F O I L
first outside inside last

If $h(x) = 5x^2 - 6$, find

116. $h(4)$

$h(x) = 5x^2 - 6$
$h(4) = 5(4)^2 - 6$
$h(4) = 5(16) - 6$
$\boxed{h(4) = 74}$

117. $h(-1)$

$h(x) = 5x^2 - 6$
$h(-1) = 5(-1)^2 - 6$
$h(-1) = 5(1) - 6$
$h(-1) = 5 - 6$
$\boxed{h(-1) = -1}$

118. $h(x+1)$

$h(x+1) = 5(x+1)^2 - 6$
$= 5(x+1)(x+1) - 6$ distributive property
$= 5(x^2 + 1x + 1x + 1) - 6$ collect like-terms
$= 5(x^2 + 2x + 1) - 6$ distributive property
$= 5x^2 + 10x + 5 - 6$ collect like-terms
$= 5x^2 + 10x - 1$

If $q(x) = x^2 + 2x + 3$, find

119. $q(4)$

$q(x) = x^2 + 2x + 3$
$q(4) = (4)^2 + 2(4) + 3$
$q(4) = 16 + 8 + 3$
$\boxed{q(4) = 27}$

120. $q(x+1)$ **CHALLENGE

$q(x) = x^2 + 2x + 3$
$q(x) = (x+1)^2 + 2(x+1) + 3$
$q(x) = (x+1)(x+1) + 2(x+1) + 3$
$q(x) = x^2 + 1x + 1x + 1 + 2x + 2 + 3$
$q(x) = x^2 + 4x + 6$

121. $q(2x-3)$ **CHALLENGE

$q(x) = x^2 + 2x + 3$
$q(2x-3) = (2x-3)^2 + 2(2x-3) + 3$
$q(2x-3) = (2x-3)(2x-3) + 2(2x-3) + 3$
$q(2x-3) = 4x^2 - 6x - 6x + 9 + 4x - 6 + 3$
$\boxed{q(2x-3) = 4x^2 - 8x + 6}$

If $g(x) = -2x + 1$, find

122. $g(4)$

$g(x) = -2x + 1$
$g(4) = -2(4) + 1$
$g(4) = -8 + 1$
$\boxed{g(4) = -7}$

123. Which variable is the independent variable?

x

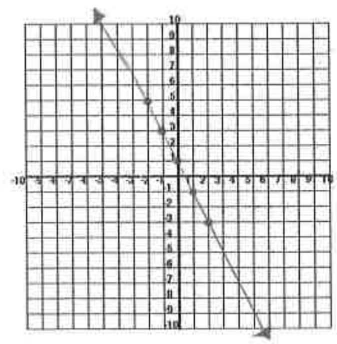
124. $g(-1)$

$g(x) = -2x + 1$
$g(-1) = -2(-1) + 1$
$g(-1) = 2 + 1$
$\boxed{g(-1) = 3}$

125. Graph $g(x)$
Domain: $x \epsilon R$

$y = -2x + 1$

x	y
-2	5
-1	3
0	1
1	-1
2	-3



**Use your graph in Q125 to check answers for Q122 and Q124.

If $f(x) = 2x^2$, find

126. $f(4)$

$f(x) = 2x^2$
$f(x) = 2(4)^2$
$f(x) = 2(16) \rightarrow \boxed{f(x) = 32}$

127. Which variable is the dependent variable?

$f(x)$

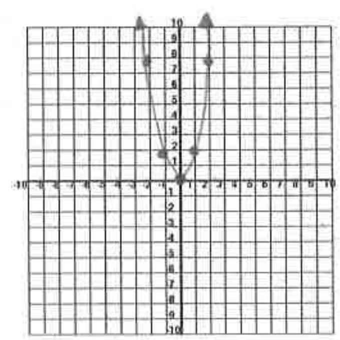
128. $f(-1)$

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

129. Graph $f(x)$ if the Domain: $x \epsilon R$

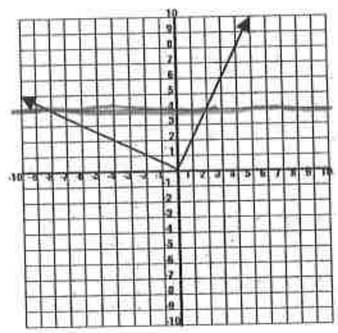
$y = 2x^2$

x	y
-2	8
-1	2
0	0
1	2
2	8



independent variable = x dependent variable = y

Use the graph of $h(t)$ to answer the following questions.



130. Find $h(2)$.

h(2)=4

131. Find $h(-6)$.

h(-6)=3

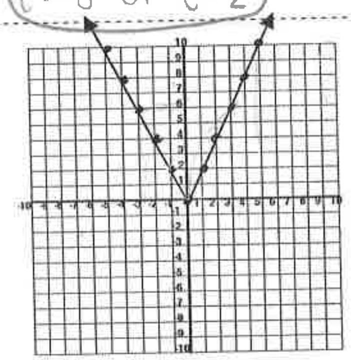
132. $h(t) = 4$
Find both values of t.

~~h(-8)=4, h~~

t=-8 or t=2

~~h(-8)=4~~
~~h(4)=4~~

Use the graph of $d(x)$ to answer the following questions.



133. Find $d(-3)$.

d(-3)=6

134. Find $d(5)$.

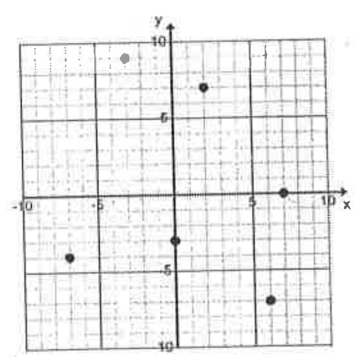
d(5)=10

|-3|=3

135. $d(x) = 2$
Find both values of x.

x=-1, x=1

Use the graph of $f(x)$ to answer the following questions.



136. Find $f(-3)$.

f(-3)=9

137. Find $f(5)$.

f(5)=i

there is no point on the graph.

138. Find x if $f(x) = 0$.

x=7

~~f(7)=0~~

Describing the same relation in various ways.

Below are three descriptions of the same relation.

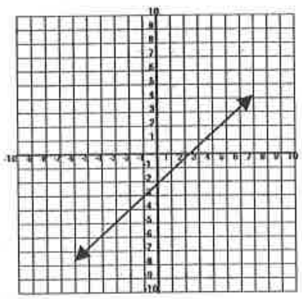
Equation:

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

Or

$$y = x - 2$$

Graph:



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

Words:

Each element in the range is two less than the element in the domain.

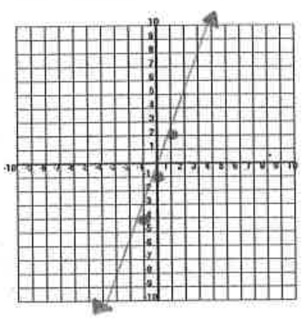
Fill in remaining two cells below for the given relation.

