

Name: Key

1. Linear Applications

- a. Kim and Cyndi are starting a business tutoring students in math. They rent an office for \$400 per month and charge \$40 per hour per student. Write an equation to represent their profit. Then find their profit for a single month if they have 15 students for one hour per week? (Assume 4 weeks per month)

$$P(h) = 40h - 400 \quad (\text{monthly})$$
$$P(60) = 40(60) - 400$$
$$= \$2000$$

15 hrs/week  
= 60 hrs/mo

- b. To fix Ms. Dukes's car, Bob's Bumper Repair charges a flat fee of \$40 plus \$45 per hour.  
i) Write an algebraic equation using C for the cost and h for the number of hours.  
ii) How much would it cost to repair the car if it took 8 hours to complete?

i)  $C(h) = 40 + 45(h)$

ii)  $C(8) = 40 + 45(8)$   
 $= \$400$

- c. A tree 5 feet tall grows an average of 6 inches each year.

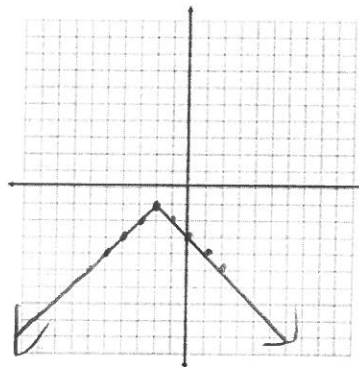
i) Write and graph a linear equation to model the tree's height (in feet) as a function of time (in years).  $h(t) = 5 + \frac{1}{2}(t)$

- ii) How tall will the tree be in 20 years?

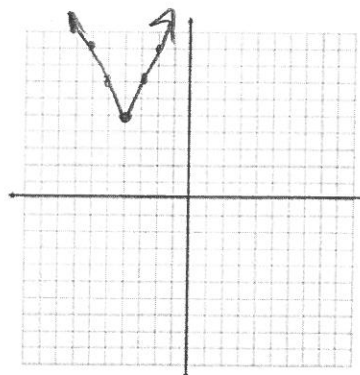
$$h(t) = 5 + \frac{1}{2}(20)$$
$$= 15 \text{ ft}$$

2. Graphing Absolute Value Functions

- a. Given the function  $f(x) = -|x + 2| - 1$   
i. What is the vertex?  $(-2, -1)$   
ii. Opens: Up or Down (circle answer)  
iii. Stretched/Compressed/Neither (circle answer)  
iv. Graph the function

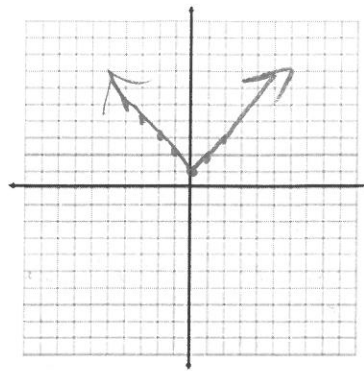


- b. Given the function  $f(x) = 2|x + 4| + 5$   
i. What is the vertex?  $(-4, 5)$   
ii. Opens: Up or Down (circle answer)  
iii. Stretched/Compressed/Neither (circle answer)  
iv. Graph the function



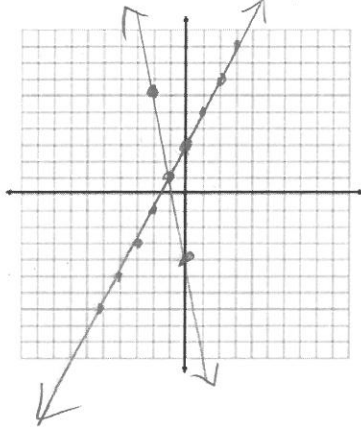
c. Given the function  $f(x) = |x| + 1$

- What is the vertex?  $(0, 1)$
- Opens up or down (circle answer)
- Stretched/Compressed/Neither
- Graph the function

