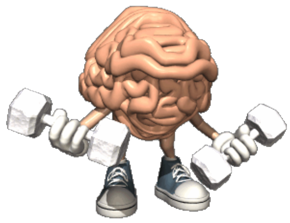
Warm Up



1) $t(x) = 3x^2 + 5$ $\qquad$ $p(x) = \dfrac{-3x - 1}{2}$

a) Evaluate

$p(-5) \times t(4)$

b) Evaluate

$p(t(-2))$

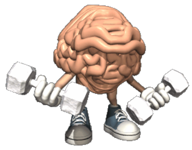
c) Evaluate

$p(x) = -17$

d) Evaluate

$t(x) = 113$

Warm Up



1) $t(x) = 3x^2 + 5$ $\qquad$ $p(x) = \dfrac{-3x - 1}{2}$

a) Evaluate

$p(-5) \times t(4)$

Input Input

$p(x) = \dfrac{-3x-1}{2}$

$p(-5) = \dfrac{-3(-5)-1}{2}$

$\dfrac{+15-1}{2}$

$\dfrac{14}{2}$

$\boxed{p(-5) = 7}$

$t(x) = 3x^2+5$

$t(4) = 3(4)^2+5$

$3(16)+5$

$t(4) = 48+5$

$\boxed{t(4) = 53}$

$\underbrace{p(-5)}_{7} \times \underbrace{t(4)}_{53}$

7×53

$\boxed{=371}$

b) Evaluate

$p(t(-2))$

first

$t(x) = 3x^2+5$

$t(-2) = 3(-2)^2+5$

$= 3 \times 4 + 5$

$= 12 + 5$

