

**Math 1210 – College Algebra I**  
 EXAM THREE: Sections 1.5, 2.1, 2.2, 2.3 and 2.4  
 Tuesday, March 29, 2011

Name: Answer Key - Version B

1. (2 pts each) For each statement below fill in the blank with the correct answer.

a. The  $x$ -intercept of the line  $2x + 7y = 28$  is  $x = 14$  or  $(14, 0)$ .

b. The  $y$ -intercept of the line  $2x + 7y = 28$  is  $y = 4$  or  $(0, 4)$ .

c. The equation of the vertical line that passes through the point  $(4, 6)$  is  $x = 4$ .

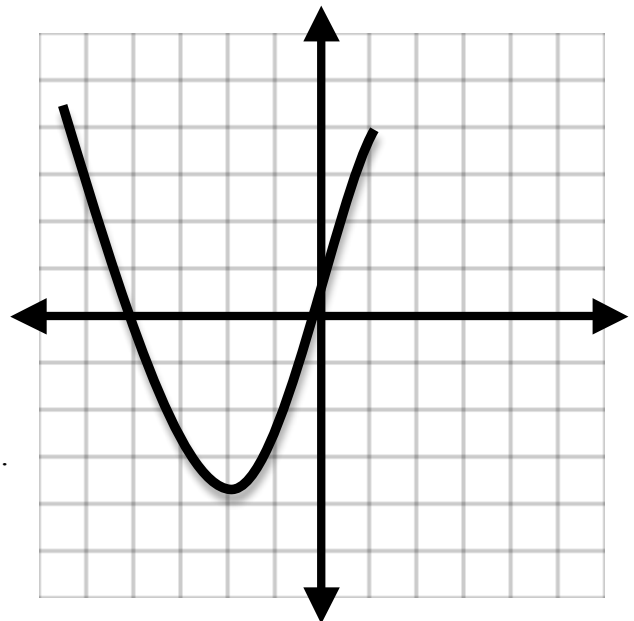
2. (2 pts) Sketch the graph of a function that has only negative average rates of change for  $x \leq -2$  and only positive average rates of change for  $x \geq -2$ . Use the grid at the right.

*Answers may vary*

3. (2 pts each) For each statement below circle T if the statement is true and F if the statement is false.

T    F    If a function is always increasing then it only has positive average rates of change.

T     F    The average rate of change between any two points of a nonlinear function is constant.



4. For parts a – c, let  $f(x) = 2x^2 - 6x - 15$ .

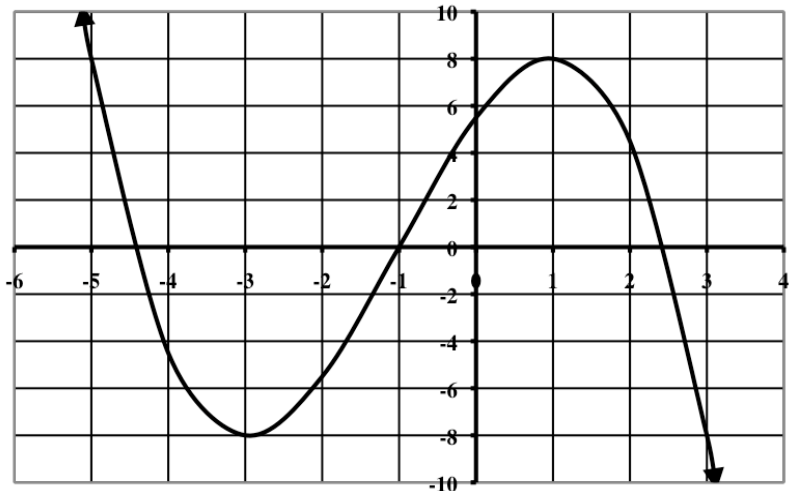
a. (4 pts) Find the average rate of change of  $f(x)$  from  $x_1 = -2$  to  $x_2 = 0$ .

$$\begin{aligned} f(-2) &= 2(-2)^2 + 6(-2) - 15 = 5 & (-2, 5) \\ f(0) &= 2(0)^2 + 6(0) - 15 = -15 & (0, -15) \end{aligned} \quad m = \frac{-15 - 5}{0 - (-2)} = \frac{-20}{2} = -10$$

b. (2 pts) Determine where the graph of  $f(x)$  is increasing. Write your answer in interval notation.  
 $[1.5, \infty)$

c. (2 pts) Determine where the graph of  $f(x)$  is decreasing. Write your answer in interval notation.  
 $(-\infty, 1.5]$

5. (2 pts each) From the list below, indicate the interval(s) where the function is increasing and the interval(s) where the function is decreasing. **You may have more than one answer.**



Decreasing A and G

Increasing C

- A.  $[1, \infty)$                       B.  $[-4.5, -1)$   
 C.  $[-3, 1]$                       D.  $[-6, 4]$                       E.  $(-\infty, -4.5]$                       F.  $[-8, 8]$                       G.  $(-\infty, -3]$   
 H.  $[-1, 2.5]$                       I.  $[-1, 2.5]$                       J.  $[2.5, \infty)$                       K.  $(-\infty, -8]$                       L.  $[8, \infty)$

6. (2 pts) The equation  $5x - 3(x + 2) = 2x - 4$  can be classified as: (Choose the best answer.)