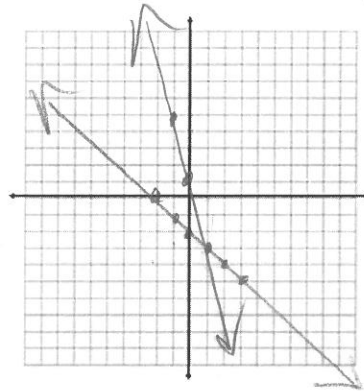


### 3. Solve the System of Equations by Graphing

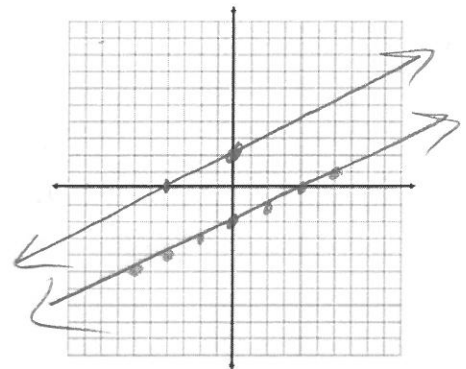
a.  $-2x + y = 3 + 2x$   
 $y = -5x - 4$   
 $(-1, 1)$



b.  $4x + y = 1 - 4x$   
 $x + y = -2 - x$   
 $(1, -3)$



c.  $y = \frac{1}{2}x - 2$   
 $-3x + 6y = 12$  No sol



### 4. Use either Substitution or Elimination to solve the following system of equations.

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

$$\begin{aligned} & \underline{-3x - 4y = 2} \\ & \quad -y = -1 \\ & \quad y = 1 \\ & -3x - 4(1) = 2 \\ & -3x - 4 = 2 \\ & -3x = 6 \\ & x = -2 \\ & (-2, 1) \end{aligned}$$

b.  $y = 5x - 7$   
 $-3x - 2y = -12$

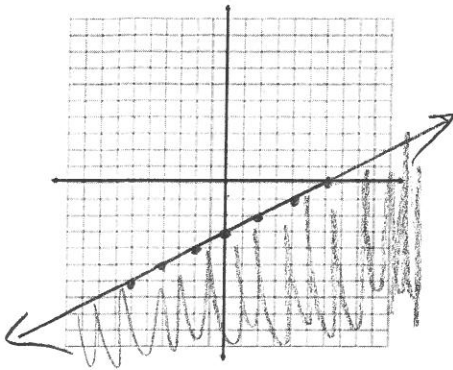
$$\begin{aligned} & -3x - 2(5x - 7) = -12 \\ & -3x - 10x + 14 = -12 \\ & \quad \quad \quad -14 \quad -14 \\ & -13x = -26 \\ & x = 2 \\ & y = 5(2) - 7 \\ & y = 3 \\ & (2, 3) \end{aligned}$$

c.  $-4x + y = 6$   
 $-5x - y = 21$

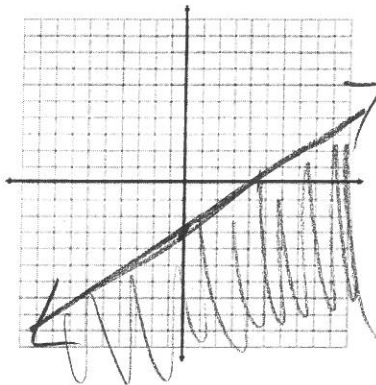
$$\begin{aligned} & \underline{-4x + y = 6} \\ & \quad -9x = 27 \\ & \quad x = -\frac{27}{9} \\ & \quad x = -3 \\ & -4(-3) + y = 6 \\ & 12 + y = 6 \\ & y = -6 \\ & (-3, -6) \end{aligned}$$