$\boxed{t(-2) = 17}$

$p(t(-2))$

$p(17) = \dfrac{-3x-1}{2}$

$\dfrac{-3(17)-1}{2}$

$\dfrac{-51-1}{2}$

$\dfrac{-52}{2}$

$\boxed{p(t(-2)) = -26}$

c) Evaluate

$p(x) = -17$

d) Evaluate

$t(x) = 113$ output

$t(x) = 3x^2+5$

$113 = 3x^2+5$

$113-5 = 3x^2+5-5$

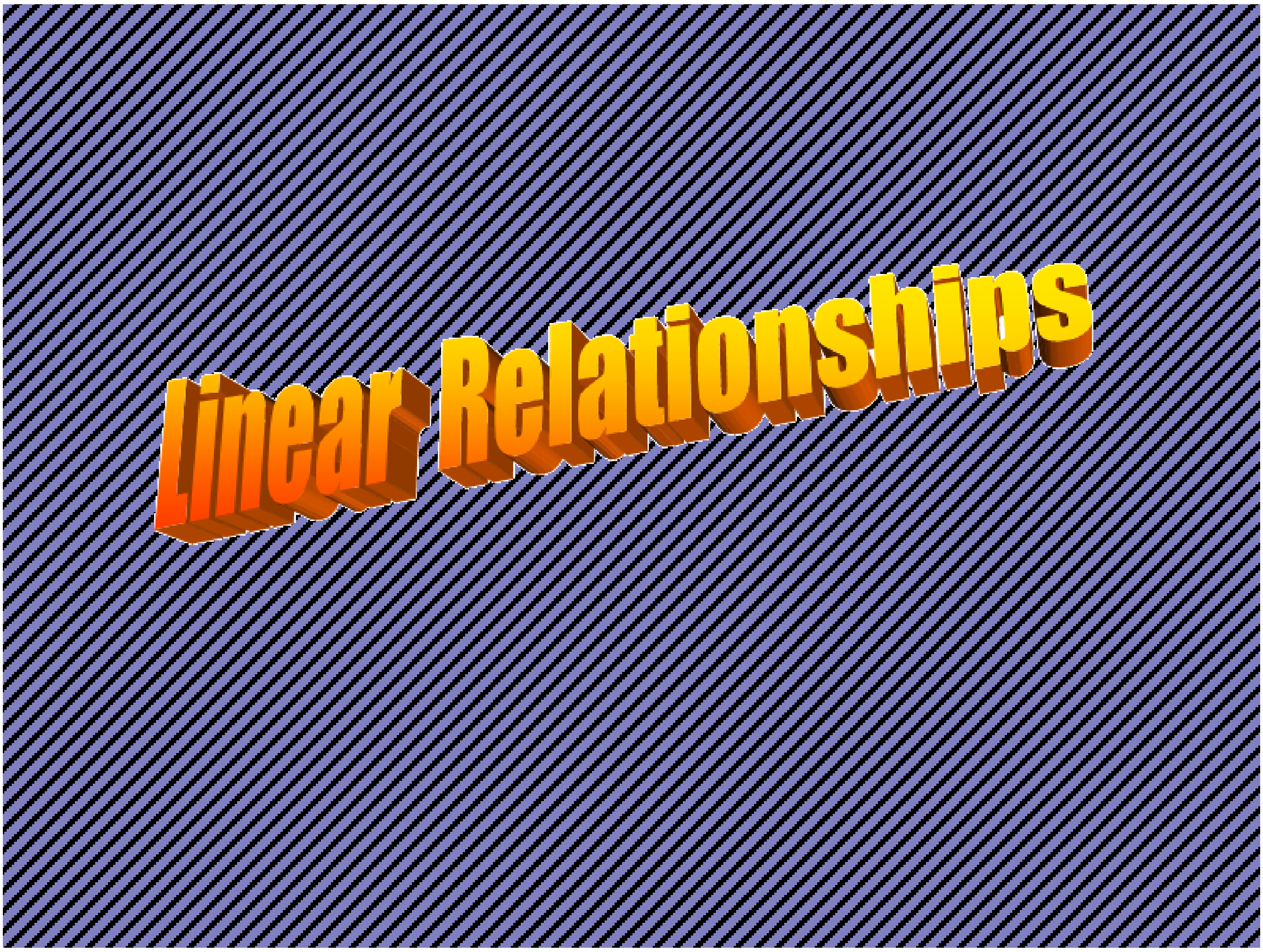
$108 = 3x^2$

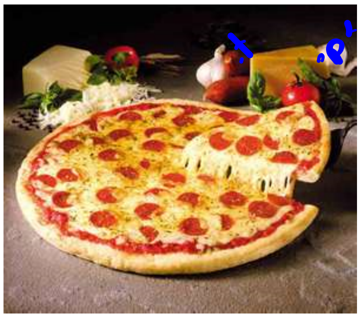
$\dfrac{108}{3} = \dfrac{3x^2}{3}$

$36 = x^2$

$\sqrt{36} = \sqrt{x^2}$

$\boxed{\pm 6 = x}$


Linear Relationships



The table of values and graph show the cost of a pizza with up to 5 extra toppings.

Ind Number of Extra Toppings	dep Cost ($)
0	12.00
1	12.75
2	13.50
3	14.25
4	15.00
5	15.75

What is the independent variable?

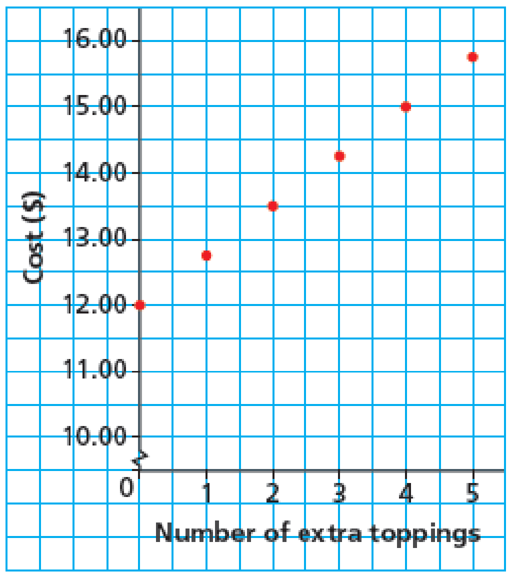
# of toppings

What is the dependent variable ?

