Name ______________________________

Translations; Stretches and Shrinks

Remember

1. A **vertical translation** is the result of adding a constant to or subtracting a constant from the function $y = f(x)$.

   For $c > 0$: $\boldsymbol{y = f(x) + c}$ is the graph of $y = f(x)$ shifted up c units.
   $\boldsymbol{y = f(x) - c}$ is the graph of $y = f(x)$ shifted down c units.

2. A **horizontal translation** is the result of adding a constant to or subtracting a constant from the x-value of the function $y = f(x)$.

   For $c > 0$: $\boldsymbol{y = f(x - c)}$ is the graph of $y = f(x)$ shifted right c units.
   $\boldsymbol{y = f(x + c)}$ is the graph of $y = f(x)$ shifted left c units.

3. A **vertical stretch or shrink** is the result of multiplying the function $y = f(x)$ by a constant.

   $\boldsymbol{y = c \cdot f(x)}$ is the graph of $y = f(x)$
   stretched vertically for $|c| > 1$ and shrunken vertically for $0 < |c| < 1$.

   For $c < 0$, the graph is also reflected across the x-axis.

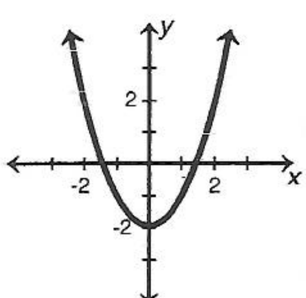
4. A **horizontal stretch or shrink** is the result of multiplying the x-value of the function $y = f(x)$ by a constant.

   $\boldsymbol{y = f(c \cdot x)}$ is the graph of $y = f(x)$
   shrunken horizontally for $|c| > 1$ and stretched horizontally for $0 < |c| < 1$.

   For $c < 0$, the graph is also reflected across the y-axis.

Write an equation to show how each of the graphs that follow can be obtained by translating, stretching, or shrinking a basic graph.

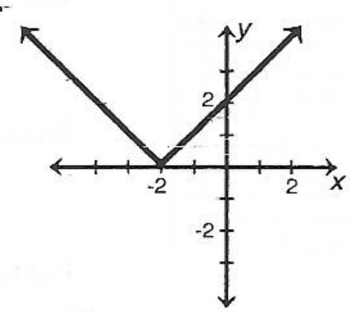
a.



$y =$ $x^2 - 2$

D

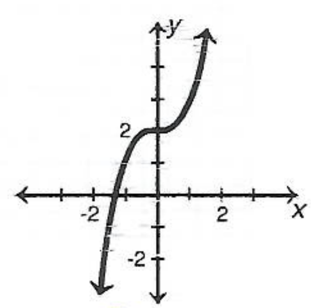
b.



$y =$ $|x + 2|$

E

c.



$y =$ $x^3 + 2$

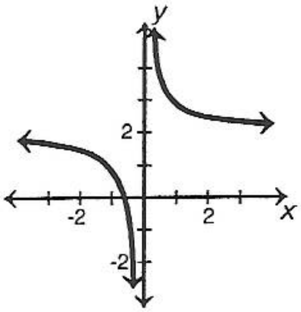
S

continued on page 9

Name ______________________

Translations; Stretches and Shrinks

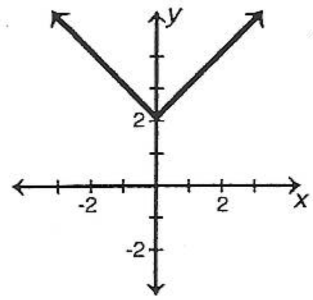
d.



$y = \frac{1}{x} + 2$

C

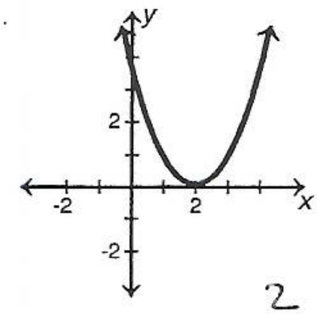
e.