5. Graph the inequality.

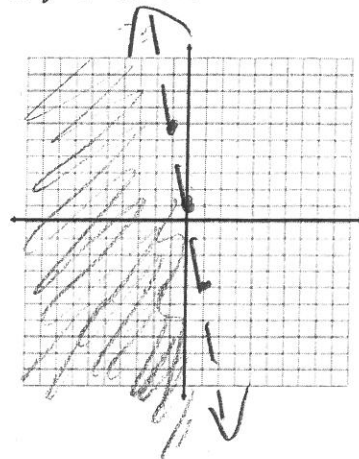
a.  $y \leq \frac{1}{2}x - 3$



b.  $2x - 3y \geq 9$



c.  $y < -5x + 1$



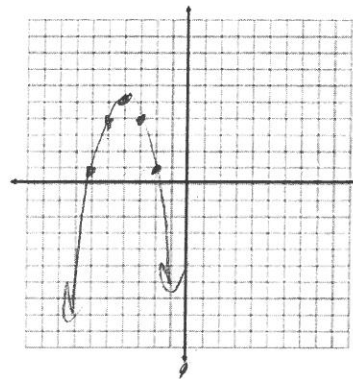
6. Graphing Quadratic Functions

a. Graph the function:  $y = -(x + 4)^2 + 5$

i. What is the vertex?  $(-4, 5)$

ii. What is the y-intercept?  $(0, -11)$

iii. Stretched/Compress/Neither (circle one).

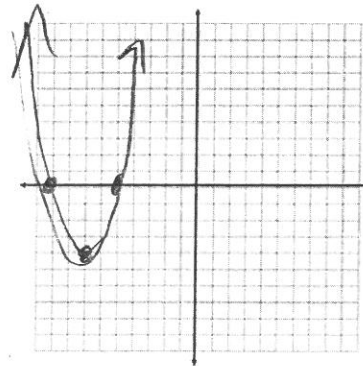


b. Graph the function:  $y = (x + 5)(x + 9)$

i. What is the vertex?  $(-7, -4)$

ii. What is the y-intercept?  $(0, 45)$

iii. Stretched/Compress/Neither (circle one).

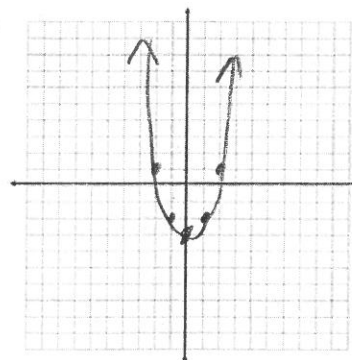


c. Graph the function:  $y = x^2 - 3$

i. What is the vertex?  $(0, -3)$

ii. What is the y-intercept?  $(0, -3)$

iii. Stretched/Compress/Neither (circle one).



## 7. Quadratic Applications- Maximum/Minimum/Zeroes

- a. A rocket carrying fireworks is launched from a hill 80 feet above a lake. The rocket will fall into the lake after exploding at its maximum height. The rocket's height above the surface of the lake is given by the function  $h(t) = -16t^2 + 64t + 80$ . What is the maximum height reached by the rocket? When does the rocket hit the ground?

$$x = \frac{-b}{2a} = \frac{-64}{2(-16)} = 2 \quad (2, 144) \quad \text{max height} = \boxed{144 \text{ ft}}$$

hits ground when  $h(t) = 0$

$$0 = -16t^2 + 64t + 80$$

$$0 = -16(t^2 - 4t - 5)$$

$$0 = -16(t - 5)(t + 1)$$

therefore  $t = 5$  or  $t = -1$   
only 5 seconds makes sense.

- b. A small business' profits over the last year have been related to the price of the only product. The relationship is  $R(p) = -0.4p^2 + 64p - 2400$  where  $R$  is the revenue measured in thousands of dollars and  $p$  is the price of the product measured in dollars. What price would maximize the profit?

$$x = \frac{-b}{2a} = \frac{-64}{2(-.4)} = 80$$

Price should be \$80 to maximize profit.