cost

Graph

Cost of a Pizza



How to determine if a table is linear or non-linear

Check Rate of change

check to see if $\frac{\text{difference in } f(x)}{\text{difference in } x}$ gives same rate at every step

$$= \frac{\Delta y}{\Delta x}$$

= Decimal

a)

Δx	x	f(x) (y)	$\Delta f(x)$
	0	21	
14	14	63	42
7	21	84	21
14	35	105	21

$\frac{\Delta y}{\Delta x} = \frac{42}{14} = 3$

$\frac{\Delta y}{\Delta x} = \frac{21}{7} = 3$

$\frac{\Delta y}{\Delta x} = \frac{21}{14} = 1.5$

Since these are not all the same then this function is nonlinear

b)

Δx	x	f(x)	Δy
	6	10	
5	11	20	10
15	26	50	30
10	36	70	20

Rate

$\frac{\Delta y}{\Delta x}$

$\frac{10}{5} = 2$

$\frac{30}{15} = 2$

$\frac{20}{10} = 2$

Since these are all the same then this function is linear

- a table of values

Independent variable → Distance (km); Cost ($) ← Dependent variable

Distance (km)	Cost ($)
0	60
100	80
200	100
300	120
400	140

100   20

$\frac{20}{100} = \$0.20/\text{km}$

Rate of Change

Important

given a chart   given graph

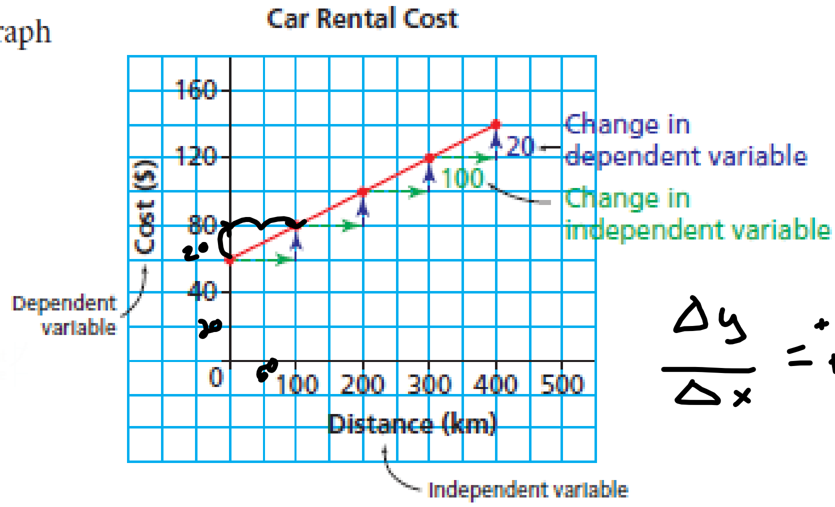
rate of change= $\dfrac{\text{change in dependent variable } (y)}{\text{change in independent variable } (x)} = \dfrac{\text{rise}}{\text{run}} =$

Rate of change for this question is

rate of change $= \dfrac{\Delta y}{\Delta x} =$

We can use each representation to calculate the **rate of change**.

- a graph



$$\frac{\Delta y}{\Delta x} = \frac{+20}{+100} =$$

The rate of change can be expressed as a fraction:

Important

Rate of Change = $\dfrac{\text{change in dependent}}{\text{change in independent}} = \dfrac{\text{rise}}{\text{run}}$

Example 2 Determining whether an Equation Represents a Linear Relation

a) Graph each equation.