$y = |x| + 2$

A

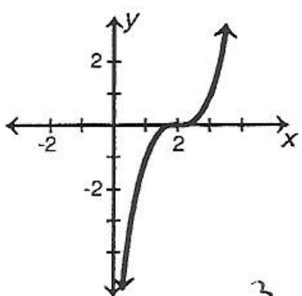
f.



$y = (x-2)^2$

R

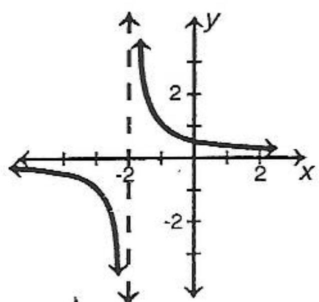
g.



$y = (x-2)^3$

T

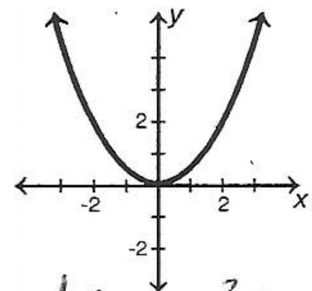
h.



$y = \frac{1}{x+2}$

E

i.



$y = \frac{1}{2}x^2$

S

Circle the cells that contain your equations, along with their code letters.

$y = \frac{1}{x} + 2$ **C**	$y = (x-2)^3$ **T**	$y = x^2 - 2$ **D**	$y = (x-2)^2$ **R**
$y = \frac{1}{x+2}$ **E**	$y = x^3 + 2$ **S**	$y = 2x^3$ **N**	$y = \lvert x\rvert + 2$ **A**
$y = \lvert x+2\rvert$ **E**	$y = 2x^2$ **M**	$y = \frac{1}{2}x^2$ **S**	$y = 2\lvert x\rvert$ **V**

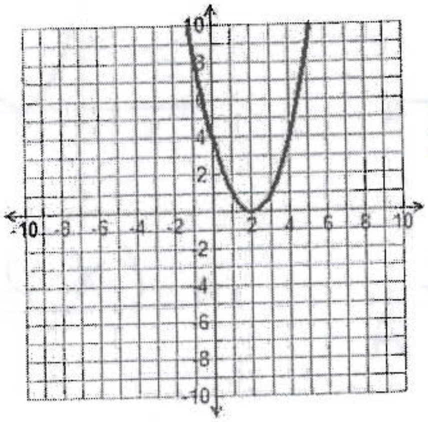
Use the code to reveal the name of the 17th century French mathematician/philosopher who is credited with establishing Analytic Geometry, a connection between Algebra and Geometry - thus relating two branches of mathematics previously thought to be unrelated. Later, Analytic Geometry then gave rise to Transformational Geometry.

D E S C A R T E S

a b c d e f g h i

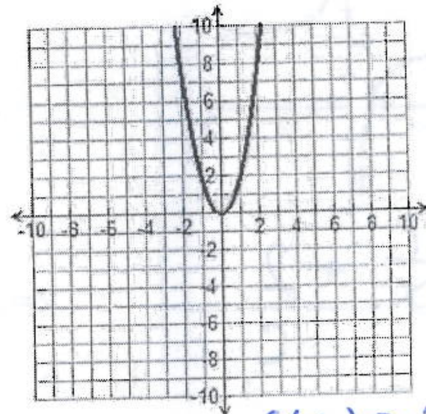
Write the quadratic equation, in vertex form for each graph.

1.



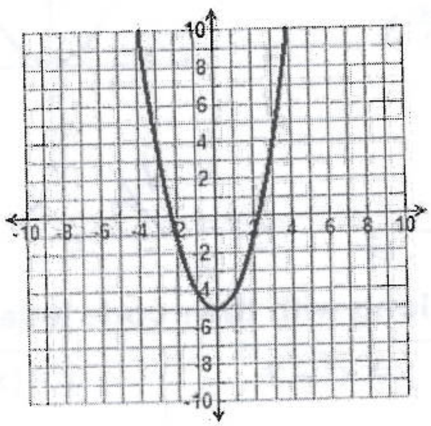
$f(x) = (x-2)^2$

2.



