

(d) In general, foot length is not a function of age. A person's age does not allow us to predict a unique foot length. For example, a 14 year old may have feet that grow considerably during the year that they are 14.

24.

x	y
0	3
1	4
2	5

x	y
0	3
0	4
2	5

The given tables of values show a function on the left and a non-function on the right. In the first relation, each value of x corresponds to a unique value of y . In the second relation, 0 corresponds to both 3 and 4, so it is not a function.

25. (a) $1 \rightarrow \boxed{\times 2} \rightarrow 2 \rightarrow (1) \rightarrow \boxed{\text{Add}} \rightarrow 3 \rightarrow \boxed{\times 2} \rightarrow 6 \rightarrow (0) \rightarrow \boxed{\text{Add}} \rightarrow 6 \rightarrow \boxed{\times 2} \rightarrow 12 \rightarrow (1) \rightarrow \boxed{\text{Add}} \rightarrow 13$
Therefore, 1101 converts to 13.

(b) This is a function because each binary number will be converted to a unique decimal number.

(c) i. $1 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 2 \rightarrow (0) \rightarrow \boxed{\text{Add}} \rightarrow 2 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 4 \rightarrow (1) \rightarrow \boxed{\text{Add}} \rightarrow 5 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 10 \rightarrow (0) \rightarrow \boxed{\text{Add}} \rightarrow 10 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 20 \rightarrow (1) \rightarrow \boxed{\text{Add}} \rightarrow 21 \rightarrow \boxed{\text{last?}} \rightarrow \text{yes} \rightarrow 21$

Therefore, 10101 converts to 21 in decimal.

ii. $1 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 2 \rightarrow (1) \rightarrow \boxed{\text{Add}} \rightarrow 3 \rightarrow \boxed{\text{last?}} \rightarrow \text{yes} \rightarrow 3$

Therefore, 11 converts to 3 in decimal.

iii. $1 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 2 \rightarrow (0) \rightarrow \boxed{\text{Add}} \rightarrow 2 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 4 \rightarrow (0) \rightarrow \boxed{\text{Add}} \rightarrow 4 \rightarrow \boxed{\text{last?}} \rightarrow \text{no} \rightarrow \boxed{\times 2} \rightarrow 8 \rightarrow (0) \rightarrow \boxed{\text{Add}} \rightarrow 8 \rightarrow \boxed{\text{last?}} \rightarrow \text{yes} \rightarrow 8$

Therefore, 1000 converts to 8 in decimal.

(d) The largest binary number we can get is 1111 with 4 digits. This converts to 15 in decimal. The smallest would be 0. Thus, the range would be: $\{y \mid y \leq 15, y \in \mathbf{W}\}$.

(e) Keyboards have a different number of keys.

Combinations of keys (e.g. shift + another key) produce even more symbols. It is reasonable that there is approximately 200 symbols to represent with binary numbers. $1111 \rightarrow 15$, $11111 \rightarrow 31$, $111111 \rightarrow 63$, $1111111 \rightarrow 127$, and $11111111 \rightarrow 255$. We probably need 8 bits to represent all the letters and symbols on a keyboard with binary numbers.

26. (a) Answers will vary. Possible numbers include:

0.405 807 641 8

0.733 812 311 2

0.043 991 987 5

0.339 362 525

0.995 466 341 1

(b) It appears that **rand** does not produce a unique output each time it is pressed. If you want “random” numbers, perhaps to play a game, we would not want a predictable output.

(c) 0.943 559 740 25

0.908 318 861

0.146 687 829 2

0.514 701 950 5

0.405 809 641 8

These values are the same for everyone.

(d) 0.943 597 402 5

0.908 318 861

0.146 687 829 2

0.514 701 950 5

0.405 809 641 8

This list is exactly the same as before.

(e)

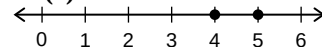
0.4	0.8	1.2
0.943 597 402 5	0.943 597 402 5	0.745 560 772 8
0.908 318 861	0.908 318 861	0.855 900 597 1
0.146 687 829 2	0.146 687 829 2	0.225 360 061 7
1.6	2.0	2.4
0.745 560 772 8	0.491 121 545 1	0.491 121 545 1
0.855 900 597 1	0.711 801 117 9	0.711 801 117 9
0.225 360 061 7	0.450 720 047 5	0.450 720 047 5
2.8		
0.491 121 545 1		
0.711 801 117 9		
0.450 720 047 5		

(f) It appears that the calculator truncates the number we store to **rand**, and then generates a list of numbers using that seed number. The “random numbers” outputted depends on the seed number and the number of times you have chosen **rand**.

