

**Math 097 Final Exam Review Problems
Rockville Campus – Revised Fall 2011**

1. The value of a certain type of automobile depreciates linearly. In 2000 the value was \$15,600 and in 2005 the value was \$9100. Use the slope formula to determine the average rate of change of the value of the car. Write your result in a complete sentence with correct units.

2. The percentages of Americans living below the poverty level are shown in the table.
a) Create a scattergram of the given data AND draw a line passing through the starred (*) data points. b) Use the slope formula and the two starred (*) points above to determine the slope of the line. Give your answer as a decimal. Write the meaning of your result from part b in a complete sentence with correct units.

Percentages of Americans Living Below the Poverty Level	
Year	Percent
*1996	13.7
1997	13.3
1998	12.7
1999	11.9
*2000	11.3

3. Fast-food sales for years since 2000 in the US are shown in the table.
a) Determine the linear model equation for this data by hand (not the calculator) using the two starred (*) points above. Use the variables t and s for your answer. b) Use the model equation to predict food sales for 2010, and write the meaning of your result in a complete sentence with correct units. c) Use the model equation to predict the year when food sales will be \$200 billion, and write the meaning of your result in a complete sentence with correct units.

Fast-Food Sales in the United States	
Year	Sales (Billions of Dollars)
*2001	88.8
2002	92.5
2003	97.5
*2004	101.4
2005	105.5

4. The linear model equation $n = -0.60t + 17.54$ represents the number of world refugees (in millions) at t years since 1990. a) Give the slope of the model and write its meaning in a complete sentence with correct units. b) Determine the n-intercept of the model. Write the ordered pair. Write the meaning of your result in a complete sentence with correct units. c) Determine the t-intercept of the model. Write the ordered pair. Write the meaning of your result in a complete sentence with correct units.
5. The number of amusement park injuries from roller coasters was 4300 injuries in 2000 and has decreased by about 450 injuries per year. Let t be the years since 2000 and n be the number of injuries from roller coasters.
a) Write the linear equation which models this information. Use the variables n and t for your answer.
b) Determine n when $t = -5$. Write the meaning of your result in a complete sentence with correct units.

6. Average tuitions at four-year colleges are listed below for various years since 1980.
a) Use the regression feature of your calculator to determine the linear model equation for public tuition at t years since 1980. b) Write the meaning of slope for the public linear model in a complete sentence with correct units. c) Use the calculator to determine the linear model for private tuition at t years since 1980. d) Write the meaning of slope for the private linear model in a complete sentence with correct units. e) Compare the two slopes of the two models and write the meaning of the comparison in this situation.

Average Tuitions at Four-Year Colleges		
Year	Public Tuition (dollars)	Private Tuition (dollars)
1984	2074	9202
1989	2395	12146
1994	3188	13844
1999	3632	16454
2004	4694	19710

7. Minimum salaries for major league baseball players for various years since 1980 are shown in the table below.

a) Create a scattergram of the given data. b) Use the **two starred points** above to determine the exponential model, $y = ab^x$, for this data; round b to four decimal places. Use s and t for your variables. c) Use your model equation to predict the minimum salary for major league baseball players in the year 2011; round to three decimal places. Write your answer in a complete sentence with correct units. d) Use your model to predict the year in which the minimum salary will be \$1 million. (Note: \$1 million = \$1000 thousand.) Write your answer in a complete sentence with correct units.

Minimum Salaries for Major League Baseball Players	
Year	Thousands of Dollars
*1980	30
1985	50
1990	100
1995	109
*2000	200
2005	316

8. The exponential model equation $n(t) = 1.20(1.0162)^t$ represents the world population in billions at t years since 1900.
- a) Use the model to predict the world population in 2011. Round to two decimal places. Write your answer in a complete sentence with correct units. b) In what year will the population be 15 billion? Write your answer in a complete sentence with correct units. c) What is the n -intercept? Write the meaning of your answer in a complete sentence with correct units.

