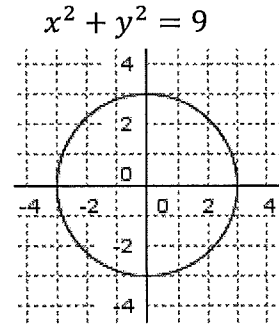
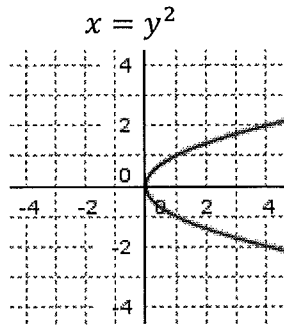
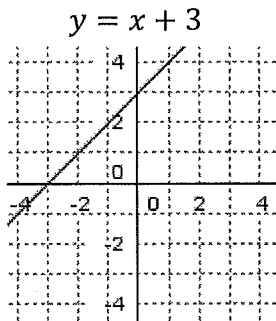


Relation: a set of ordered pairs; values of the independent (x) variable are paired with values of the dependent (y) variable

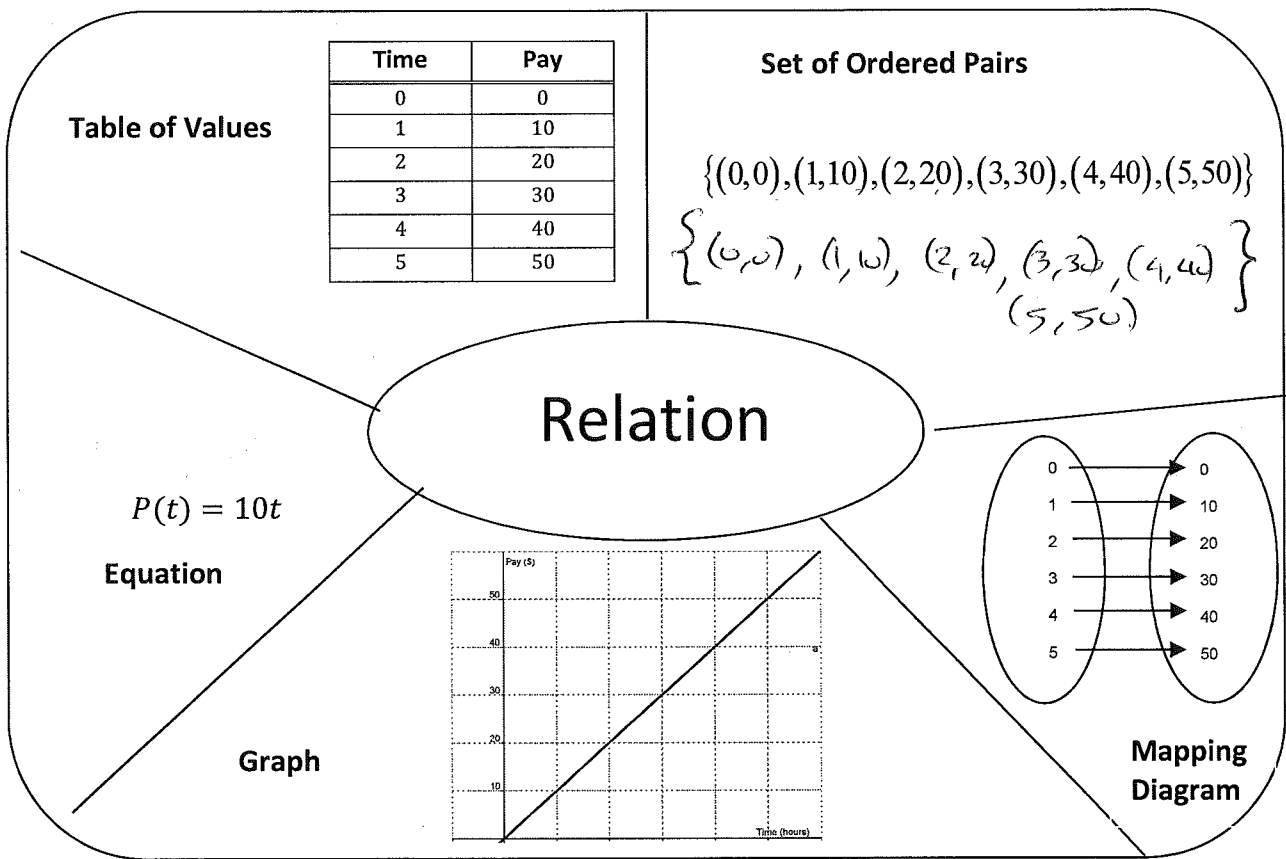
eg.