Equation:

GIVEN THE FUNCTION…

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

139. Graph:



140. Words:

Each element in the range is one less than triple an element in the domain.

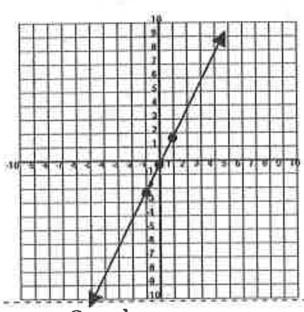
141. Equation:

$y = mx + b$

$\frac{\text{rise}}{\text{run}} = \frac{2}{1}$

$y = \frac{2}{1}x + 0 \rightarrow \boxed{y = 2x}$

GIVEN THE FUNCTION…



142. Words:

Each element in the range is double an element in the domain.

$y = 2x + 0$

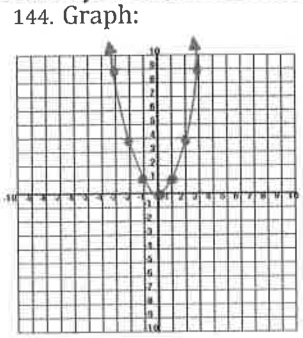
143. Equation:

$f(x) = x^2$

$(y = x^2)$

x	y
-2	4
-1	1
0	0
1	1
2	4

144. Graph:



Words:

GIVEN THE FUNCTION…

Each element of the range is equivalent to the square of an element in the domain.

The following two examples demonstrate a relationship between two quantities.

A computer service technician charges a fee of $120 to assess a problem and a fee of $60 per hour to fix the problem. If the high school network requires 12 hours of work, what will the total cost be?

Cost:
= $120 + 12($60)
= $120 + $720
= $840

$C(h) = 60h + 120$

$C(12) = 60(12) + 120$

$C(12) = 720 + 120$

$C(12) = \$840$

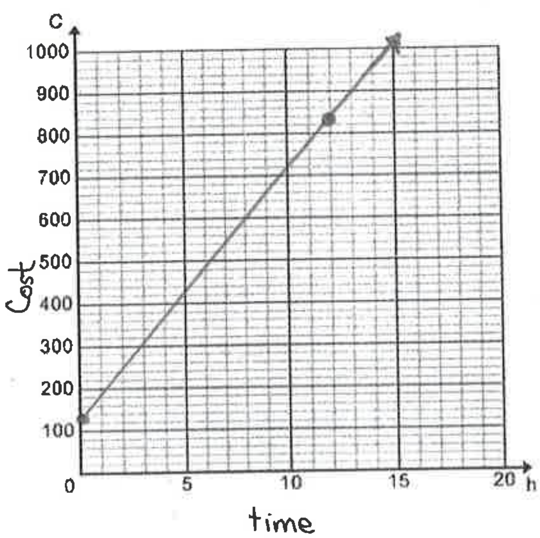
This is a relationship between **time worked** and **cost.**

We could show this as (12, 840).

145. Create a set of data for the relation above.

$(0, 120), (1, 180), (2, 240), \boxed{(3, 300) \ldots}$

146. Graph the data you created in the question above.



why line??
hourly fee??

The height of a thrown object can be modeled as a function of time (since it was thrown) by the following equation.

$$h(t) = -5t^2 + 12.5t + 100$$

Find the height of the object 2 seconds after it has been thrown.

Height is found by *substituting* 2 into the right side of the equation.

$h(2) = -5(2)^2 + 12.5(2) + 100$
$h(2) = -20 + 25 + 100$
$h(2) = 105\ m$

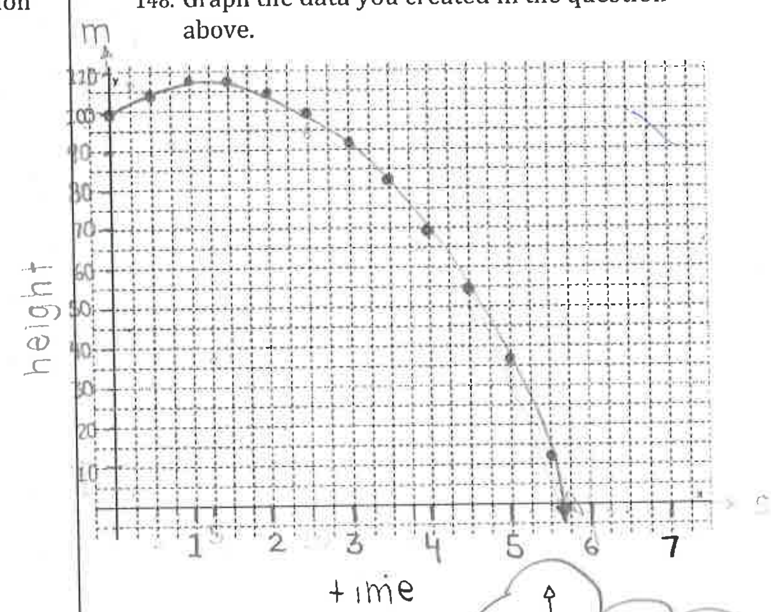
This is a relationship between height and time.

We could show this as (2, 105).

147. Create a set of data for the relation above.

$(1, 107.5), (2, 105), (3, 92.5), (4, 70), \ldots$

148. Graph the data you created in the question above.



x	y
0	100
0.5	105
1	107.5
1.5	107.5
2	105
2.5	100
3	92.5
3.5	82.5

★ can it be negative ft? ★

Solve each problem using any strategy that works.

A computer service technician charges a fee of $120 to assess a problem and a fee of $60 per hour to fix the problem.

$C(h) = 60h + 120$

y = cost ($)
x = hours

149. If the high school network requires 7 hours of work, what will the total cost be?

$y = 60x + 120$

$y = 60(7) + 120 \rightarrow y = \boxed{\$540}$

150. What are the two variables in this problem?

x: hours worked

y: cost ($)

151. Which variable would be the "dependent variable?" (see pg.30)

y = cost ($)

152. Does the dependent variable correspond to the domain or range?

The range.

153. Do you think this problem models discrete or continuous data? Explain.

Discrete b/c cost is charged by the hour, so there is no in between points

154. What is significant about the point (0,120)?

It means the technician doesn't work but just came. Also, it's the starting point of the graph (nothing can be less than it).

The height of a thrown object can be modeled as a function of time since thrown by the following equation.

$$h(t) = -5t^2 + 12.5t + 100$$

— how do you know the units?

155. Find the height of the object 3 seconds after it has been thrown.

$h(3) = -5(3)^2 + 12.5(3) + 100$

$h(3) = -5(9) + 12.5(3) + 100$

$h(3) = -45 + 37.5 + 100$

$\boxed{h(3) = 92.5\text{m}}$

156. Can you think of any values for time (t) that don't make sense?

$t < 0$ *(negative values)

157. What does time represent domain or range?

domain

158. Can you think of any values for height (h) that don't make sense?

$h > 0$ (negative values)

159. Is height the dependent or independent variable?

dependent?