9. A person invests an amount of \$5000 in an account at 4% interest compounded annually.
- a) Write an exponential model, $y = ab^x$, for this investment. Use A and t for your variables. b) Use your model to predict the amount of the investment in 5 years. Write your answer in a complete sentence with correct units. c) Use your model to predict when the original amount of the investment will double. Write your answer in a complete sentence with correct units.

10. The number of lawsuits filed against tobacco companies is shown in the table below for various years since 1990.

a) Use the regression feature on your calculator to determine the exponential model equation for this data. Round to three decimal places. Use n and t for your variables.

Number of Lawsuits Filed Against Tobacco Companies	
Year	Number of Lawsuits
1993	49
1994	73
1995	200
1996	352
1997	733

b) Use your model equation to predict when the number of lawsuits will be 5000. Write your answer in a complete sentence with correct units. c) Use your model to predict the number of lawsuits that will be filed in 2011. Write your answer in a complete sentence with correct units.

11. The BlackBerry is a wireless handheld device. The numbers of BlackBerry Subscribers are shown on the table for various years. Let $f(t)$ be the number of BlackBerry subscribers (in millions) at t years since 2000. A possible equation of f is: $f(t) = 0.05e^{0.77t}$

a) Verify that f models the situation well. b) According to the model, how many BlackBerry subscribers were there in 2008? c) Predict when there will be 500 million subscribers.

Year	Number of Subscribers (millions)
2000	0.03
2001	0.17
2002	0.32
2003	0.53
2004	1.07
2005	2.51
2006	5.0
2007	10.0

12. A company started business in 1995. Assume that a company has a profit per year shown in the table below. (Negative profits are losses.) Let the model $P(t) = -0.19t^2 + 2.56t - 2.38$ represent the amount of profit in millions of dollars, where t is the number of years since 1995.

Year	Profit millions of dollars
1995	-2.4
1996	0
1997	2.0
1998	3.6
1999	4.8
2000	5.7
2001	6.2

- a) Find $P(8)$. Write the meaning of your result in a complete sentence using correct units. b) Find t when $P(t) = 4.23$. Write the meaning of your result in a complete sentence using correct units. c) Find t when $P(t) = 0$. Write the meaning of your result in a complete sentence using correct units. d) In which year will the company have a maximum profit? e) Use the regression feature on your calculator to determine the quadratic model equation for this data and compare the calculator model to the given model.

13. A person standing on top of a building throws a stone into the air so that it hits the ground at the base of the building. The stone's height in feet after t seconds is given by the equation: $h = -16t^2 + 30t + 200$.

- a) Find the t -intercepts. Write your answer in a complete sentence with correct units. b) Find the h -intercept. Write your answer in a complete sentence with correct units. c) Find the vertex. Write your answer in a complete sentence with correct units. d) Sketch the graph indicating the intercepts and vertex.

14. An insurance company offers a \$25,000 life insurance policy for men who are smokers. The monthly rates are listed for various ages. Let $r(t)$ represent the monthly rate in dollars for a man t years of age who smokes.

Age	Monthly Rate in Dollars
30	50.85
35	61.74
40	92.27
45	134.97
50	193.25
55	290.18
60	444.54
65	674.06

- a) Use your calculator to draw a scatter-gram of the data. What kind of function (linear, quadratic, or exponential) best fits the data? b) Use the regression feature of your calculator to find the appropriate model for $r(t)$. Round to four decimal places. c) Find $r(25)$ and write your result in a complete sentence with correct units.

15. The table lists women's and men's total enrollments at all institutions of higher learning in Country X for various years. The enrollments (in millions) of women and men, respectively, where t is the number of years since 1980, can be modeled by the following system.

$$W(t) = 0.14t + 5.69$$

$$M(t) = 0.07t + 5.62$$

College Enrollments (Millions)		
Year	Women	Men
1988	6.3	5.9
1990	7.4	6.5
1994	8.1	6.8
2002	8.9	7.1
2006	9.2	7.4

- a) Find $(W + M)(t)$. What does it mean in the situation?
 b) Find $(W + M)(12)$. What does it mean in the situation?
 c) When was the total enrollment of men and women the same? What was that enrollment?