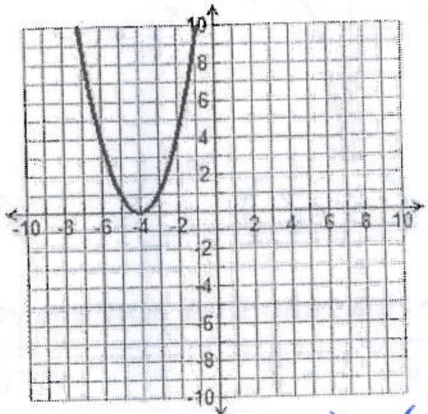
$f(x) = 2x^2$

3.



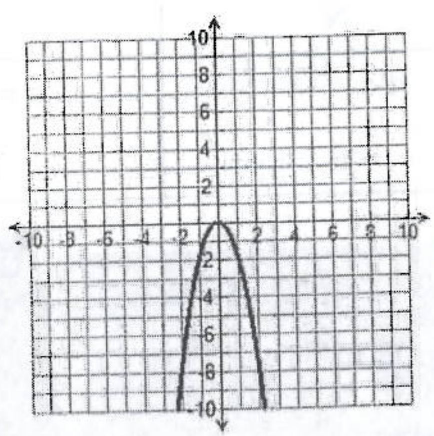
$f(x) = x^2 - 5$

4.



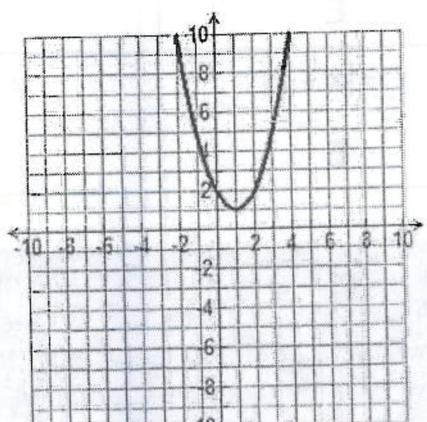
$f(x) = (x+4)^2$

5.



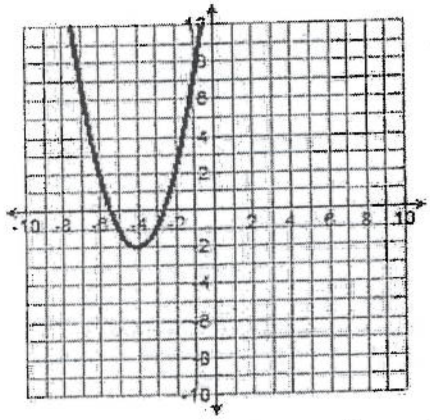
$f(x) = -2x^2$

6.



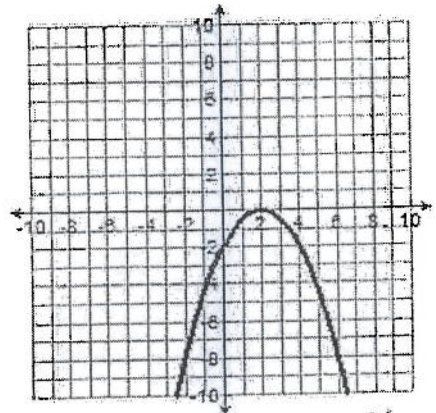
$f(x) = (x-1)^2 + 1$

7.



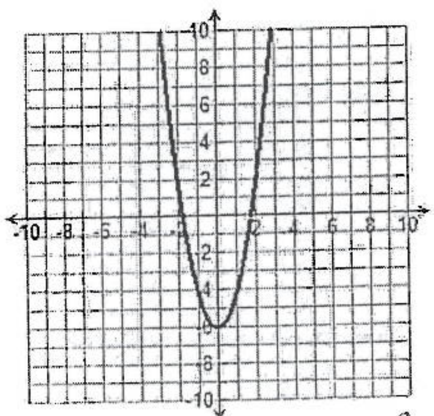
$f(x) = (x+4)^2 - 2$

8.