160. Use the graph on the previous page to estimate the time it takes the object to reach maximum height.

1 second

BONUS: Can you calculate the time it takes the object to land?

≈5.9 seconds. X

what would equation be??

Solve each problem using any strategy that works.

161. A bike technician charges $40 for a basic tune-up and $20/h for any additional work.

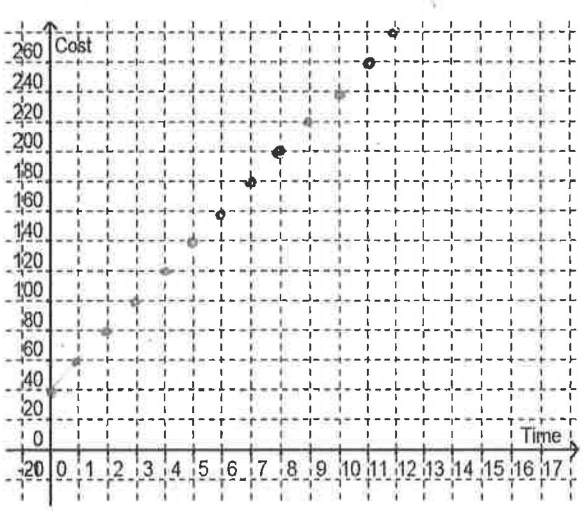
$C(h) = 20h + 40$

Write an equation that relates cost (C) to time (t) for the scenario above.

162. Create a table for the scenario above.

Time (hours)	Cost ($)
0	40
1	60
2	80
3	100
4	120
5	140

163. Graph the relation above.



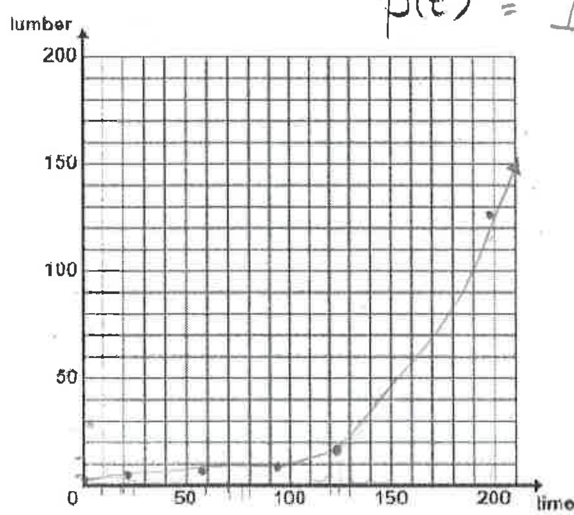
164. The population of a colony of bacteria grows through cell division. The doubling time for the population is 30 minutes. Complete the table below for the growth of bacteria starting with one bacterium.

t $P(t)$

Time (minutes)	Number of Bacteria
0	1
30	2
60	4
90	8
120	16
210	~~32~~ 128

165. Graph the relation above.

$p(t) = 1(2^t)$



166. What numbers are acceptable values for the horizontal axis (domain) of the graph above? (Think about what numbers would not make sense.)

negative values would not

☆ Any positive values would be acceptable ☆

☆ $h \geq 0$ ☆

167. Going to the movies. The cost of going to the movies for a group of grade 10 students is represented by the equation $C = 10.5n$.

a) What is a reasonable range for this function?

21 - 210

b) What is the dependent variable?

C

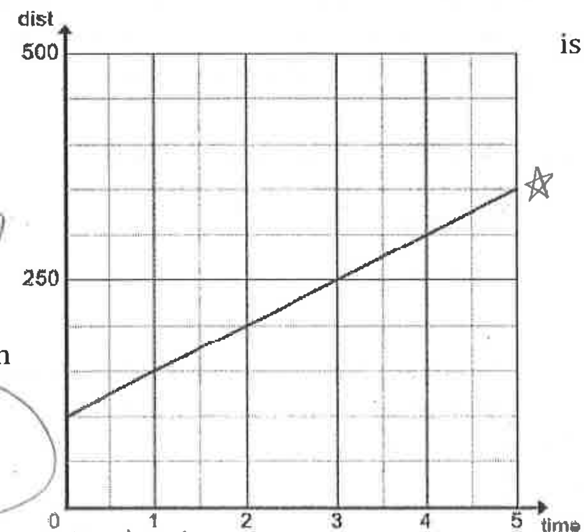
c) Write the equation using function notation.

f(n) = 10.5(n)

☆ c(n) = 10.5n

168. Driving Distance. JJ leaves Nanaimo driving north. At the time he left, he was 105 km from home. The following graph represents the relationship between distance from home and elapsed driving time.

The equation for the relation is $d(t) = 50t + 100$.



a) Explain why the function is called $d(t)$.

because the graph is showing the relationship between distance (d) and time (t).

b) Suggest a reasonable domain for the function $d(t)$.

1 - 10

☆ 1 - 5 ☆ ??

NO ARROW!

c) Find $d(3)$.

d(3) = 50(3) + 100 → d(3) = 150 + 100 → $\boxed{d(3) = 250 \text{ Km}}$

d) Why is the graph a line and not a series of dots?

b/c he can drive between hours and he drive continuously.

→ ☆ both distance and time are continuous ☆ ←

169. Halloween dance. Student's Council plans on hiring DJ-Jae-Sun for this year's Halloween dance. Jae-Sun appreciates what he remembers of math functions and sends the council the following pricing information.

$$C(n) = 2000 + 17.50n$$

a) Explain what you think the equation above means.

The cost (c) is \$2000 for him coming and \$17.50 for every hour.

b) What would be a reasonable domain at your school?

$D\{x = 1, 2, 3, 4, x \in W\}$

★ $D\{0 \leq n \geq 4, n \in W\}$ ★

c) What is a reasonable range for your school?

$R\{2000 \leq C \geq 2070, C \in W\}$

d) What does the range represent?

cost (c)

e) Is this the dependent or independent variable?

dependent

170. Wedding banquet. Lin-Karen is planning her dream wedding. Catering costs are a function of the number of people that attend the wedding. A high end caterer quoted Lin-Karen a set-up cost of 1500 dollars plus 75 dollars per guest.