16. Given $2x + 3y = 18$, determine a) the x -intercept b) y -intercept and c) slope. d) Sketch the graph.

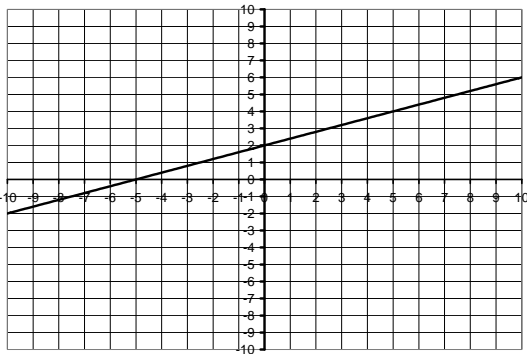
17. Let $f(x) = 3 - 4x$, a) Find and simplify $f(-2)$ b) Find x when $f(x) = -2$

18. Determine the vertex, the x - and y - intercepts, $f(2)$ and $f(-2)$ for the following function:
 $f(x) = 3x^2 - 6x + 1$

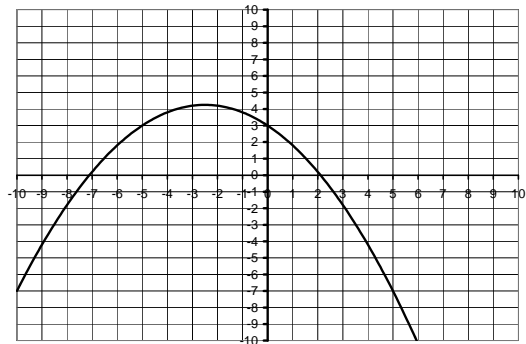
19. Solve the following quadratic equations.

a) $3x^2 + 5x = 2$ b) $2x^2 - 10x = -3$

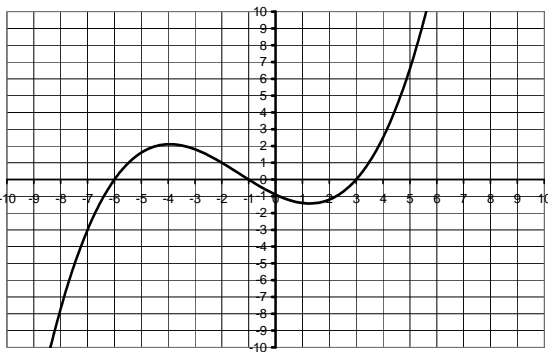
20. Function I



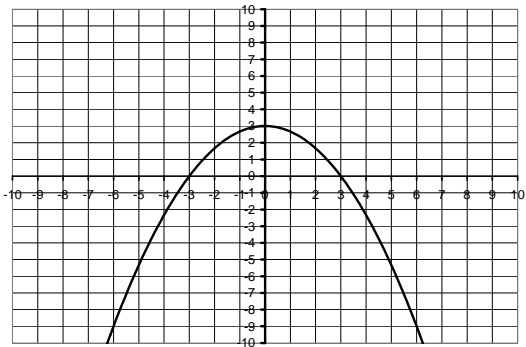
Function II



Function III



Function IV



- a) List all the functions for which $f(3) = 0$ b) List all the functions for which $f(0) = 3$.
 c) What are the zeros of function III? d) Approximate the equation of the line in function I

21. Four tables are given below -- three are functions, and one is not. One of the functions is linear, and one is exponential.

- a) Which one is the linear function? What is the slope of the line?
 b) Which one is the exponential function? Explain how you recognize the exponential function.
 c) Which one is not a function? Explain how you know this relation isn't a function.