A) a conditional equation

B) an identity

C) a contradiction

$$5x - 3x - 6 = 2x - 4$$

$$2x - 6 = 2x - 4$$

7. (4 pts) Solve the following equation for  $x$ .

$$\begin{aligned} y &= 3(x - 5) + 2 \\ y &= 3x - 15 + 2 \\ y &= 3x - 13 \\ y + 13 &= 3x \end{aligned}$$

$$x = \frac{y + 13}{3} = \frac{y}{3} + \frac{13}{3}$$

8. (4 pts each) Solve the linear equations symbolically. Give an exact answer.

a.  $5 - 2x - 7(4 - x) = 2(x + 3)$   
 $5 - 2x - 28 + 7x = 2x + 6$   
 $-23 + 5x = 2x + 6$   
 $3x - 23 = 6$   
 $3x = 29$

$$x = \frac{29}{3}$$

b.  $\frac{1}{3}(x - 4) + \frac{5}{3} = \frac{2}{5}x$   
 $\frac{1}{3}x - \frac{4}{3} + \frac{5}{3} = \frac{2}{5}x$   
 $\frac{1}{3}x + \frac{1}{3} = \frac{2}{5}x$   
 $\frac{1}{3} = \frac{1}{15}x$

$$x = 5$$

9. (4 pts each) Solve the following inequalities symbolically for  $x$ . Give an exact answer.

a.  $\frac{4-5x}{-6} > 2x$

$$4 - 5x < -12x$$

$$4 < -7x$$

$$\frac{-4}{7} > x$$

$$x < \frac{-4}{7}$$

$$\left(-\infty, \frac{-4}{7}\right)$$

b.  $-9 \leq 4x - 9 \leq 8$

$$0 \leq 4x \leq 17$$

$$0 \leq x \leq \frac{17}{4}$$

$$\left[0, \frac{17}{4}\right]$$

10. The required cooling capacity, in BTUs, for a room air conditioner is directly proportional to the area of the room being cooled. A room of 270 square feet requires an air conditioner whose cooling capacity is 9000 BTUs.

- a. (3 pts) What is the constant of proportionality? Give an exact answer.

$$C = kA$$

$$9000 = k(270)$$

$$\frac{100}{3} = k$$

- b. (3 pts) If a room is 15 feet by 14 feet (210 square feet) what size, in BTUs, room air conditioner should you buy?

$$C = \frac{100}{3}A$$

$$C = \frac{100}{3}(210) = 7,000 \text{ BTUs}$$

11. Answer the following questions using the graph of the linear function  $f(x)$  shown at the right.

- a. (1 pt) Identify the  $y$ -intercept.

$$y = 2 \text{ or } (0, 2)$$

- b. (1 pt) Identify the  $x$ -intercept.