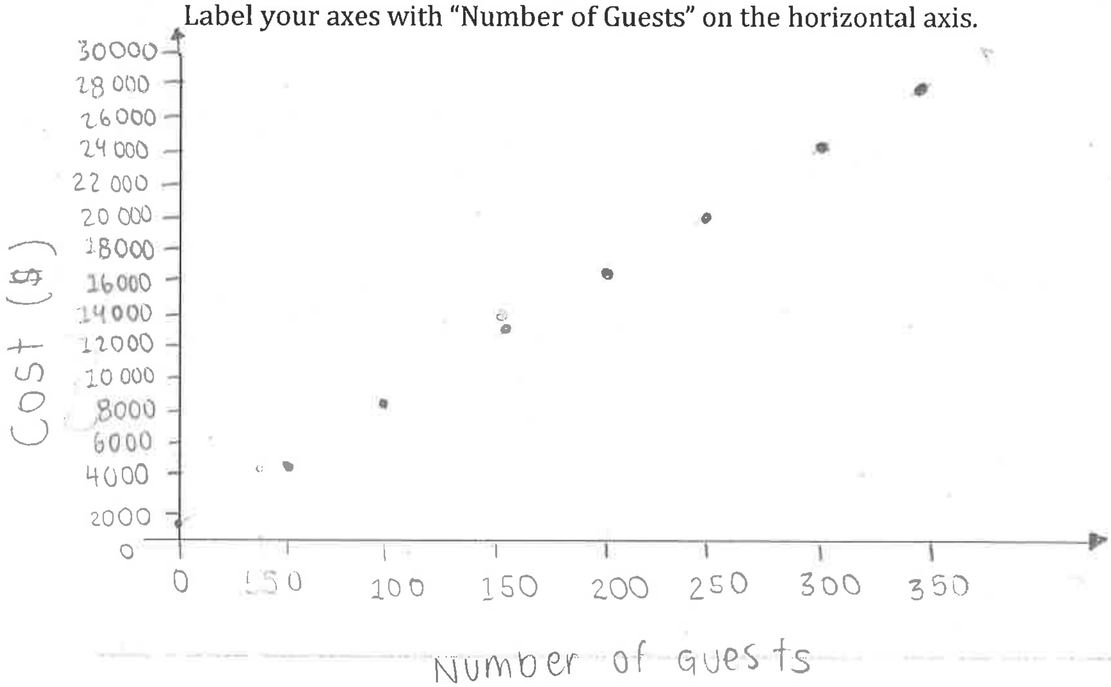
a) Write the cost as a function of the number of guests using function notation.

$C(n) = 1500 + 75n$

b) Is this **Discrete** or **Continuous** data?

discrete

c) Graph the relation above using a reasonable domain. Use a ruler to mark your axes. Label your axes with "Number of Guests" on the horizontal axis.



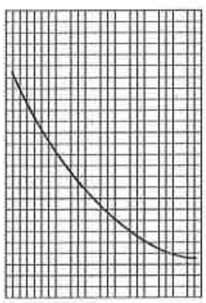
General relations

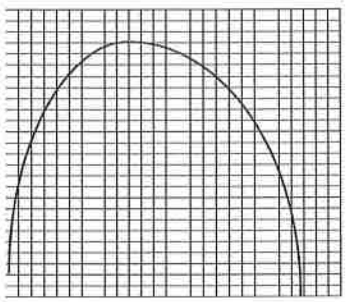
When considering some relationships, it is solely the pattern or trend that we are interested in.

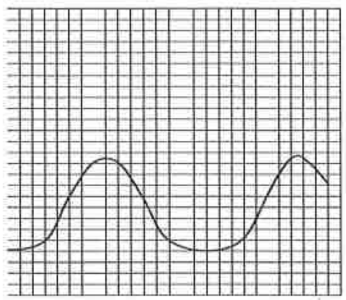
Can you visualize a graph for the following relationships?

- #1: The height above the ground of a passenger on a Ferris Wheel as a function of time.
- #2: The number of cars in a parking lot as a function of the time of day.
- #3: Temperature of a cup of coffee as a function of time since it was poured.
- #4: The cost of mailing a package as a function of its mass.
- #5: The height of a football as a function of time since it was kicked.

Match each of the following with an example from above. Then describe below why you made that choice.







#3 — b/c temp. goes from high to low and eventually levels out/ stays the same when it reaches room temp.

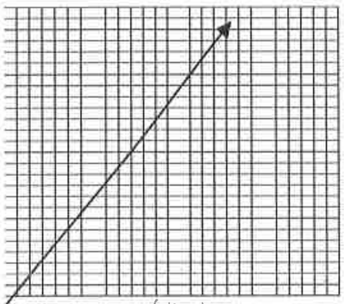
#5 — b/c ball goes from low → high → low

#2 — b/c it varies throughout the day

Some notes here possibly... room temp.

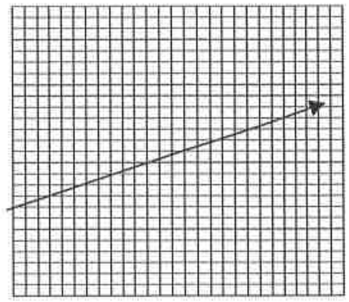
Answer the questions associated with each graph.

171. Describe a relationship that could be represented by the graph below.



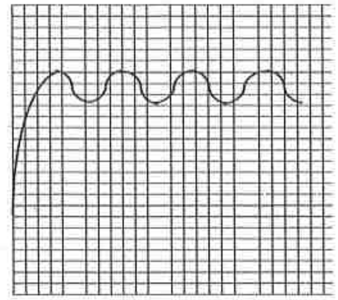
Distance (km) travelled and time (h) drived.

172. Describe a relationship that could be represented by the graph below.



cost of a technician and time worked.
(fixed cost + time worked)

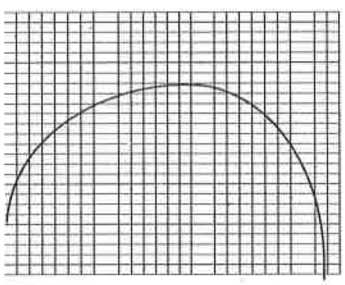
173.



Above is a graph of the temperature inside an oven set to 425°C. Why does the graph fluctuate?

b/c ppl could open the oven door, which would drop the temp.

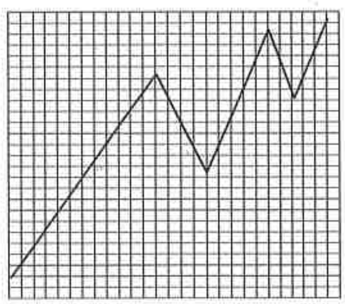
174.



The graph above represents the height of a kicked ball as a function of time. Why is the graph not symmetrical?

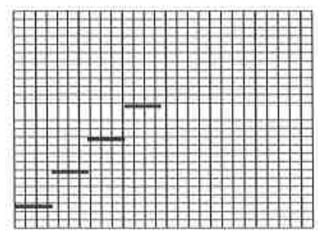
b/c the kickball starts in the air and not on the ground, but it lands on the ground.

175. Describe a relationship that could be represented by the graph below.



☆ rise and fall of stock price over time ☆

176.