Table A	
x	y
-1	4
0	0
1	0
2	4

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

Table C	
x	y
0	-5
1	-3
1	3
0	5

Table D	
x	y
0	2
1	10
2	50
3	250

22. Solve the following systems of equations.

a)
$$\begin{cases} 3s - 4t = 8 \\ 2s + 3t = -6 \end{cases}$$

b)
$$\begin{cases} 2x + y = 5 \\ 6x - 15y = -3 \end{cases}$$

23. a) Convert $3^4 = 81$ to logarithmic notation. b) Convert $\log_{25} 5 = \frac{1}{2}$ to exponential notation.

24. Solve algebraically: a) $3 \cdot 5^x = 10$ and b) $2 \cdot \log_4 x = 3$

25. Find the equation of the exponential function of the form $y = ab^x$ containing points $(0,2)$ and $(3,250)$.

26. Evaluate : a) $\log(1)$

b) $\ln(e^5)$

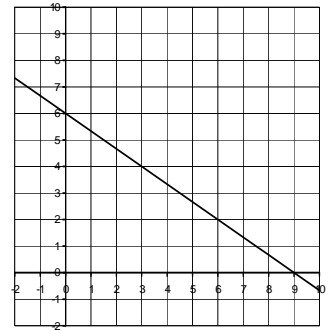
c) $\ln(5)$

d) $\log_2 16$

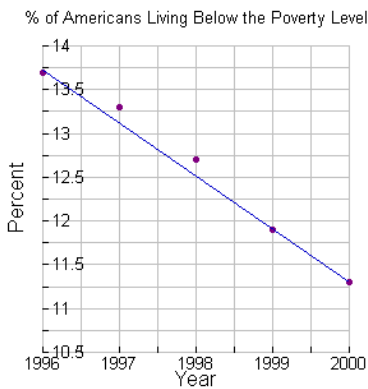
Answers

1. $m = -1300$ dollars/year; The value of the car is decreasing by \$1300 per year.
2. a) Refer to graph at the end of the solutions; b) $m = -0.6$ %/year; From the year 1996 to the year 2000 the percentage of Americans living below the poverty level decreased by 0.6 per year.
3. a) $s = 4.2t + 84.6$ b) $s(10) = 126.6$; In 2010, fast-food sales in the US will be \$126.6 billion. c) $t \approx 27$, In 2027, fast-food sales in the US will be \$200 billion.
4. a) $m = -0.60$ million refugees/year; The number of world refugees is decreasing by 0.60 million per year. b) $(0, 17.54)$; In 1990, there were 17.54 million world refugees. c) $(29,0)$; In 2019, there will be no world refugees. (Most likely a model breakdown.)
5. a) $n = -450t + 4300$ b) $n(-5) = 6550$; In 1995, there were 6550 injuries from roller coasters.
6. a) $y = 129.54x + 1383.04$ b) Public tuition is increasing by \$129.54 per year. c) $y = 506.48x + 7180.48$ d) Private tuition is increasing by \$506.48 per year. d) Private tuition is increasing at a faster rate than public tuition.
7. a) Refer to the graph at the end of the solutions; b) $s(t) = 30(1.0995)^t$ c) $s(31) = 567.771$ In 2011, minimum salaries for Major League Baseball Players will be \$567.771 thousand, that is, \$567,771. d) $t = 37$, In 2017, minimum salaries for Major League Baseball Players will be \$1 million.
8. a) $n(111) = 7.14$, In 2011, the world population will be 7.14 billion. b) $t \approx 157$, In 2057, the world population will be 15 billion. c) $n = 1.20$, In 1900, the world population was 1.2 billion.
9. a) $A(t) = 5000(1.04)^t$ b) $A(5) = 6083.26$; In 5 years, the investment will be worth \$6083.26. c) $t \approx 18$; In about 18 years, the investment will double.
10. a) $n(t) = 5.454(2.01)^t$ b) $t \approx 9.77$; In 2000, the number of lawsuits filed against tobacco companies was 5000. c) $n(21) = 12,700,837$; Model breakdown: 12 million lawsuits is unrealistic.
11. a) Use the calculator to sketch the scatter-diagram and enter the given function into the Y1 of the calculator. It appears that f is a reasonable model. (Refer to the graph at the end of the solutions) b) According to the model, in 2008 there were 23.7 million subscribers. c) The model predicts that there will be 500 million subscribers in 2012.
12. a) $P(8) = 5.94$; In 2003, the profit was \$5.94 million. b) $t \approx 3, 10$; In 1998 and 2005, the profit is \$4.23 million. c) $t = 1, 12$; In 1996 and 2007, the company had 0 profit. d) vertex: $(6.74, 6.24)$; A maximum profit of 6.24 million was in the year 2002 (between 2001 and 2002).
13. a) $t \approx -2.7, 4.6$; The ball will hit the ground in 4.6 seconds. -2.7 has no meaning in this problem. b) $h = 200$; The ball is at 200 feet when it is thrown. c) $t = 0.9375$ and $h(0.9375) = 214.0625$, vertex: $(0.9375, 214.0625)$, The ball reaches a MAXIMUM height of 214.0625 feet after 0.9375 seconds. d) Refer to graph at the end of the solutions.