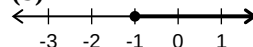
(g) **rand** is a function of the seed and the number of times you have selected **rand**. For example, knowing that 0 was stored in **rand**, and **rand** was selected 3 times always produces the answer: 0.146 687 829 2. These are not really random numbers - they just appear to be random. If we perform an experiment or design a game using random numbers from the calculator, the results will not be random, but actually quite predictable.

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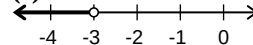
1. (a)



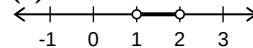
(b)



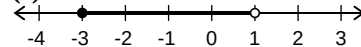
(c)



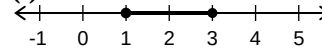
(d)



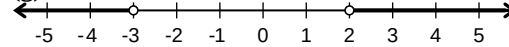
(e)



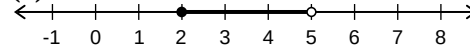
(f)

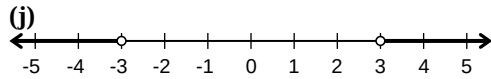
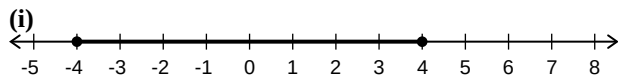


(g)



(h)





2. (a) $\{x \mid -3 \leq x \leq 3, x \in \mathbf{I}\}$ or $\{x \mid x^2 < 16, x \in \mathbf{I}\}$

(b) $\{x \mid x > -2, x \in \mathbf{I}\}$ or $\{x \mid x \geq -1, x \in \mathbf{I}\}$

(c) $\{x \mid x \leq -2, x \in \mathbf{R}\}$

(d) $\{x \mid x > -1, x \in \mathbf{R}\}$

(e) $\{x \mid -5 \leq x < 3, x \in \mathbf{R}\}$

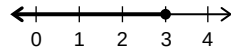
(f) $\{x \mid x > 1 \text{ or } x < -1, x \in \mathbf{R}\}$ or $\{x \mid x^2 > 1, x \in \mathbf{R}\}$

(g) $\{x \mid -3 \leq x \leq 3, x \in \mathbf{R}\}$ or $\{x \mid x^2 \leq 9, x \in \mathbf{R}\}$

3. (a) $3a - 2 \leq 7$

$$3a \leq 9$$

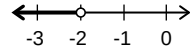
$$a \leq 3$$



(b) $3 - 7t > 17$

$$-7t > 14$$

$$t < -2$$



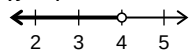
(c) $5 - 2x > x - 7$

$$5 > 3x - 7$$

$$12 > 3x$$

$$4 > x$$

$$x < 4$$



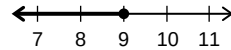
(d) $2(s + 3) - 3(s - 5) \geq 12$

$$2s + 6 - 3s + 15 \geq 12$$

$$-s + 21 \geq 12$$

$$-s \geq -9$$

$$s \leq 9$$



(e) $10 < 5 - (2x - 1)$

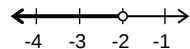
$$10 < 5 - 2x + 1$$

$$10 < -2x + 6$$

$$4 < -2x$$

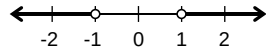
$$-2 > x$$

$$x < -2$$



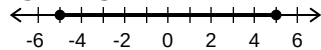
(f) $x^2 > 1$

$$x > 1 \text{ or } x < -1$$



(g) $r^2 \leq 25$

$$-5 \leq r \leq 5$$



(h)

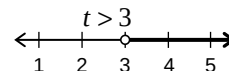
$$t + 1 < \frac{3t - 1}{2}$$

$$2(t + 1) < 2\left(\frac{3t - 1}{2}\right)$$

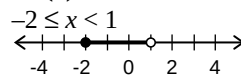
$$2t + 2 < 3t - 1$$

$$2 < t - 1$$

$$3 < t$$



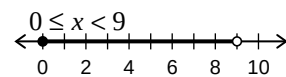
4. (a) $1 \leq x + 3 < 4$



(b)

$$-1 \leq \frac{x}{3} - 1 < 2$$

$$0 \leq \frac{x}{3} < 3$$



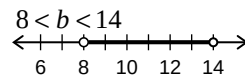
(c)