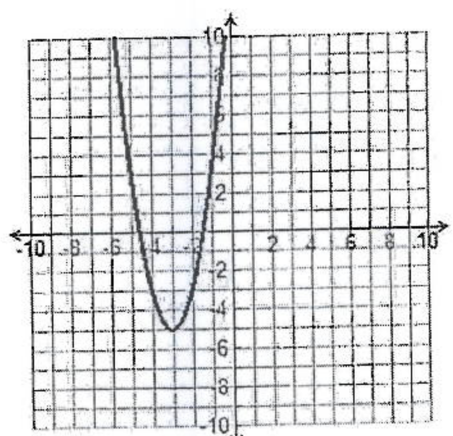
$f(x) = -\frac{1}{2}(x-2)^2$

9.



$f(x) = 2x^2 - 6$

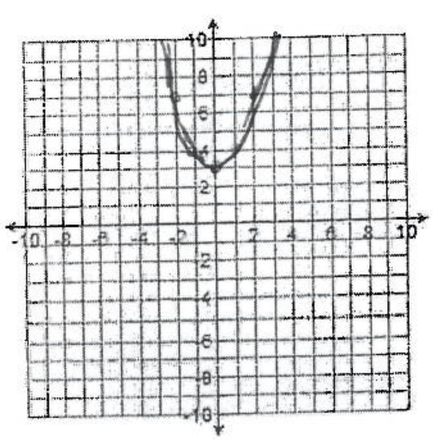
10.



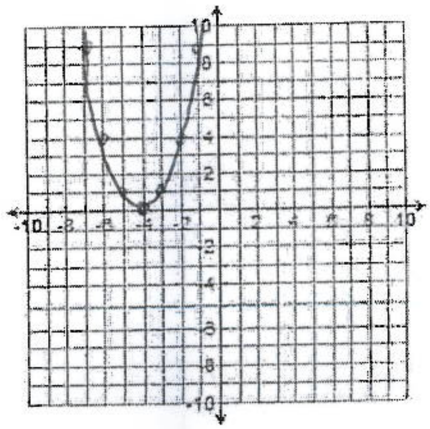
$f(x) = 2(x+3)^2 - 5$

Graph the quadratic equation on the provided grid.

11. $f(x) = (x-0)^2 + 3$



12. $f(x) = (x+4)^2 + 0$



Name ______________________________

Combining Transformations

— Remember

Examples Write an equation for the graph that results from the indicated transformations of the graph of $y = x^3$.

1. a vertical stretch of factor 6, then a shift right of 2 units

vertical stretch: Multiply the function by 6. $y = 6x^3$

shift right: Subtract 2 from x. $y = 6(x - 2)^3$

2. a reflection across the y-axis, then a shift left of 5 units.

reflection across the y-axis: Replace x by $-x$. $y = (-x)^3 = -x^3$

shift left: Add 5 to x. $y = -(x + 5)^3$

Draw line segments to match each transformation of the graph of $y = x^2$ with an equation for the resulting graph.

1. a shift left of 4 units, then a vertical stretch of factor 3

2. a shift right of 4 units, then a reflection across the x-axis

3. a shift down of 4 units, then a vertical stretch of factor 3

4. a shift left of 4 units, then a horizontal shrink of factor 1/3, then a shift down of 4 units

5. a shift left of 4 units, then a vertical stretch of factor 3, then a shift up of 4 units

6. a shift right of 4 units, then a horizontal shrink of factor 1/3, then a shift down of 4 units

7. a shift right of 4 units, then a shift down of 4 units, then a reflection across the x-axis

P A T L E Q R B N F E D J C T K

a. $y = 3x^2 - 4$

b. $y = 3(x + 4)^2 + 4$

c. $y = -[(x - 4)^2 + 4]$

$-(x-4)^2 - 4$

d. $y = -(x - 4)^2$

e. $y = 3(x + 4)^2$

f. $y = \frac{1}{3}(x + 4)^2 - 4$

g. $y = \frac{1}{3}(x - 4)^2 - 4$

Write the uncrossed letters in order in the spaces below to reveal a message.

P E R F E C T !