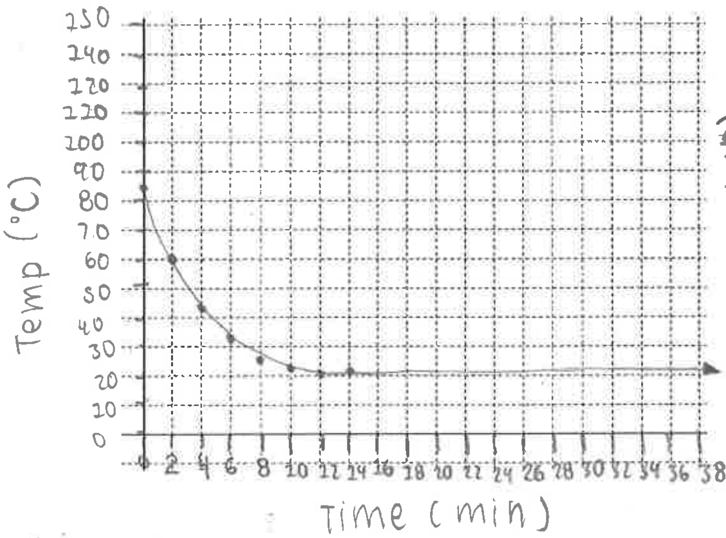


Explain why this graph of postage rates appears stepped.

b/c the postage rate for a mass from certain weights is the same.

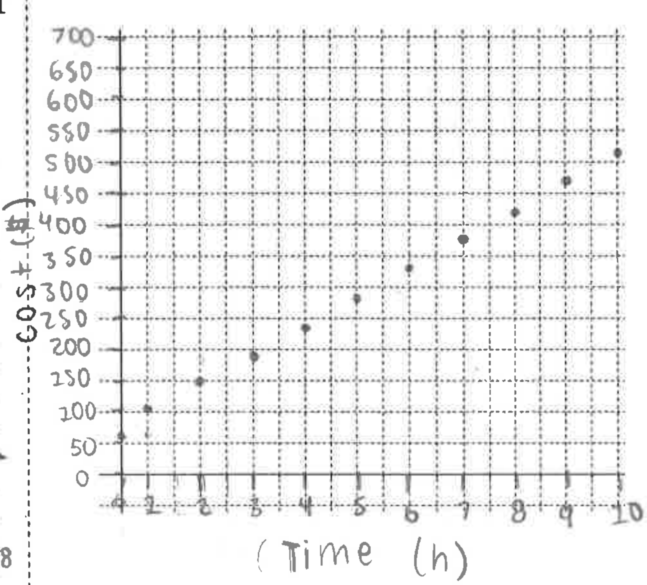
(177) A hot cup of coffee was left on the table to cool. Graph the data below.

Time (min)	0	2	4	6	8	10	12	14
Temp. (°C)	84	60	44	34	26	23	21	21



★ On answer key - no line?? ★

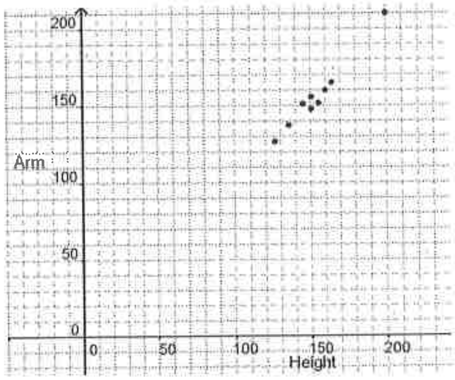
(178) To hire a plumber to fix his drain, Mr. J had to pay an initial "call-out" fee of $60 then he had to pay the plumber $45 per hour. Graph the Cost as a function of Time in hours for this service.



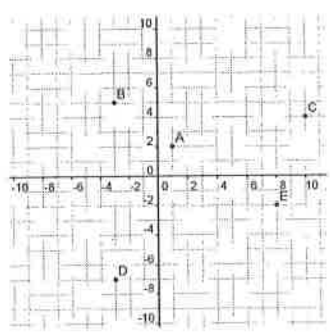
★ why line?? ★

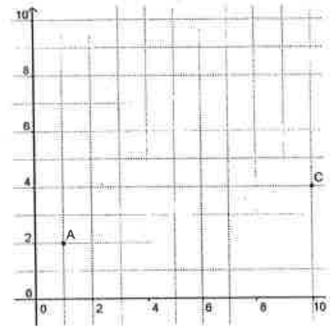
Answers:

1. Answers may vary.
   Possible relations:
   Age and height, cost and time, wage and hours, ...
2. (27 years, 180 cm),
   (9 years, 110 cm)
   (0.6 years, 55 cm)
3. Their order is important.
4. Height and Arm Span.
5.

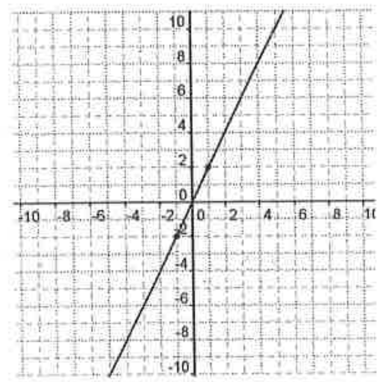


6. Points appear to resemble a line.
7. Check with a classmate or teacher.
8. y-axis
9. x-axis
10. Graph on left includes negative coordinates.
11. Graphs of data where negatives are not included. (eg. Distance vs. Time)
12. Graphs of data where negatives are appropriate. (eg. Altitudes, temperatures)
13. Two units right and five units up of the origin (middle).
14.

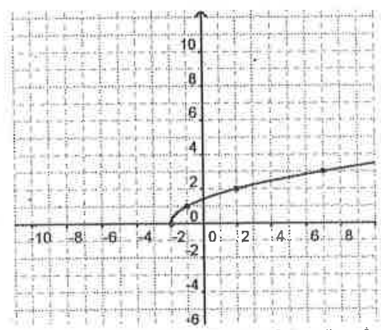




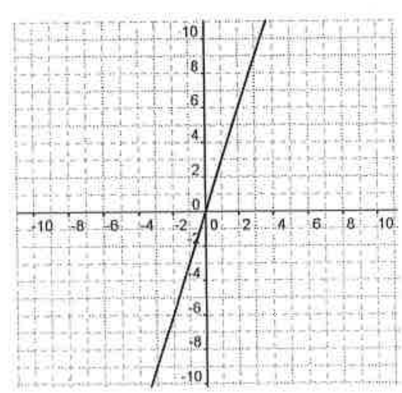
15.



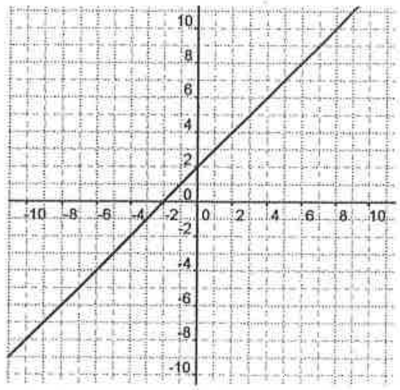
16.