- c. A ball is thrown and follows the path described by the function  $h(t) = -5t^2 + 20t + 1$ , where  $h$  is the height of the ball and  $t$  is the time since the ball was released. How long does it take for the ball to reach its maximum height? When does the ball hit the ground?

$$h(t) = -5t^2 + 20t + 1$$

$$x = \frac{-b}{2a} = \frac{-20}{2(-5)} = 2$$

max height is in 2 seconds

hits ground when  $h(t) = 0$

$$0 = -(5t^2 - 20t - 1)$$

$$0 = 5t^2 - 20t - 1$$

not factorable

$$x = \frac{20 \pm \sqrt{400 - 4(5)(-1)}}{2(5)}$$

$$x = \frac{20 \pm \sqrt{420}}{10} \approx \sqrt{4.05 \text{ sec}}$$

+ neg does not make sense

## 8. Solve the equations by factoring:

a)  $v^2 - 18 = -3v$

$$v^2 + 3v - 18 = 0$$

$$(v + 6)(v - 3) = 0$$

$$v = -6 \text{ or } v = 3$$

b)  $5n^2 + 31n + 30 = 0$

$$(5n + 6)(n + 5) = 0$$

150  
6 x 25  
31

$$(5n + 6)(n + 5) = 0$$

5n  
25n

$$5n + 6 = 0 \text{ or } n + 5 = 0$$

$$5n = -6$$

$$n = \frac{-6}{5} \text{ or } n = -5$$

c)  $6x^2 - 10x - 4 = 0$

$$2(3x^2 - 5x - 2) = 0$$

$$2(3x + 1)(x - 2) = 0$$

$$x = \frac{-1}{3} \text{ or } x = 2$$

9. Solve the equations with the quadratic formula:

a)  $2k^2 - 4k - 16 = 0$

$$X = \frac{4 \pm \sqrt{16 - 4(2)(-16)}}{2(2)}$$

$$X = \frac{4 \pm \sqrt{144}}{4}$$

$$X = \frac{4 \pm 12}{4}$$

$$X = -2 \text{ or } X = 4$$

b)  $r^2 + 5r + 24 = 0$

$$X = \frac{-5 \pm \sqrt{25 - 4(1)(24)}}{2}$$

$$X = \frac{-5 \pm \sqrt{-71}}{2}$$

$$X = \frac{-5 \pm \sqrt{-71}}{2}$$

$$X = \frac{-5}{2} \pm \frac{\sqrt{-71}}{2} i$$

c)  $5v^2 + 10v - 3 = 0$

$$X = \frac{-10 \pm \sqrt{100 - 4(5)(-3)}}{2(5)}$$

$$X = \frac{-10 \pm \sqrt{160}}{10}$$

$$\frac{-10 \pm 4\sqrt{10}}{10} = \frac{-1 \pm 2\sqrt{10}}{5}$$

or

$$\frac{-1 \pm 2\sqrt{10}}{5}$$

10. Simplify the expressions:

a)  $(3 - 7i) + (-2 + 3i)$

$$15 + 23i$$

b)  $(8 + 6i) - (-1 - i)$

$$-2 - 14i$$

c)  $(7 - 3i)(-4 - 8i)$

$$-52 - 44i$$

11. Simplify the expressions:

a)  $(2x^4 + 5) - (3x^4 - 1)$

$$-x^4 + 6$$

b)  $(2x^3 + 5x^4) + (3x^4 + x^3)$

$$8x^4 + 3x^3$$

c)  $(6 - 2n^2) + (4n - 14n^2 + 11)$

$$-16n^2 + 4n + 17$$

12. Simplify the expression:  $(8m^4n^3 + 4) - (-12 + 8m^2n^3 + 14m^4n^3) + (14m^2n^3 - 13)$