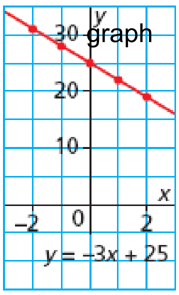
i) $y = -3x + 25$

SOLUTION

a) Create a table of values, then graph the relation.

i) $y = -3x + 25$

x	y
-2	31
-1	28
0	25
1	22
2	19



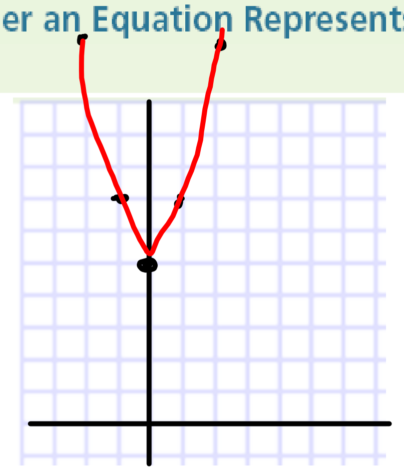
ontinues.)

Example 2 Determining whether an Equation Represents a Linear Relation

ii) $y = 2x^2 + 5$

x	y
-2	13
-1	7
0	5
1	7
2	13

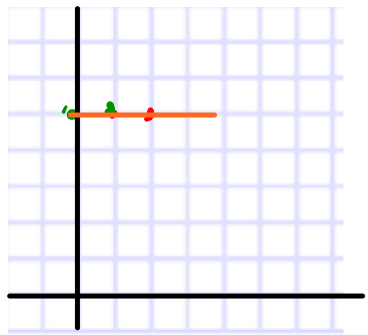
graph



iii) $y = 5$

x	y
0	5
1	5
2	5

grap



Example 2 Determining whether an Equation Represents a Linear Relation

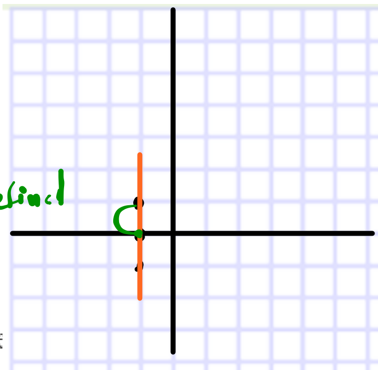
iv) $x = 1$

graph

x	y
1	-1
1	0
1	1

$\frac{rise}{run} = \frac{1}{0}$

$=$ undefined



NOTICE

b) The graphs in parts i, iii, and iv are straight lines, so the equations represent linear relations; that is, $y = -3x + 25$, $y = 5$, and $x = 1$.
The graph in part ii is not a straight line, so its equation does not represent a linear relation.

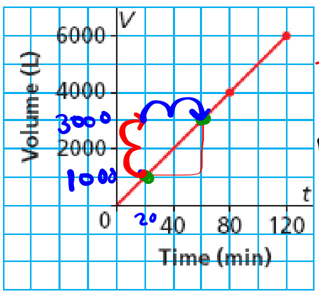
Solutions

Example 4 Determining the Rate of Change of a Linear Relation from Its Graph

A water tank on a farm near Swift Current, Saskatchewan, holds 6000 L.
Graph A represents the tank being filled at a constant rate.
Graph B represents the tank being emptied at a constant rate.

