, both in metres.
a) What is the vertex of this relation?
b) What is the maximum height of the ball?
c) What is the height of the ball when it has travelled a horizontal distance of 6 m?
d) What do the coordinates of the vertex represent in this situation?

8. The parabola $y = x^2$ is transformed. Write the relation of each transformed parabola in the form $y = a(x - h)^2 + k$.
a) The parabola is vertically stretched by a factor of 2.
b) The parabola is vertically stretched by a factor of 3, translated 5 units right and 4 units up.
c) The parabola is vertically compressed by a factor of 0.5, reflected in the x-axis, translated 4 units left and 3 units down.

9. A hotel can rent all 600 rooms at $72 per night. Market research has shown that for every $4 increase in price, 10 fewer rooms will be rented. This situation can be modelled by the relation $R = -40(x - 21)^2 + 60\ 840$ where R is revenue and x represents the number of $4 increases in the price.
a) What is the vertex of the parabola?
b) What do the coordinates of the parabola represent?
c) What is the price to rent a room when the maximum revenue is obtained?