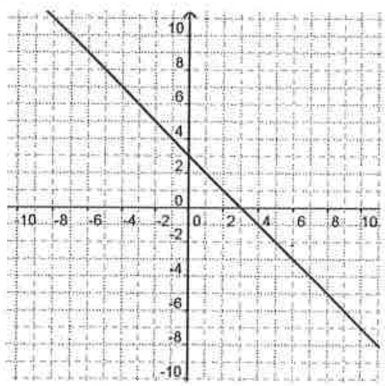
17. Same as Q15. All input values "make sense" mathematically.
18. Same as Q16. Any value of 'x' less than -2 will make the equation (function) undefined over the set of real numbers.
19. The graph will have breaks or stopping points where values are not permitted.
20.



21.



22. $-2, 5$. Any real value is a possible element of the domain.
23. $-7, 1$. Any real value is a possible element of the range.
24.



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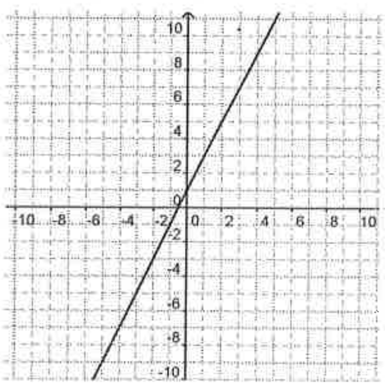

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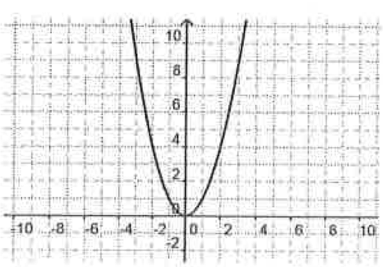
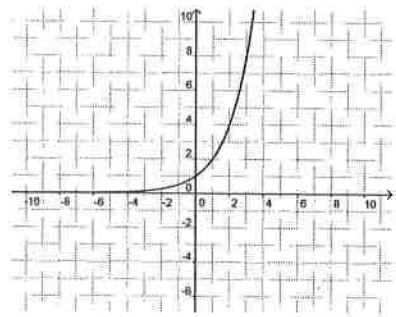
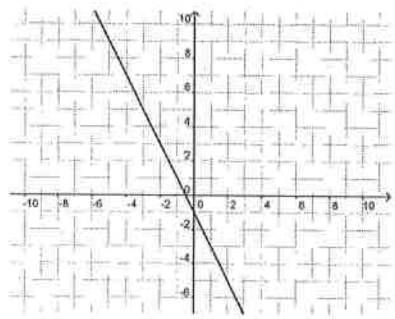


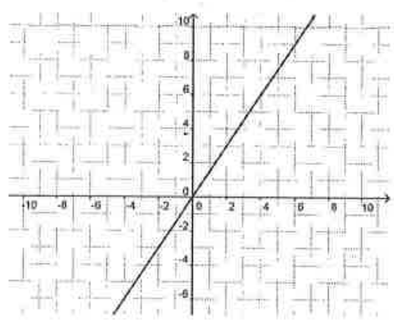
27.



28. No negative values can be contained in the range.
29. No negative values can be contained in the range.
30.



31.



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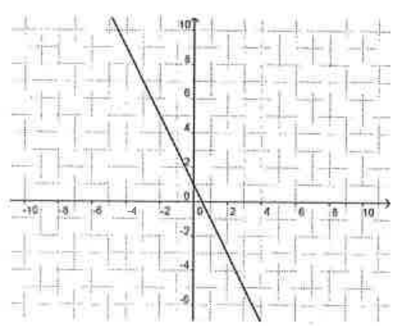
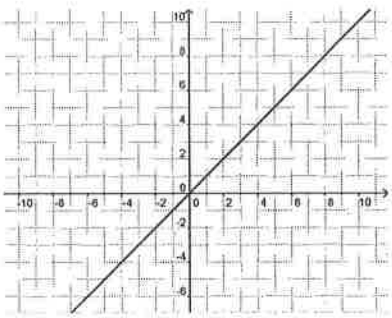
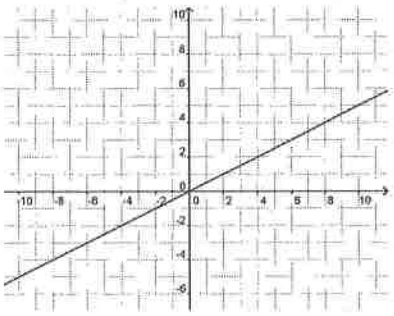


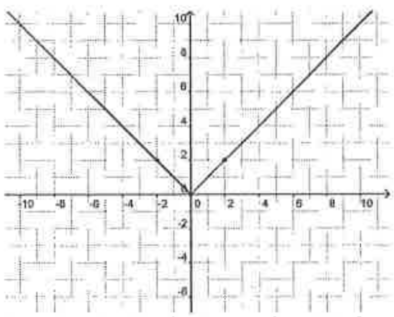
33.



34.



35.

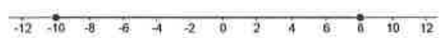


36. Domain: $\{1,2,3,4\}$, Range: $\{1,4,9,16\}$ or $\{x|1,2,3,4\}, \{y|1,4,9,16\}$
37. a and d
38. $\{x|-2,3,5,8\}$ $\{x | x = -2, 3, 5, 8\}$
39. $\{y|3\}$ $\{y | y = \}$
40. $\{x|-1,0,1,2,3\}$
41. $\{ x \geq 0, x \in \mathbb{R}\}$ The domain is the real numbers greater than or equal to zero.
42. Infinite
43. 0
44. There is not a largest value. Infinity.
45. Infinite
46. 2
47. There is not a largest value. Infinity.
48. $(\infty, \infty), (\infty, \infty)$
49. $\{x|x \geq -4, x\epsilon R\}, \{y|y \geq 1, y\epsilon R\}$
50.

x:

y:

51. The domain consists of all real numbers from -6 to 5 inclusive.
The range consists of all real numbers from -1 to 2 inclusive.
52. $\{x| -5 < x < 7, x\epsilon R\}, \{y|y = 4\}$
53. $(\infty, \infty), (\infty, \infty)$
54. Find the upper and lower limits. Separate them with a comma. Use a square bracket if the limit is included, a curved bracket if it is not.
55. Plot the limit(s) on a number line with a solid dot if included or hollow dot if excluded. Draw an arrow/line in the appropriate direction (unless the data is only a point or points).
56. Find the limit(s). Choose the correct symbol, $<, \leq, >, \geq, \neq$. Fill out the inequality using one of the following as a guide:
$x \geq$ ____
____ $\leq x \leq$ ____
57. A.4 B.5 C.3 D.6 E.1 F. 2
58. $\{x\epsilon R\}, \{y\epsilon R\}$
59. $[-7,6], [-5,7]$
60. x:

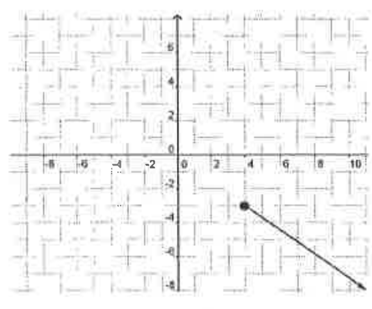


y:

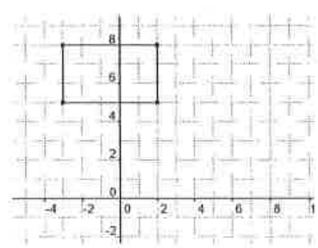
61. $\{x| -5 \leq x \leq 8, x\epsilon R\}, \{y| -3 \leq y \leq 5,\ y\epsilon R\}$
62. $(-6, \infty), (\infty, 3)$
63. x:

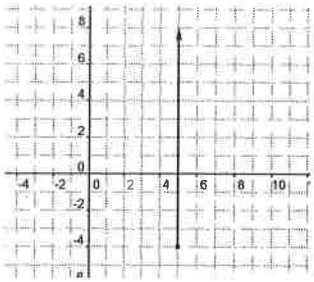
y:

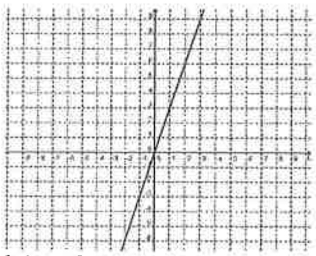
64. $\{x|2\}, \{y|-3,-1,1,3\}$
65. $\{x|-7,-5,-3,6\}, \{y|-4,5,7\}$
66. $(-8,9), [-5,7)$
67.



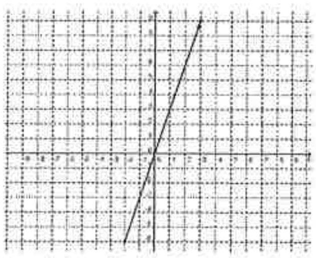
68.

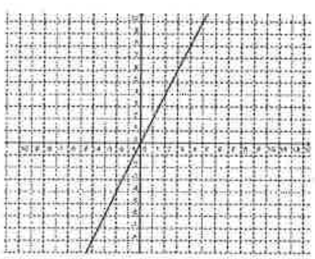


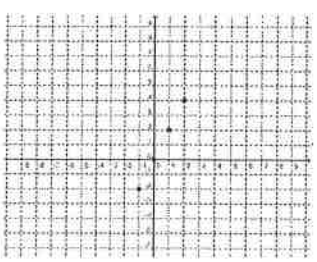
69.


70.


71. $\{x|\ x\epsilon R\}$

72.


73.


74.


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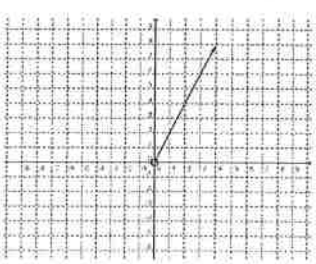
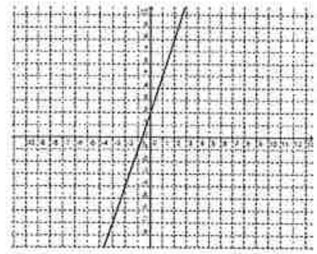
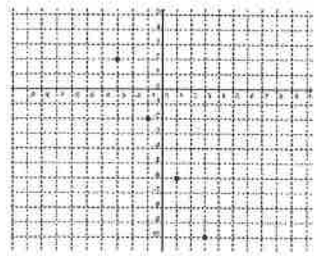
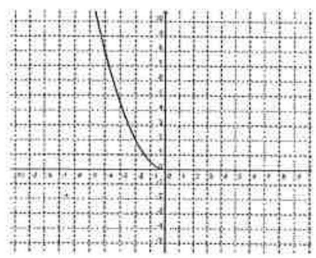
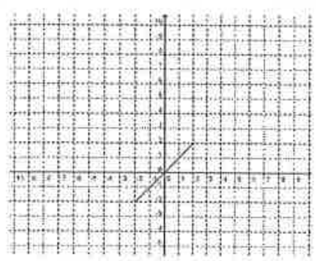
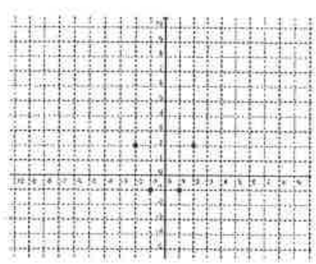


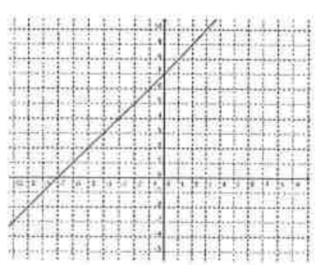
76.


77.


78.


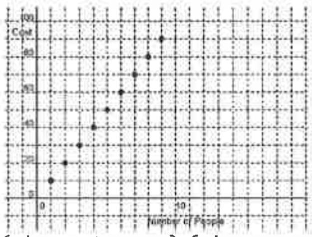
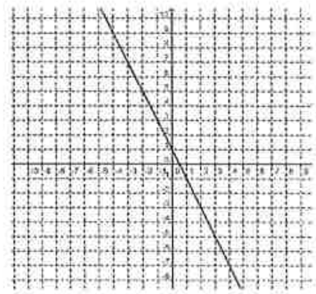
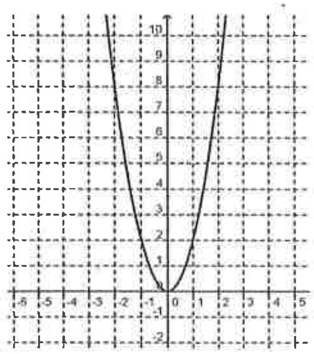
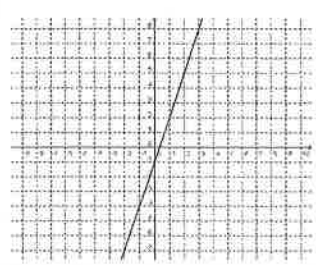
79.


80.


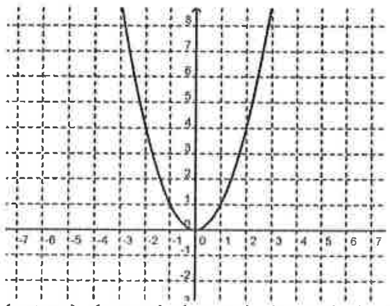
81.