$$4 < \frac{4 - 2b}{-3} < 8$$

$$-3(4) > -3\left(\frac{4 - 2b}{-3}\right) > -3(8)$$

$$-12 > 4 - 2b > -24$$

$$-16 > -2b > -28$$

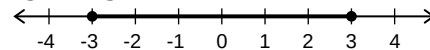


(d) $2x^2 - 7 \leq 11$

$$2x^2 \leq 18$$

$$x^2 \leq 9$$

$$-3 \leq x \leq 3$$



5. (a)

$$\frac{5 - 4b}{3} < 5$$

$$3\left(\frac{5 - 4b}{3}\right) < 3(5)$$

$$5 - 4b < 15$$

$$-4b < 10$$

$$\frac{-4b}{-4} > \frac{10}{-4}$$

$$b > -\frac{5}{2}$$

(b)

$$2 \geq 5 - \frac{2}{3}x \geq 1$$

$$-3 \geq -\frac{2}{3}x \geq -4$$

$$-\frac{3}{2}(-3) \leq -\frac{3}{2}\left(-\frac{2}{3}x\right) \leq -\frac{3}{2}(-4)$$

$$\frac{9}{2} \leq x \leq 6$$

(c)

$$\frac{3(1-2x)}{4} - \frac{1}{2}x < 1$$

$$4\left(\frac{3(1-2x)}{4}\right) - 4\left(\frac{1}{2}x\right) < 4(1)$$

$$3(1-2x) - 2x < 4$$

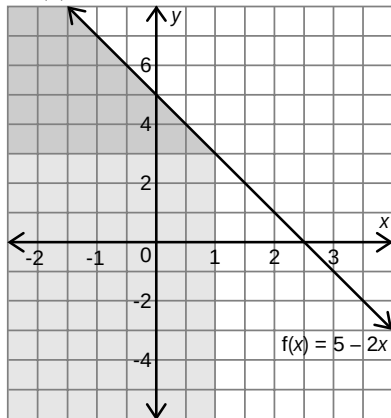
$$3 - 6x - 2x < 4$$

$$3 - 8x < 4$$

$$-8x < 1$$

$$x > -\frac{1}{8}$$

6. (a)



(b) Use the graph in part (a). When $x \leq 1$, $y \geq 3$. Therefore, $R = \{y \mid y \geq 3, y \in \mathbf{R}\}$.

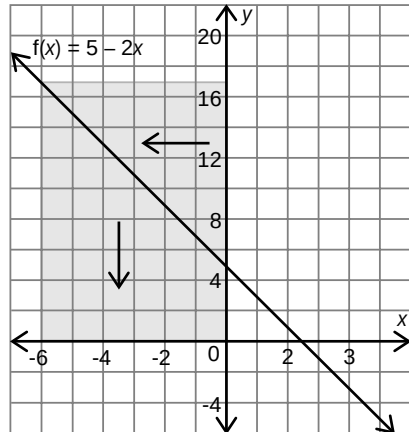
(c) if $x \leq 1$, then:

$$-2x \geq -2$$

$$5 - 2x \geq 3$$

$$y \geq 3$$

(d)



$$5 \leq f(x) \leq 17$$

$$5 \leq 5 - 2x \leq 17$$

$$0 \leq -2x \leq 12$$

$$0 \geq x \geq -6$$

$$D = \{x \mid -6 \leq x \leq 0, x \in \mathbf{R}\}$$

(e) $5 \leq f(x) \leq 17$

$$5 \leq 5 - 2x \leq 17$$

$$0 \leq -2x \leq 12$$

$$0 \geq x \geq -6$$

$$-6 \leq x \leq 0$$

7. (a) $x > 4$

$$g(4) = 2(4 - 3)^2 + 4 = 2 + 4 = 6$$

The graph increases to the right of (4, 6). Thus, the range of g would be: $\{y \mid y > 6, y \in \mathbf{R}\}$.

(b) $0 \leq x \leq 6$

$$g(0) = 2(0 - 3)^2 + 4 = 2(9) + 4 = 22$$

$$g(6) = 2(6 - 3)^2 + 4 = 2(9) + 4 = 22$$

This section of the parabola includes the vertex, so the range would be: $\{y \mid 4 \leq y \leq 22, y \in \mathbf{R}\}$.

(c) If $f(x) \leq 12$, we can use the graph to determine that the domain would be: $\{x \mid 1 \leq x \leq 5, x \in \mathbf{R}\}$.