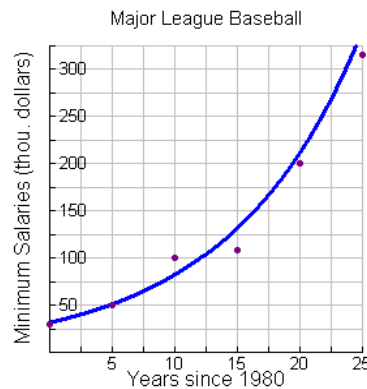
14. a) Exponential b) $r(t) = 4.6489(1.0785)^t$ c) \$30.75; The monthly rate for a 25 year old man who smokes is \$30.75.
15. a) $(W + M)(t) = 0.21t + 11.31$ The function represents the combined enrollment of women and men, in millions, at t years since 1980.
 b) $(W + M)(12) = 13.83$ million. In 1992, there were 13.83 million students enrolled at all institutions of higher learning in Country X
 c) Solution: $(-1.00, 5.55)$; This means that in 1979, both women's and men's enrollment was the same at about 5.6 million students.
16. a) $(9,0)$ b) $(0,6)$ c) $m = -\frac{2}{3}$ d) See the graph to the right.
17. a) 11 b) $\frac{5}{4}$
18. $(1, -2)$ $(0,1)$, $(0.184,0)$, $(1.816,0)$, $f(2) = 1$, $f(-2) = 25$
19. a) $\frac{1}{3}$, -2 c) $\frac{10 \pm \sqrt{76}}{4} = 0.3$ or 4.7
20. a) III and IV b) II and IV c) $-6, -1, 3$ d) $y = 0.4x + 2$
21. a) Table B; $m = \frac{1}{2}$ b) Table D c) Table C
22. a) $(0, -2)$ b) $(2, 1)$
23. a) $\log_3 81 = 4$ b) $25^{\frac{1}{2}} = 5$
24. a) 0.748, or $\frac{\ln(\frac{10}{3})}{\ln(5)}$ b) 8
25. $y = 2(5)^x$
26. a) 0 b) 5 c) 1.609 d) 4



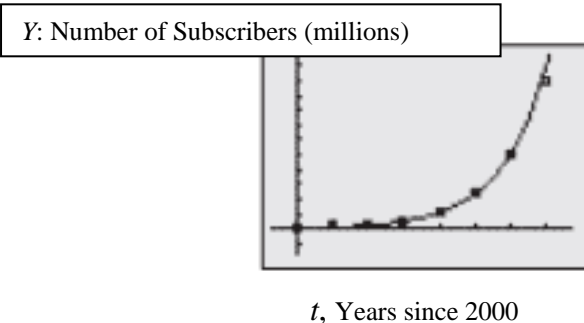
Graph for problem #2



Graph for problem #7



Graph for problem #11



Graph for problem #13

