Section 2.1 Linear Functions

$y = mx + b \rightarrow \boxed{f(x) = mx + b}$

$y - y_1 = m(x - x_1)$ $\quad y = f(x)$

Examples $\quad m = \frac{y_2 - y_1}{x_2 - x_1}$

1) Write and graph the linear function $f(x)$ for which $f(-2) = 5$ and $f(4) = -4$.

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

$m = \frac{-4-5}{4--2} = \frac{-9}{6} = \boxed{\frac{-3}{2} = m}$

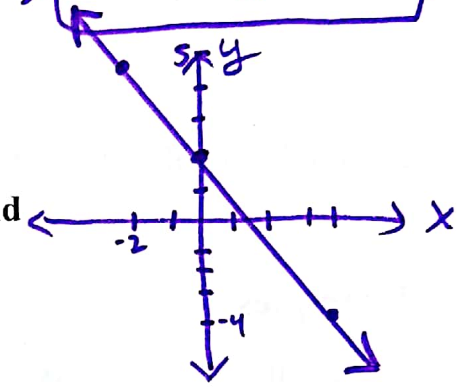
$y - 5 = -\frac{3}{2}(x + 2)$

$y - 5 = -\frac{3}{2}x - 3$

$+5 \qquad +5$

$y = -\frac{3}{2}x + 2$

$\boxed{f(x) = -\frac{3}{2}x + 2}$



Average Rate of Change of a function $y = f(x)$ between x = a and x = b where a is not equal to b is given by

$$\frac{f(b) - f(a)}{b - a}$$

← HW #78

In other words,

(change in the output values)/(change in the input values)

In a linear function, the rate of change is constant and is equivalent to the slope of the line.

Modeling Depreciation with a Linear Function → losing value - slope will be neg.

2) Camelot Apartments bought a \$50,000 building and for tax purposes are depreciating it \$2000 per year over a 25-year period using straight-line depreciation.

a) What is the rate of change of the value of the building?

-2000

b) Write an equation for the value v(*t*) of the building as a linear function of the time *t* since the building was placed in service.

$v(t) = 50\,000 - 2000t$

$v(t) = -2000t + 50\,000$

c) Evaluate v(0) and v(16)

$v(0) = 50000 - 2000(0) = \$50{,}000$

$v(16) = 50\,000 - 2000(16) = \$18{,}000$

d) Solve v(t)= 39,000

$39{,}000 = \cancel{50\,000} - 2000t$

$-50\,000 \qquad -\cancel{50\,000}$

$\frac{-11{,}000}{-2000} = \frac{-2000t}{-2000}$

$\boxed{t = 5.5 \text{ yrs}}$

Section 2.1 Quadratic Functions

Standard form of a Quadratic Equation $f(x) = ax^2 + bx + c$

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

y-intercept (0,c)

y-intercept let $x = 0$

Vertex form of a Quadratic Equation $f(x) = a(x - h)^2 + k$

Vertex (h,k)

axis of sym. $x = h$

Factored form of a Quadratic Equation $f(x) = a(x - m)(x - n)$

$x - m = 0$ $\quad x - n = 0$

x-intercept let $y = 0$

Zeros x=m and x=n

x-intercepts

Examples

* For HW leave fractions No decimals

1) Find the vertex and axis of the graph of the function. Rewrite the equation in vertex form.

~~$f(x) = 8x - x^2 + 3$~~ $\quad f(x) = -x^2 + 8x + 3$ $\quad x = \frac{-b}{(2a)}$

$f(x) = a(x-h)^2 + k$

$\boxed{f(x) = -1(x-4)^2 + 19}$

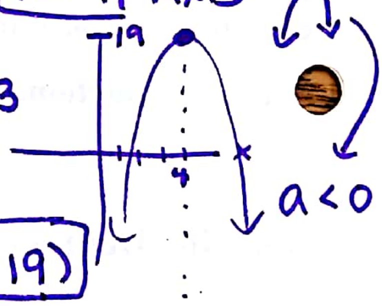
$x = \frac{-8}{(2(-1))} = \frac{-8}{-2} = 4$ $\quad \boxed{x = 4}$ Axis

$f(4) = -1 \cdot (4)^2 + 8(4) + 3$

$\quad\;\; -1 \cdot 16$

$f(4) = -16 + 32 + 3$

$f(4) = 19$ $\quad \boxed{\text{vertex } (4, 19)}$



$a < 0$

2) Use completing* the square to describe the graph of each function. Support your answer graphically.

$f(x) = 10 - 16x - x^2$ $\quad f(x) = -x^2 - 16x + 10$

$f(x) = -x^2 - 16x \qquad + 10$

$= -1(x^2 + 16x \underline{+64}) + 10 \quad \underline{+64}$ ← opposite of $a \cdot \left(\frac{b}{2}\right)^2$

$(8)^2$

$f(x) = -1(x+8)^2 + 74$

Describe:

Axis $x = -8$

vertex $(-8, 74)$ ← max.

opens downward

x-intercepts $(0.602, 0)$ & $(-16.602, 0)$

y-intercept $(0, 10)$

$x = -8 + \sqrt{74} \approx 0.602$

$x = -8 - \sqrt{74} \approx -16.602$

x-intercepts

$0 = -1(x+8)^2 + 74$

$\pm\sqrt{74} = \sqrt{(x+8)^2}$

$\pm\sqrt{74} = x + 8$

3) Write an equation of for the quadratic function whose vertex is (-5, 13) and that passes through the point (-2, 22).

vertex $(-5, 13)$ — h, k

pt $(-2, 22)$ — x, y

$f(x) = a(x-h)^2 + k$

$y = a(x+5)^2 + 13$

$22 = a(-2+5)^2 + 13$

$22 = 9a + 13$

$9 = 9a$

$\boxed{1 = a}$

$\boxed{f(x) = 1(x+5)^2 + 13}$

CLASSWORK SECTION 2.1 key

Linear Functions

Tuesday 8/28 Also # 55

53. Fuel Economy Table 2.6 shows the average U.S. fuel economy for "light duty" vehicles (passenger cars and small trucks) for several years. Let x be the number of years since 1985, so that $x = 5$ stands for 1990 and so forth.