$$-6m^4n^3 + 6m^2n^3 + 3$$

13. Find the Product:

a)  $5r(7r + 4)$

$35r^2 + 20r$

b)  $(6v - 5)(3v + 5)$

$18v^2 + 15v - 25$

c)  $(7x^2 + 3x + 1)(4x - 3)$

$28x^3 - 21x^2 + 12x^2 - 9x + 4x - 3$   
 $28x^3 - 9x^2 - 5x - 3$

14. Use long division to simplify:

a)  $(3x^2 - 11x - 26) \div (2x - 5)$

$2x - 5 \overline{) 3x^2 - 11x - 26}$   
 $\underline{-(3x^2 - \frac{15}{2}x)}$   
 $\phantom{2x - 5 \overline{) 3x^2 - 11x - 26}} -\frac{7}{2}x - 26$   
 $\underline{-( -\frac{7}{2}x - \frac{35}{4})}$   
 $\phantom{2x - 5 \overline{) 3x^2 - 11x - 26}} -\frac{69}{4}$   
 $\frac{3}{2}x - \frac{7}{4} + \frac{69}{8x-20}$

$-\frac{22}{2}$   
 $+\frac{15}{2}$   
 $-\frac{7}{2}$

b)  $(7x^3 + 11x^2 + 7x + 5) \div (x^2 + 1)$

$x^2 + 1 \overline{) 7x^3 + 11x^2 + 7x + 5}$   
 $\underline{-(7x^3 + 7x)}$   
 $\phantom{x^2 + 1 \overline{) 7x^3 + 11x^2 + 7x + 5}} 4x^2 + 5$   
 $\underline{-(4x^2 + 4)}$   
 $\phantom{x^2 + 1 \overline{) 7x^3 + 11x^2 + 7x + 5}} -6$

c)  $\frac{x^2+x-17}{x-4}$

$x - 4 \overline{) x^2 + x - 17}$   
 $\underline{-(x^2 - 4x)}$   
 $\phantom{x - 4 \overline{) x^2 + x - 17}} 5x - 17$   
 $\underline{-(5x - 20)}$   
 $\phantom{x - 4 \overline{) x^2 + x - 17}} 3$

Really hard!

15. Use synthetic division to simplify:

a)  $(2x^2 - 7x + 10) \div (x - 5)$

$5 \overline{) 2 \quad -7 \quad 10}$   
 $\phantom{5 \overline{) 2 \quad -7 \quad 10}} \underline{10 \quad 15}$   
 $\phantom{5 \overline{) 2 \quad -7 \quad 10}} 2 \quad 3 \quad 25$   
 $2x + 3 + \frac{25}{x-5}$

b)  $\frac{x^4 - 5x^3 - 8x^2 + 13x - 12}{x - 6}$

$6 \overline{) 1 \quad -5 \quad -8 \quad 13 \quad -12}$   
 $\phantom{6 \overline{) 1 \quad -5 \quad -8 \quad 13 \quad -12}} \underline{6 \quad 6 \quad -12 \quad 6}$   
 $\phantom{6 \overline{) 1 \quad -5 \quad -8 \quad 13 \quad -12}} 1 \quad 1 \quad -2 \quad 1 \quad -6$   
 $x^3 + x^2 - 2x + 1 + \frac{-6}{x-6}$

c)  $(x^3 - 5x^2 - 2) \div (x - 4)$

$4 \overline{) 1 \quad -5 \quad 0 \quad -2}$   
 $\phantom{4 \overline{) 1 \quad -5 \quad 0 \quad -2}} \underline{4 \quad -4 \quad -16}$   
 $\phantom{4 \overline{) 1 \quad -5 \quad 0 \quad -2}} 1 \quad -1 \quad -4 \quad -18$   
 $x^2 - x - 4 + \frac{-18}{x-4}$