$\{(13, 5), (2, 4), (0, 6), (5, 2)\}$

Modelling Relations

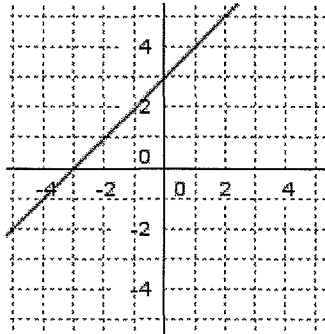
Bob has a summer job cutting lawns for \$10/hour. The amount he earns is related to the number of hours he works.



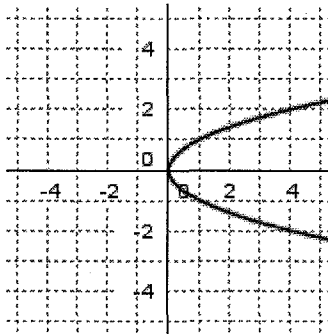
Function: a relation where each value of the independent variable corresponds with only one value of the dependent variable.

Note: All functions are relations but not all relations are functions.

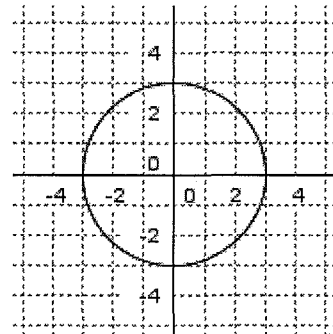
Looking at these graphs, which ones are functions?



YES



NO. 2 y-values for $x=1$

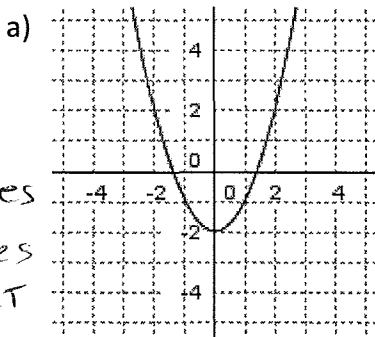


NO. 2 y-values for $x=0$

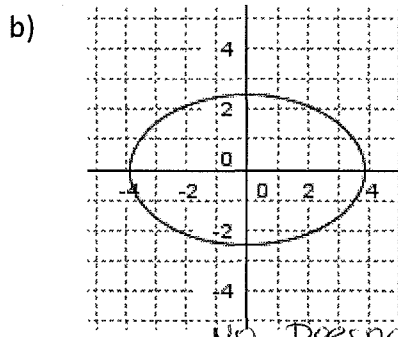
Graphic Test: If a relation is a function, a vertical line drawn anywhere on the graph will intersect the graph in only one location.

Algebraic Test: If a relation is a function, substituting any value for x will result in one value of y .

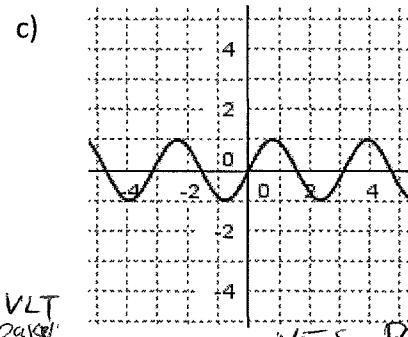
Example 1 Which of the following are functions? Justify your answer.