Table 2.6 Light Duty Vehicles

Year L1		Fuel Economy (mpg) L2
1990	5	20.3
1995	10	21.1
2000	15	21.9
2005	20	22.1
2010	25	23.5

Source: National Transportation Statistics 2012, U.S. Department of Transportation.

(a) **Writing to Learn** Find the linear regression model for these data. What does the slope in the regression model represent?

$f(x) = 0.148x + 19.56$

(b) Use the linear regression model to predict the average U.S. fuel economy for light duty vehicles in the year 2015.

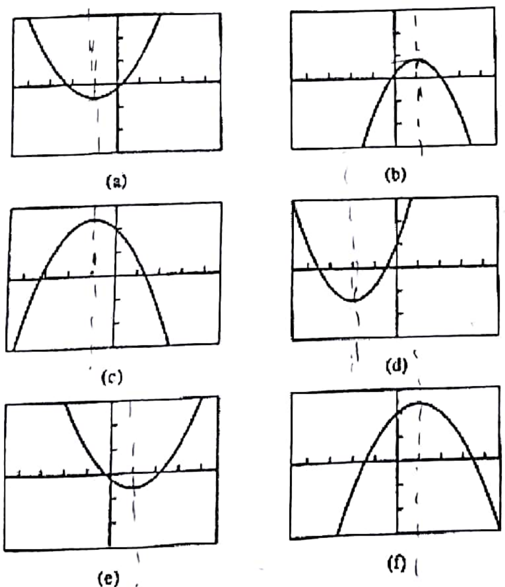
$x = 30$

24 mpg

Quadratic Functions

☆ Monday 8/27

In Exercises 13–18, match a graph to the function. Explain your choice.



13) v (-1,-3) ↑ 14) (-2,-7) ↑
15) v (1,4) ↓ 16) (1, 12) ↓
17) v (1,-3) ↑ 18) (-1, 12) ↓

First identify vertex & opens up/down

13. $f(x) = 2(x + 1)^2 - 3$ A **14.** $f(x) = 3(x + 2)^2 - 7$ D

15. $f(x) = 4 - 3(x - 1)^2$ B **16.** $f(x) = 12 - 2(x - 1)^2$ F

17. $f(x) = 2(x - 1)^2 - 3$ E **18.** $f(x) = 12 - 2(x + 1)^2$ C

In Exercises 19–22, describe how to transform the graph of $f(x) = x^2$ into the graph of the given function. Sketch each graph by hand.

19. $g(x) = (x - 3)^2 - 2$

Rt 3 down 2

20. $h(x) = \frac{1}{4}x^2 - 1$

v. shrink by $\frac{1}{4}$
down 1

21. $g(x) = \frac{1}{2}(x + 2)^2 - 3$

v. shrink by $\frac{1}{2}$
left 2
down 3

22. $h(x) = -3x^2 + 2$

reflect over X axis, v. Stretch by 3
up 2

In Exercises 23–26, find the vertex and axis of the graph of the function.

23. $f(x) = 3(x - 1)^2 + 5$

24. $g(x) = -3(x + 2)^2 - 1$

25. $f(x) = 5(x - 1)^2 - 7$

26. $g(x) = 2(x - \sqrt{3})^2 + 4$

23) $(1, 5)$
$x = 1$

24) $(-2, -1)$
$x = -2$

25) $(1, -7)$
$x = 1$

26) $(\sqrt{3}, 4)$
$x = \sqrt{3}$

key

CLASSWORK SECTION 2.1

55. Determining Revenue The per unit price p (in dollars) of a popular toy when x units (in thousands) are produced is modeled by the function

$$\text{price} = p = 12 - 0.025x.$$

The revenue (in thousands of dollars) is the product of the price per unit and the number of units (in thousands) produced. That is,

Quadratic → $\boxed{\text{revenue} = xp = x(12 - 0.025x).}$

(a) State the dimensions of a viewing window that shows a graph of the revenue model for producing 0 to 100,000 units.

(b) How many units should be produced if the total revenue is to be \$1,000,000?

(1000 = y)

x = # of units (in thousands)

p = price (in dollars)

r = in thous of \$

A) start

$X_{min} = 0$

$X_{max} = 100$ (in thous)

$Y_{min} = 0$

$Y_{max} = 100(12-0.025 \cdot 100)$

950 (thousand)

B) change window

$Y_2 = 1000$ (1000×1000 is 1mill)

change $X_{max} = 200$

$Y_{max} = 2000$

(107.335, 1000)

$\boxed{107,335 \text{ units}}$

for a total revenue of \$1,000,000

2 intersection pts.

Change $X_{max} = 400$

$\boxed{372,665 \text{ units}}$

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