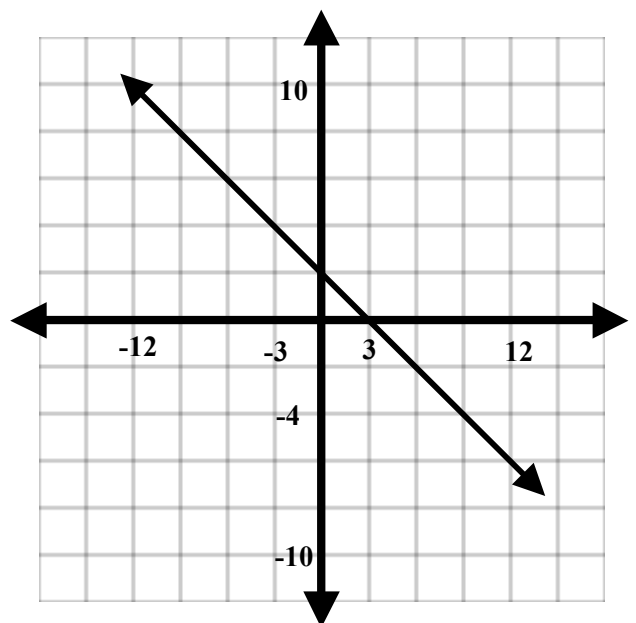
$$x = 3 \text{ or } (3, 0)$$

- c. (2 pts) Identify the slope.  $m = \frac{-2}{3}$

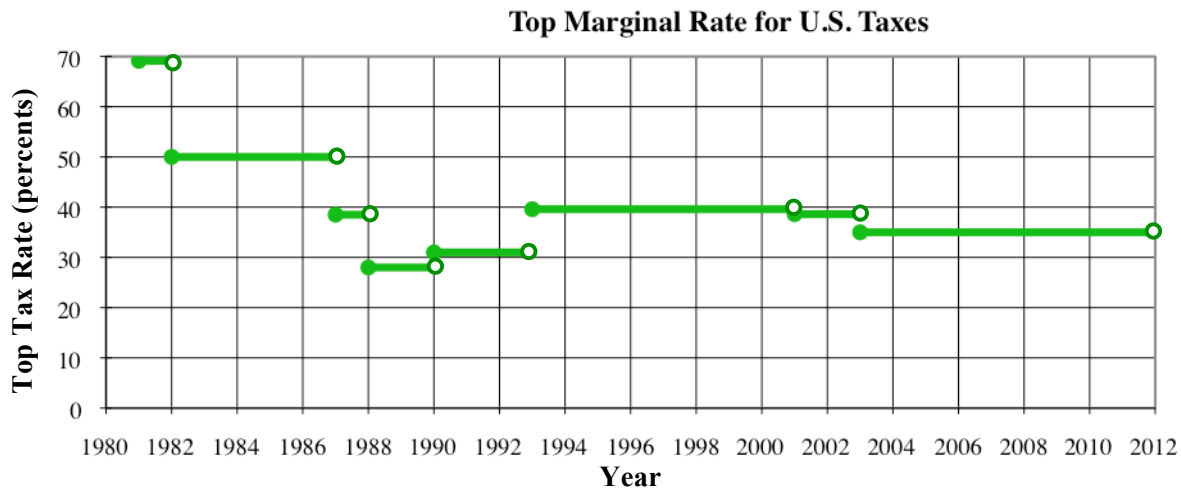
- d. (2 pts) Write a formula for  $f$ .

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

- e. (1 pt) Find any zeros of  $f$ .  $x = 3 \text{ or } (3, 0)$



12. The graph below shows the top tax rate for U.S. income tax from 1981 until 2011.  
<http://www.taxpolicycenter.org/taxfacts/displayafact.cfm?Docid=213>



- a. (2 pts) What year did the top tax rate decrease by the largest amount?

**1982**

- b. (2 pts) In part a, how much was this decrease in the top tax rate?

**18%**

- c. (2 pts) What was the top tax rate in 1993?

**40%**

13. In 1990 the federal minimum wage was \$3.80. By 2010 the minimum wage had increased to \$7.25.  
 (Source: <http://www.laborlawcenter.com/t-federal-minimum-wage.aspx>)

- a. (2 pts) Find the slope of the line that passes through the points (1990, 3.80) and (2010, 7.25). Show work to get full credit for this problem.

$$m = \frac{7.25 - 3.80}{2010 - 1990} = .1725$$

- b. (2 pts) Interpret the slope in part a in context of the problem.

*Each year the minimum wage increases by \$.1725 or 17.25¢.*

- c. (2 pts) Assuming the minimum wage increased at a constant rate, find an equation of a line that models this data, where  $x$  is the year.

$$y = .1725(x - 2010) + 7.25 \quad y = .1725x - 346.725 + 7.25$$

$$y = .1725(x - 1990) + 3.80 \quad y = .1725x - 339.475$$

14. Let  $f(x) = \begin{cases} -\frac{1}{2}x - 1 & \text{if } -6 \leq x \leq -2 \\ 5 & \text{if } -2 < x \leq 5 \end{cases}$

- a. (2 pts) Determine the domain of  $f$ .

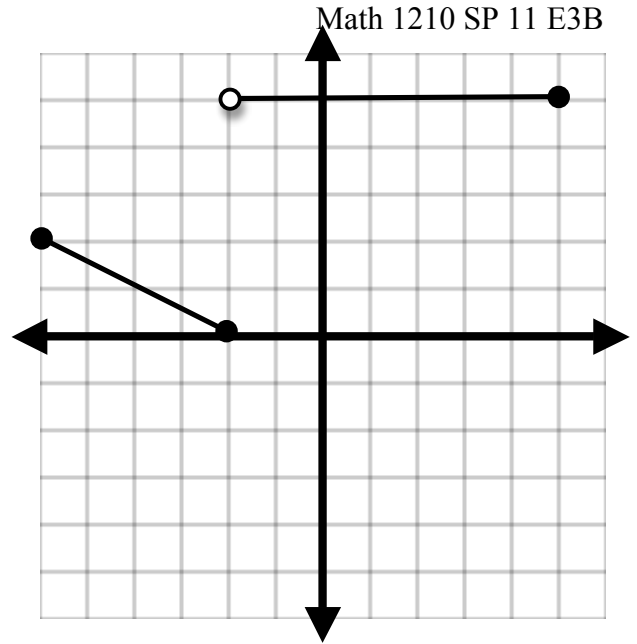
$$[-6, 5]$$

- b. (2 pts each) Evaluate each of the following.

$$f(-2) = 0$$

$$f(-1) = 5$$

- c. (4 pts) Graph  $f$  on the grid on the right.