8. $1 - x \leq -3$

$$-x \leq -4$$

$$x \geq 4$$

9. $f(x) = x(x - 2)$ defines a parabola with zeros at 0 and 2.

$$f(1) = 1(1 - 2) = -1$$

Thus, its vertex is at (1, -1) and the parabola opens upward.

$$f(-2) = -2(-2 - 2) = -2(-4) = 8$$

$$f(3) = 3(3 - 2) = 3(1) = 3$$

If $-2 < x < 3$, then: $D = \{x \mid -2 < x < 3, x \in \mathbf{R}\}$ and

$R = \{y \mid 3 < y < 8, y \in \mathbf{R}\}$.



10. $h(t) = -4.9t(t - 5)$ defines a parabola that opens downward with zeros at 0 and 5. The domain must be $\{t \mid 0 \leq t \leq 5, t \in \mathbf{R}\}$, since $h(t) \geq 0$.

11. (a) $3 < x < -2$ means that x is larger than 3 and x is smaller than -2. No value of x can satisfy both of these restrictions. Thus, there is no solution to this inequality.

(b) $2 < x > -3$ means that x is larger than 2 and x is larger than -3. Any value of x that is larger than 2 is also larger than -3. Thus, $2 < x > -3$ is equivalent to $x > 2$.

(c) $5 > x < 2$ means that x is smaller than 5 and x is smaller than 2. Any value of x that is smaller than 2 is also smaller than 5. Thus $5 > x < 2$ is equivalent to $x < 2$.

12. Since the vertex is at A(1, 2), the equation is of the form:

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

$$f(5) = a(5 - 1)^2 + 2 = 16a + 2$$

We want (5, $f(5)$) to fall between B(5, 10) and C(5, 34):

$$10 < f(5) < 34$$

$$10 < 16a + 2 < 34$$

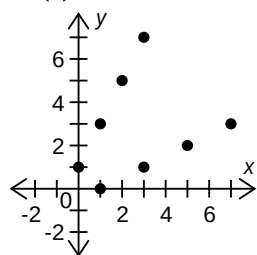
$$8 < 16a < 32$$

$$\frac{1}{2} < a < 2$$

Thus, the coefficient of x^2 in the equation of the parabola must lie between $\frac{1}{2}$ and 2.

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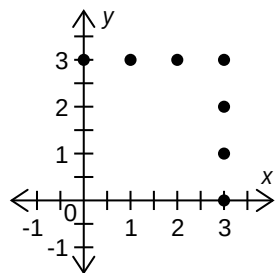
1. (a) i.



inverse: $\{(1, 0), (3, 1), (5, 2), (7, 3)\}$

ii. Both the relationship and its inverse are functions because each element of the domain corresponds to a unique value of the range.

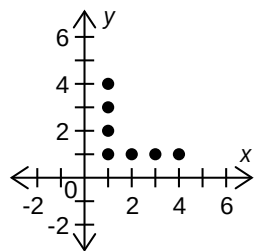
(b) i.



inverse: $\{(3, 0), (3, 1), (3, 2), (3, 3)\}$

ii. The original relationship is a function because it passes the vertical line test, but the inverse is not a function. 3 is mapped onto more than one value.

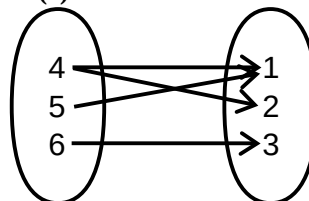
(c) i.



inverse: $\{(1, 1), (2, 1), (3, 1), (4, 1)\}$

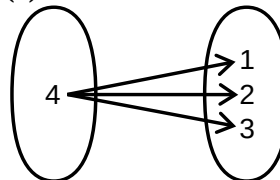
ii. The original relationship is not a function because 1 is mapped onto more than one value. The inverse is a function because each x -coordinate corresponds to a unique y -coordinate.

2. (a) i.



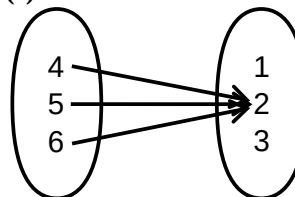
ii. The inverse is not a function because 4 maps onto 1 and 2.

(b) i.



ii. The inverse is not a function because 4 maps onto 1, 2, and 3.

(c) i.



ii. The inverse is a function because each element of the domain corresponds to one value in the range.

3. (a) f:

x	y	first differences
-5	5	
		-1
-3	4	
		-1
-1	3	
		-1
1	2	
		-1
3	1	
		-1
5	0	
		-1
7	-1	