Yes
Passes
VLT



NO. Does not pass VLT



YES. Passes VLT

d) $\{(1, 3), (2, 4), (3, 5), (4, 6)\}$

Yes. x not repeated.

e) $\{(1, 3), (1, 4), (1, 5), (1, 6)\}$

NO. $x=1$ has 2 y-values

f) $\{(3, 1), (4, 1), (5, 1), (6, 1)\}$

Yes. x not repeated

g) $y = 2x + 1$

Yes. Linear line.

h) $x^2 + y^2 = 25$

NO. Circle. fails VLT.

Are all lines functions?

Other than the vertical line, all lines are functions.

1.1 Relations and Functions

1. State which relations are functions. Explain.

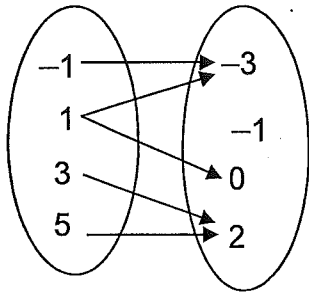
a) $\{(-5, 1), (-3, 2), (-1, 3), (1, 2)\}$

Yes. x not repeated.

b) $\{(0, 4), (3, 5), (5, -2), (0, 1)\}$

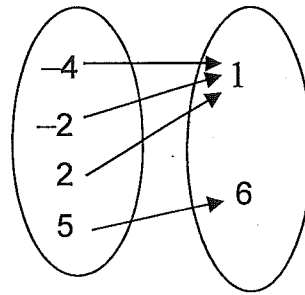
No. $x=0$ has 2 y -values.

c)



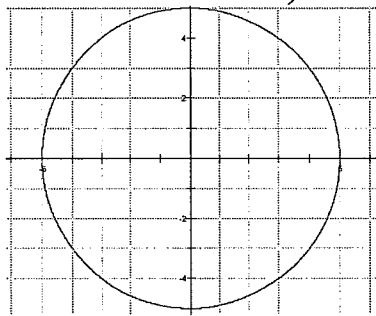
No. $x=1$ has 2 y -values.

d)



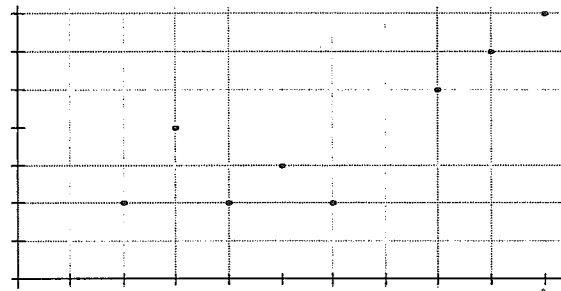
Yes. x not repeated.

e)



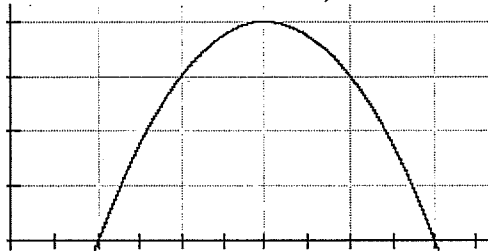
No. fails VLT

f)



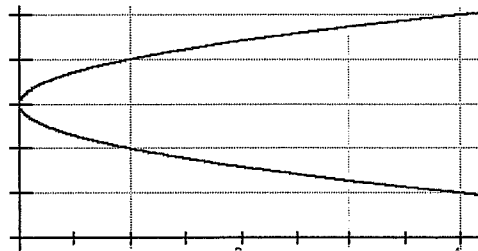
Yes. x not repeated.

g)



Yes. passes VLT

h)



No. fails VLT.

i) $y = 3 - x$

Yes Linear
Passes VLT.