16. Factor the following:

a)  $x^3 + 64$

$(x+4)(x^2 - 4x - 16)$

b)  $125n^3 - 27$

$(5n-3)(25n^2 + 15n + 9)$

c)  $27a^3 - 1000$

$(3a-10)(9a^2 + 30a + 100)$

d)  $x^3 - 3x^2 - 16x + 48$

$x^2(x-3) - 16(x-3)$

$(x-3)(x^2 - 16)$

$(x-3)(x+4)(x-4)$

e)  $x^3 + 7x^2 - 9x - 63$

$x^2(x+7) - 9(x+7)$

$(x+7)(x^2 - 9)$

$(x+7)(x+3)(x-3)$

f)  $g^3 + 3g^2 - g - 3$

$g^2(g+3) - (g+3)$

$(g^2 - 1)(g+3)$

$(g+1)(g-1)(g+3)$

17. Solve the following:

a)  $x^3 + 2x^2 - 25x - 50 = 0$

$x^2(x+2) - 25(x+2) = 0$

$(x^2 - 25)(x+2) = 0$

$(x-5)(x+5)(x+2) = 0$

$x = 5$  or  $x = -5$  or  $x = -2$

b)  $3x^3 - 27x = 0$

$3x(x^2 - 9) = 0$

$3x(x+3)(x-3) = 0$

$x = 0$  or  $x = -3$  or  $x = 3$

c)  $n^4 + 6n^3 = 0$

$n^3(n+6) = 0$

$n = 0$  or  $n = -6$

d)  $16g^2 - 625 = 0$

$(4g-25)(4g+25) = 0$

$g = \frac{25}{4}$  or  $g = -\frac{25}{4}$

e)  $3x^3 + 15x^2 - 18x = 0$

$3x(x^2 + 5x - 6) = 0$

$3x(x+6)(x-1) = 0$

$x = 0$  or  $x = -6$  or  $x = 1$

d)  $x^3 - 25x = 0$

$x(x^2 - 25) = 0$

$x(x+5)(x-5) = 0$

$x = 0$  or  $x = -5$  or  $x = 5$

or

$16g^2 = 625$

$g^2 = \frac{625}{16}$

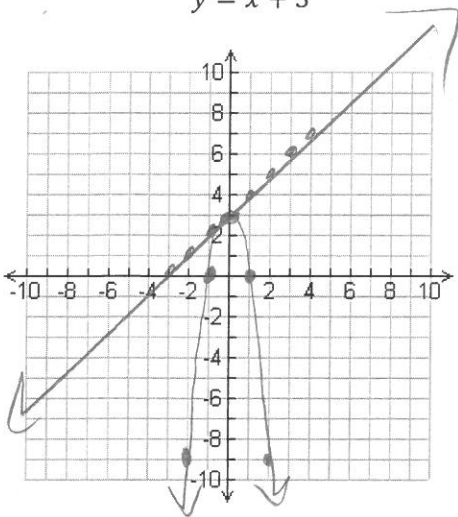
$g = \pm \sqrt{\frac{625}{16}}$

$g = \pm \frac{25}{4}$

same answer

18. Solve the following systems either by algebraically or by graphing:

a)  $y = -3x^2 + 3$   
 $y = x + 3$



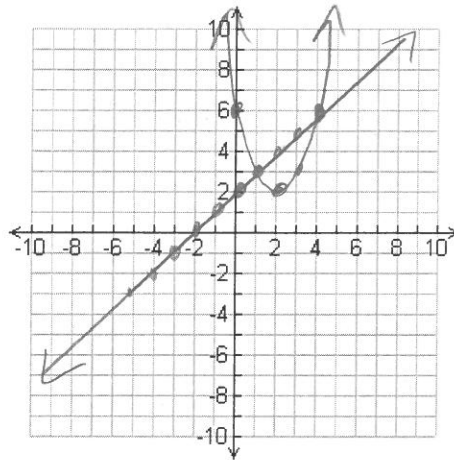
$$\begin{aligned} -3x^2 + 3 &= x + 3 \\ -3x^2 - x &= 0 \\ -x(3x + 1) &= 0 \end{aligned}$$