$\frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x}$

Graph A
Filling a Water Tank

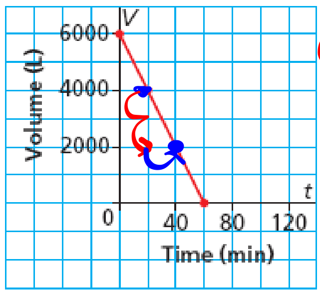


$\frac{\text{rise}}{\text{run}} = \frac{+2000\text{ L}}{+40\text{ min}}$

divide out

$\boxed{\text{rate} = 50\text{ L/min}}$

Graph B
Emptying a Water Tank



down

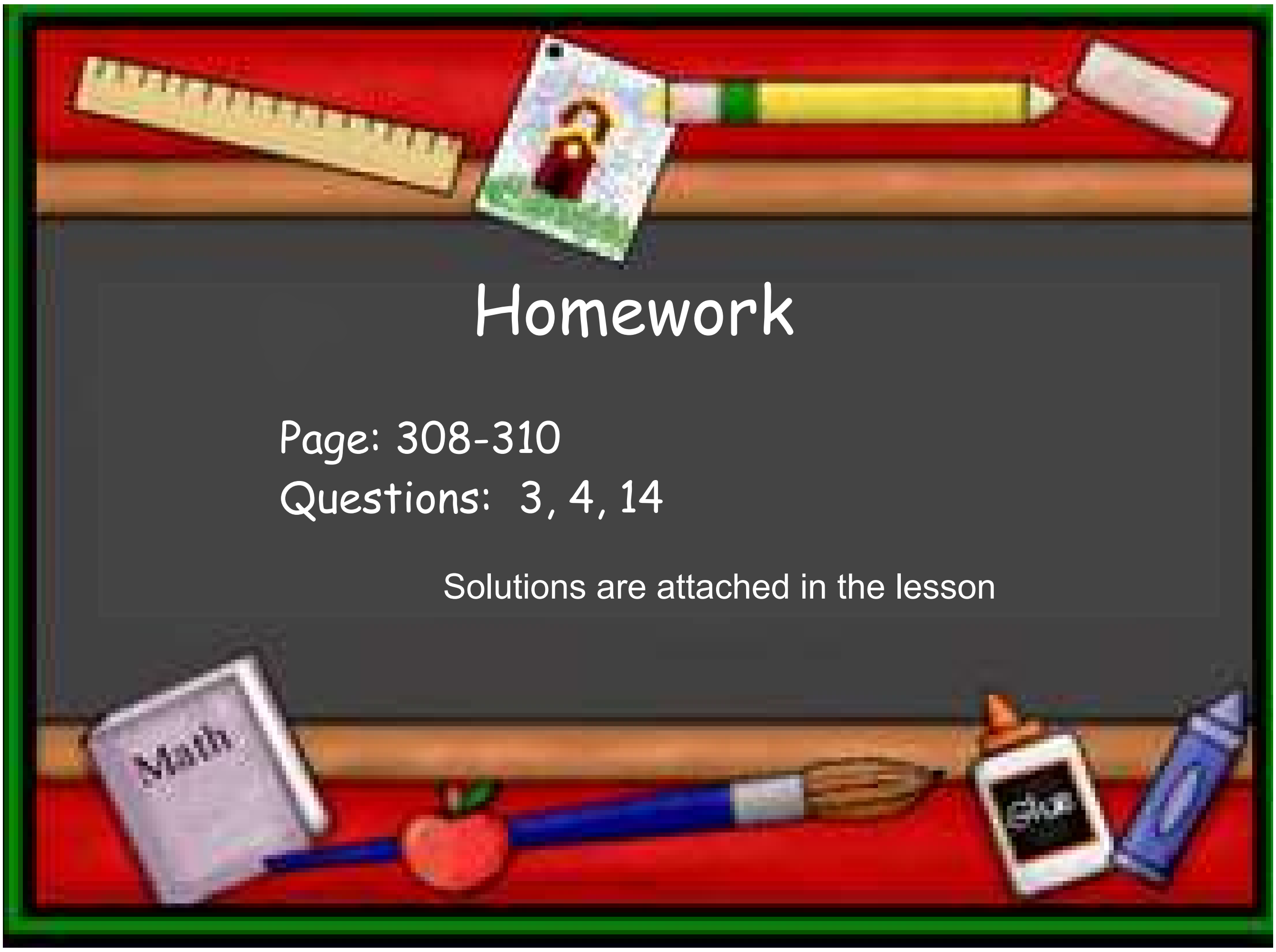
$\text{rise} = \frac{-2000\text{ L}}{120\text{ min}}$

$= \boxed{100\text{ L/min}}$

a) Identify the independent and dependent variables.

Time (min)   Volume (L)

b) Determine the rate of change of each relation, then describe what it represents.