82. Consider, points, lines, breaks, …

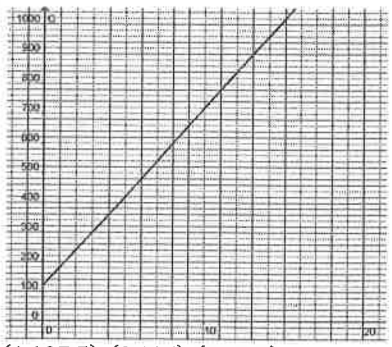
83. $\{x|\ x\epsilon R\}$ or $[\infty, \infty]$

84. $x \geq 2$ or $[2, \infty)$ or All real numbers greater than or equal to 2.
85. $\{x |\ x \epsilon R\}$ or (∞, ∞) or All real numbers.
86. $\{y | y \epsilon R\}$ or (∞, ∞) or All real numbers.
87. $y \geq 0$ or $[0, \infty)$ or All real numbers greater than or equal to 0.
88. $\{y |\ y \geq 0\}$ or $([0, \infty)$or Real numbers greater than zero.
89. 
90. $\{x | 2,3,4,5,6,7,8,9\}$, $\{y | 20,30,40,50,60,70,80,90\}$
91. The space between points represents "fractions of people" and the corresponding cost. The domain is limited to whole numbers in this case.
92. The temp. of the coffee will cool until it reaches room temperature.
93. a) Several (3 or 4) hours.
    b) Continuous
94. a) $\{n | 0 \leq n \leq 75, n\ \epsilon W\}$ b) discrete
95. a) Time
    b) Continuous
    c) Continuous
    d) An human's height would range from about 45 cm to about 200cm. There are exceptions of course!
96. Cost is a function of number of bars. Discrete data.
97. Earnings are a function of hours worked. Discrete data.
98. Yes. Each x-value has only one corresponding y-value.
99. Yes. Each x-value has only one corresponding y-value.
100. No. There are two possible outputs when x is 3.
101. No. The $\pm$ indicates that each input, except zero, will have two outputs.
102. Yes. Each x-value has only one corresponding y-value.
103. No. There are two possible outputs when x is -3.
104. No.
105. No.
106. Yes.
107. Yes. Each input value (x) will produce only one output value (y).
108. Yes. Each input value (x) will produce only one output value (y).
109. No. There will be two outputs (one positive, one negative) for each input. Except when the input is zero.
110. 14
111. -11
112. $5x - 21$
113. 4
114. -6
115. $2x - 6$
116. 74
117. -1
118. $5x^2 + 10x - 1$
119. 27
120. $x^2 + 4x + 6$
121. $4x^2 - 8x + 6$
122. -7
123. x is independent.
124. 3
125. 
126. 32
127. $f(x)$ which has replaced y.
128. 2
129. 
130. 4
131. 3
132. $2, -8$
133. 6
134. 10
135. $x = -1, 1$
136. 9
137. Not possible. 5 is not an element of the domain in this function.
138. $x = 7$
139. 
140. Each element in the range is one less than triple an element in the domain.

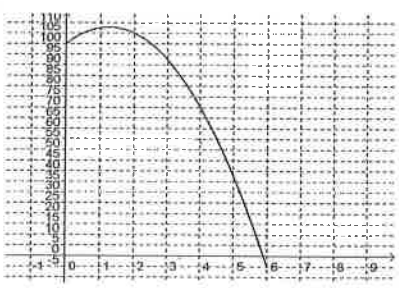
141. $f(x) = 2x$
142. Each element in the range is double an element in the domain.
143. $f(x) = x^2$
144.



145. (1,180), (2,240), (3,300), (4,360), (5,420), ...
146.



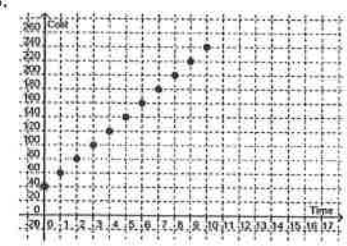
147. (1,107.5), (2,105), (3,92.5), ...
148.



149. $540
150. C: total cost
    h: hours worked
151. Cost (C)
152. Range
153. Explain your answer.
154. The technician has not performed any hours of repair work but there is still a cost of $120.
155. 92.5 m
156. Negative values.
157. Domain
158. Negative values (unless the object thrown can fall below the height that we have called height zero. For example, it may land in a hole or crevace.
159. Dependant
160. Approximately 1.5 seconds.
161. $C = 40 + 20h$ or
    $C(h) = 20h + 40$.
162.

Time (hours)	Cost ($)
0	40
1	60
2	80
3	100
4	120
5	140

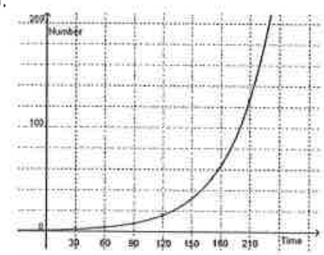
163.



164.

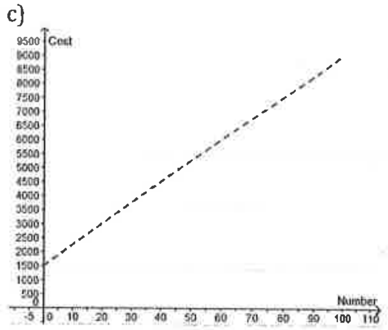
Time (minutes)	Number of Bacteria
0	1
30	2
60	4
90	8
120	16
210	128

165.

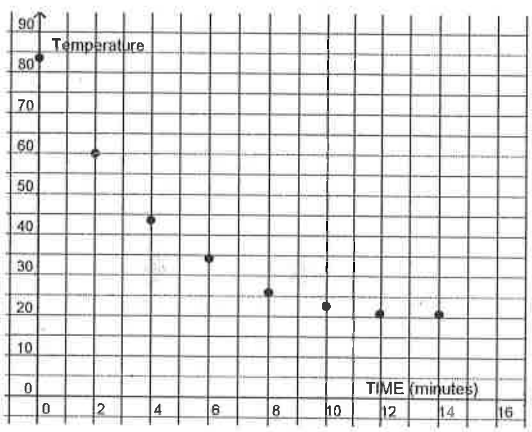


166. Real numbers greater than or equal to zero.
167. a)
    $\{C|10.5, 21, 31.5, 42, 52.5, 63, 73.5, 84, 94.5, 105\}$
    b) C, cost.
    c) $C(n) = 10.5n$
168. a) The function is called $d(t)$ beacure "distance" is a function of "time".
    b) Real numbers between 0 and 5 inclusive.
    c) 250
    d) This data is a line because both distance and time are continuous (no gaps).
169. a) $C(n) = 2000 + 17.50n$
    The DJ charges is a $2000 fixed cost in addition to $17.50 per hour or possibly per student. It is not clear what n represents. I will work assuming n represents hours.
    b) eg. $\{n|0 \le n \le 4, n\epsilon W\}$
    c) eg. $\{C|2000, 2017.50, 3035, 2052.50, 2070\}$
    d) Cost of the DJ.
    e) Dependent
170. a) $C(n) = 1500 + 75n$
    b) Discrete

c)



171. Many answers. Eg. Wage ($/hr)
172. Many answers. Eg. Cost to hire a taxi.
173. The heating element must turn on and off to maintain an approximately constant temperature.
174. The ball is kicked from a height above zero (ground).
175. The rise and fall of a stock's price over time.
176. Each line on the graph represents a range of masses. There is not a different price for every possible mass. For example, it currently costs $0.64 to send any letter under 30g from one part of Victoria, B.C. to another.
177.



178.