$x = 0$  or  $x = -\frac{1}{3}$

$(0, 3)$   
 $(-\frac{1}{3}, \frac{7}{3})$

b)  $y = x^2 - 4x + 6$   
 $y = x + 2$

$x = \frac{4}{2} = 2$   
 $(2, 2)$

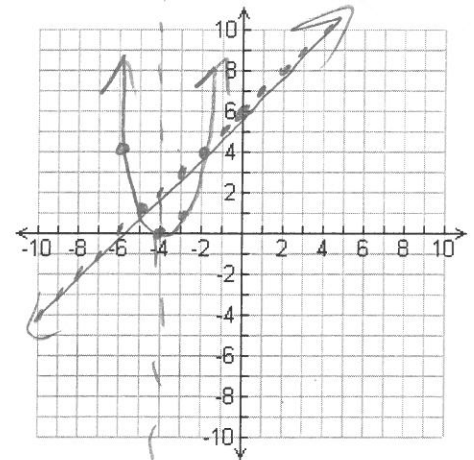


$$\begin{aligned} x^2 - 4x + 6 &= x + 2 \\ x^2 - 5x + 4 &= 0 \\ (x - 4)(x - 1) &= 0 \end{aligned}$$

$(4, 6)$   $(1, 3)$

c)  $y = x^2 + 8x + 16$   
 $y = x + 6$

$x = \frac{-8}{2} = -4$



$$\begin{aligned} x^2 + 8x + 16 &= x + 6 \\ x^2 + 7x + 10 &= 0 \\ (x + 5)(x + 2) &= 0 \end{aligned}$$

$(-5, 1)$   $(-2, 4)$

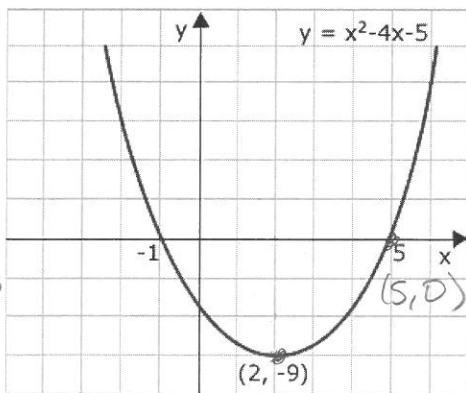
$y = -5 + 6$   
 $y = 1$

$y = -2 + 6$   
 $y = 4$

19. Find the average rate of change of the following:

a) Find the average rate of change from

$x = 2$  to  $x = 5$

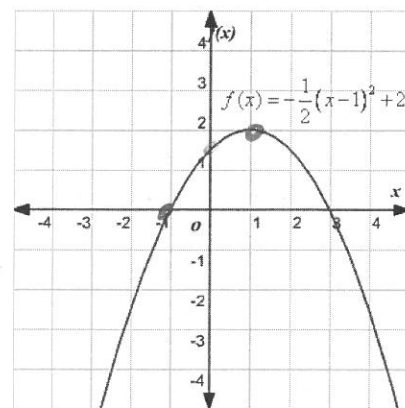


$AROC = \frac{9}{3}$

$\frac{0 - (-9)}{5 - 2} = 3$

b) Find the average rate of change from

$x = -1$  to  $x = 1$



$(-1, 0)$   
 $(1, 2)$

$AROC = \frac{2 - 0}{1 - (-1)}$   
 $= \frac{2}{2}$   
 $= 1$

c) Find the average rate of change from  $x = 0$  to  $x = 2$

x	f(x)
0	5
1	1
2	-3
3	-7
4	-11

$(0, 5)$   
 $(2, -3)$

$AROC = \frac{5 - (-3)}{0 - 2} = \frac{8}{-2} = -4$