15. The table below shows the percentage of the total federal personal income tax paid by U.S. adult citizens that are in the bottom 50% of income earned. In 2008 this included all adults that made less than \$33,048. (Source: <http://www.ntu.org/tax-basics/who-pays-income-taxes.html>)

Year	1999	2000	2002	2004	2005	2007	2008
Percentage of Federal Personal Income Tax Paid	4	3.91	3.5	3.3	3.07	2.89	2.7

- a. (2 pts) Use your calculator to make a scatterplot of the data. Choose the best answer that describes the data. You do not have to show your scatterplot.

A) The data is approximately linear.

B) The data is exactly linear.

C) The data does not resemble a linear function.

- b. (2 pts) Find the least-squares regression line that models the data. Round values to 4 decimal place.

$$y = -.1447x + 293.1585$$

- c. (2 pts) Estimate the percent of personal income tax that will be paid by the bottom 50% of wage earners in 2011.

$$y = -.1447(2011) + 293.1585 = 2.1668$$

- d. (2 pts) Did your calculation in part c involve interpolation or extrapolation? Explain your answer.

*The calculation involved extrapolation, because 2011 does not fall within the x-values given.*

16. (3 pts) Write the formula for a linear function  $f$  whose graph has a slope  $-3$  and passes through  $(-2,5)$ . Give answer in slope intercept form.

$$f(x) = -3(x + 2) + 5$$

$$f(x) = -3x - 6 + 5$$

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

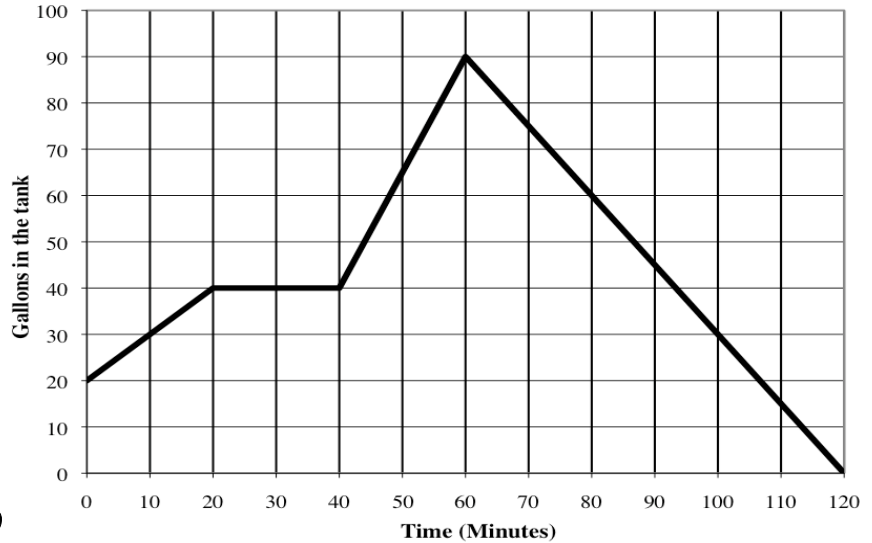
17. The graph at the right shows the amount of liquid in a tank after  $x$  minutes.

- a. (2 pts) Over what time interval(s) was the water level constant?

*The water level was constant between 20 minutes and 40 minutes.*

- b. (2 pts) Over what time interval was the tank filling the fastest? Explain your answer.

*The tank was filling the fastest between 40 and 60 minutes because the slope is the largest over this interval.*



- c. (2 pts) What was the rate at which the tank was filled between 0 minutes and 20 minutes? Make sure to include units on your answer.

$(0, 20)$   $(20, 40)$

$$m = \frac{40 - 20}{20 - 0} = 1 \text{ gallon per minute}$$

- d. (2 pts) State the  $y$ -intercept and interpret it in context of the question.

*The  $y$ -intercept is 20. The tank had 20 gallons of liquid in it initially.*

- e. (2 pts) Is the graph continuous on its domain? Explain your answer.

*The graph is continuous because I can trace it without lifting my pencil; there are no breaks in the graph.*