Homework
Page: 308-310
Questions: 3, 4, 14
Solutions are attached in the lesson
Math

3. Which tables of values represent linear relations? Explain your answers.

a)

Time (min)	Distance (m)
0	10
2	50
4	90
6	130

b)

Time (s)	Speed (m/s)
0	10
1	20
2	40
3	80

c)

Speed (m/s)	Time (s)
15	7.5
10	5
5	2.5
0	0

d)

Distance (m)	Speed (m/s)
4	2
16	4
1	1
9	3

4. Which sets of ordered pairs represent linear relations? Explain your answers.

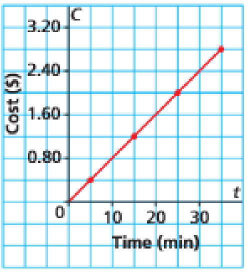
a) $\{(3, 11), (5, 9), (7, 7), (9, 5)\}$

b) $\{(-2, 3), (0, 1), (2, -3), (4, -7)\}$

c) $\{(1, 1), (1, 3), (2, 1), (2, 3)\}$

14. This graph represents Jerome's long distance phone call to his pen pal in Nunavut. Jerome is charged a constant rate.

The Cost of Jerome's Phone Call



a) Identify the dependent and independent variables.

b) Determine the rate of change, then describe what it represents.

pg 308 - 310
3, # 4, 14

Solutions

3a)

Time (min)	Distance (m)
0	10
2	50
4	90
6	130

+2, +2, +2 ; +40, +40, +40

$\text{rate} = \frac{\Delta y}{\Delta x} = \frac{40\text{m}}{2\text{min}} = 20\text{m/min}$

divide

Same

Same

all Same then linear

3b)

Time (s)	Speed (m/s)
0	10
1	20
2	40
3	80

+1, +1 ; +10, +20

$\text{rate} = \frac{\Delta y}{\Delta x} = \frac{10\text{ m/s}}{+1\text{ s}} = 10\text{ m/s}^2$

$\text{rate} = \frac{\Delta y}{\Delta x} = \frac{+20\text{ m/s}}{1\text{ s}} = 20\text{ m/s}^2$

Not same so Not linear

c) Linear

Speed (m/s)	Time (s)
15	7.5
10	5
5	2.5
0	0

−5 ; −2.5, −2.5, −2.5

All $\frac{-2.5}{-5} = 0.5\text{m/s}^2$

d) Non Linear

Distance (m)	Speed (m/s)
4	2
16	4
1	1
9	3

+12, −15 ; +2, −3, +2

$\text{Rate} = \frac{2}{12} = 0.1\overline{6}$

$R = \frac{-3}{-15} = 0.2$

5.6 Properties of Linear Relations

Page 308 Solutions

4. Which sets of ordered pairs represent linear relations? Explain your answers.

a) {(3, 11), (5, 9), (7, 7), (9, 5)}

Linear

x	y
3	11
5	9
7	7
9	5

+2   -2

$R = \frac{-2}{2} = -1$

b) {(−2, 3), (0, 1), (2, −3), (4, −7)}

+2 +2 +2

−2 −4 −4

Non Linear

c) {(1, 1), (1, 3), (2, 1), (2, 3)}

0 +1 0

+2 −2 +2

Non Linear

ar Relations

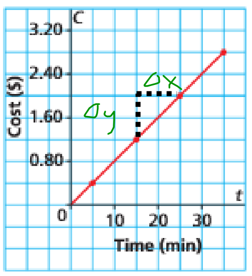
4. a) Linear relation **b)** Not a linear relation

c) Not a linear relation

solutions

14. This graph represents Jerome's long distance phone call to his pen pal in Nunavut. Jerome is charged a constant rate.

The Cost of Jerome's Phone Call



a) Identify the dependent and independent variables.

b) Determine the rate of change, then describe what it represents.

a) Independent= is Time in minutes

Dependent is Cost in dollars

notice that the y axis has each block going up by $0.40

notice that the x-axis has each block going up by 5 min

B) $$\frac{\Delta y}{\Delta x} = \frac{\$0.80}{10\ \text{min}} = \$0.08/\text{min}$$

Rate of change represents what you pay for 1 minute.

Here we pay 8 cents for 1 minute.