j) $y = 3(x + 4)^2 - 1$

Yes. parabola
Passes VLT

k) $x^2 + y^2 = 4$

No. Circle.
fails VLT

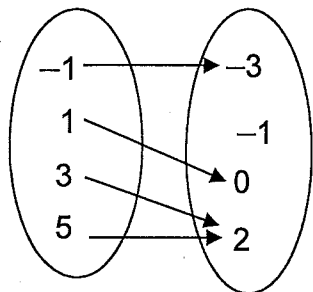
Solutions
Functions: a, d, f, g, i, j

1.4 Domain and Range of a Function

8. For $f(x) = \{(-5, 1), (-3, 2), (-1, 3), (1, 2)\}$, determine the domain and range.

$$D = \{-5, -3, -1, 1\} \quad R = \{1, 2, 3\}$$

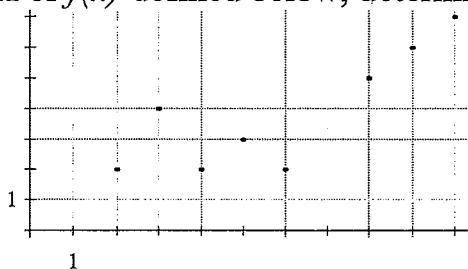
9. For $f(x)$ defined below, determine the domain and range.



$$D = \{-1, 1, 3, 5\}$$

$$R = \{-3, 0, 2\}$$

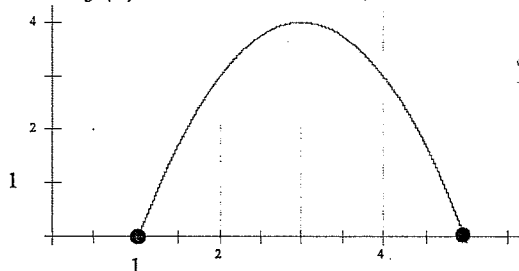
10. For $f(x)$ defined below, determine the domain and range.



$$D = \{2, 3, 4, 5, 6, 8, 9, 10\}$$

$$R = \{2, 3, 4, 5, 6, 7\}$$

11. For $f(x)$ defined below, determine the domain and range.



$$D = \{x \in \mathbb{R} \mid 1 \leq x \leq 5\}$$

$$R = \{y \in \mathbb{R} \mid 0 \leq y \leq 4\}$$

12. For $f(x) = 4x - 5$, determine the domain and range $D = \{x \in \mathbb{R}\}$

$$R = \{y \in \mathbb{R}\}$$

13. Consider the function $h(n) = -3(n - 5)^2 + 8$. Determine the domain and range.

$$D = \{n \in \mathbb{R}\}$$

$$R = \{h(n) \in \mathbb{R} \mid h(n) \leq 8\}$$

Solutions

1. a) 2 b) 2 2. a) 0 b) 2 3. a) 4 b) 5 4. a) 3 b) 0 5. a) -1 b) -13
6. a) -8 b) -1 c) -4 d) 7 e) $12a^2 + 8a - 8$ f) $6a + 7$ 7. a) 1 b) -2

8. $D = \{-5, -3, -1, 1\}$ $R = \{1, 2, 3\}$ 9. $D = \{-1, 1, 3, 5\}$ $R = \{-3, 0, 2\}$

10. $D = \{2, 3, 4, 5, 6, 8, 9, 10\}$ $R = \{2, 3, 4, 5, 6, 7\}$ or $R = \{y \in \mathbb{I} \mid 2 \leq y \leq 7\}$

11. $D = \{x \in \mathbb{R} \mid 1 \leq x \leq 5\}$ $R = \{y \in \mathbb{R} \mid 0 \leq y \leq 4\}$

12. $D = \{x \in \mathbb{R}\}$ $R = \{y \in \mathbb{R}\}$ 13. $D = \{n \in \mathbb{R}\}$ $R = \{h(n) \in \mathbb{R} \mid h(n) \leq 8\}$