

Name: Solutions PID: _____

Instructions:

1. **DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO.**
2. Print your full name and your PID on your exam. Then finish reading these instructions, and **sign the bottom of this page.**
3. Without fully opening the exam, check the page numbers in this exam booklet. Including this cover page, you should have 6 different pages. If you do not, please request another copy immediately.
4. Neither books nor scratch paper are needed for this exam. Clear your desk of everything but this booklet, your pencils and your calculator. If you need more space to write your solutions, use the backs of the exam pages.
5. Calculators are not to be shared. Do not ask your instructor any questions about the use of your calculator. Only those calculators appropriate for MTH 124 (as specified in the course syllabus) are allowed for use during this exam.
6. All electronic equipment (such as cell phones, mp3 players, etc) must be turned off and stored away during the exam time.
7. Crib sheets (pre-compiled lists of formulas or other information) either written or in a calculator are specifically forbidden. **Use of a crib sheet of any kind on this exam will result in an automatic zero grade.**
8. **No talking is allowed during the exam.**
9. The problems on this exam vary in difficulty. You should try to solve these problems in an order that will maximize your score. Solve all the easier problems first, then go back to the ones that require more thought.
10. Unless otherwise indicated, **SHOW ALL YOUR WORK.** If no work is shown, no partial credit can be awarded. Even for calculator solutions, you should include relevant information, such as the equation to be solved, the function whose graph is to be sketched, etc. Your work and answer need to be accurate and relevant to receive points.
11. Unless you are specifically instructed to do otherwise, **DO NOT ROUND YOUR ANSWERS – GIVE EXACT ANSWERS.**
12. You will be given **exactly 50 minutes** for this exam.
13. *Any student not following the above instructions nor behaving according to the above instructions during the exam may have their exam confiscated and points deducted.*

I have read and fully understood all of the above instructions: **Signature:** _____

Problem	1	2	3	4	5	6	7	8	9	TOTAL
Points										
Maximum	12	9	15	7	15	6	23	5	8	100

1. A town has a population of 4,720 people in 2000. In each of the following cases, express the town's population, P , as a function of the years, t , since 2000. [4+4+4 = 12]

(a) When the population increases by 331 people per year.

$$P(t) = 4720 + 331t.$$

(b) When the population increases at a continuous rate of 2.8% per year.

$$P(t) = 4720 e^{0.028t}$$

(c) Using your answer in (b), when will the population reach 6,000? Please round your answer to two decimal places.

$$6000 = 4720 e^{0.028t} \Rightarrow t = \frac{\ln\left(\frac{6000}{4720}\right)}{0.028}$$

$$\Rightarrow \frac{6000}{4720} = e^{0.028t}$$

$$\Rightarrow \ln\left(\frac{6000}{4720}\right) = \ln e^{0.028t} = 0.028t$$

$$\approx \boxed{8.57 \text{ years}}$$

2. Solve the following equations for t , rounding your answer to three decimal places. [3+3+3 = 9]

(a) $3^t = 5$

$$\ln 3^t = \ln 5$$

$$t \ln 3 = \ln 5$$

$$t = \frac{\ln 5}{\ln 3} \approx 1.465$$

(b) $(1.03)^{3t} = 1$

$$3t \ln 1.03 = \ln 1 = 0 \Rightarrow \boxed{t = 0}$$

(c) $2 \cdot 6^t = 41 \cdot 2^t$

$$\frac{6^t}{2^t} = \frac{41}{2}$$

$$\Rightarrow 3^t = \frac{41}{2}$$

$$\Rightarrow t \ln 3 = \ln \frac{41}{2}$$

$$\Rightarrow t = \frac{\ln \frac{41}{2}}{\ln 3} \approx 2.749$$

3. You purchase some stocks in CON CORP at time $t = 0$, where t is given in months. At the end of every month, you can compute your total stock worth (in dollars) using the function $h(t)$. [3+6+6 = 15]

(a) What does the statement $h(12) = 298,123$ mean in terms of this problem?

After 12 months, the stock is
worth \$298,123.

(b) Explain what the value of the vertical intercept of this function means in the context of this situation.

It is the initial value of
the stock.

(c) If this function has a horizontal intercept, explain what the value of it would mean in the context of this situation.

It is the time at which
the stock is worth \$0,
or nothing.

4. Does the table below represent a linear function? If yes, find the rate of change (including units). If no, then briefly explain why it is not linear. [7]

Hours	6	12	18	24	30
Widgets Produced	33	66	99	132	165

33 33 33 33

Constant, so yes.

The rate is $\frac{33 \text{ widgets}}{6 \text{ hours}} = 5.5 \text{ widgets/hr.}$

5. Oceanic 815 and Qantas 3 are two competing flights from Sydney to Los Angeles. In 2013, the Oceanic flight costs \$1700 and the Qantas flight costs \$2300. But every year the cost of the Oceanic flight is expected to rise \$80 and the cost of the Qantas flight is expected to rise \$55. [8+7 = 15]

- (a) Give two formulas, one for each of the cost of the airfares, as a function of time. Make sure to label any variables you use in your formulas.

$$\text{Oceanic: } O(t) = 1700 + 80t$$

$$\text{Qantas: } Q(t) = 2300 + 55t$$

- (b) In what year will the airfare be the same? Be sure to give your answer as a year after 2013.

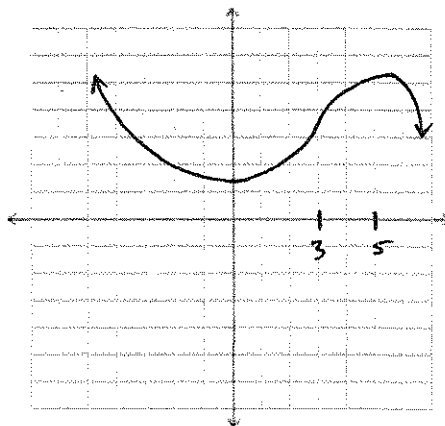
$$\begin{array}{r} 1700 + 80t = 2300 + 55t \\ -1700 \quad -55t \quad -1700 \quad -55t \\ \hline \end{array}$$

$$25t = 600$$

$$t = 24 \text{ years} \quad \text{or} \quad 2037$$

6. Graph a function $f(x)$ which satisfies the following conditions: [6]

- increasing inside the interval $[0, 5]$
- decreasing outside the interval $[0, 5]$
- concave up for $x < 3$
- concave down for $x > 3$



7. *Wheels 'n More* is a company which manufactures bicycles. Each month, the company pays \$150,000 in wages and utility bills. Further, producing each bike costs \$100. These bikes are then sold for \$400 each. Let q be the quantity of bikes the company produces each month. Find the following: [3+3+3+3+5+6 = 23]

(a) The total cost, $C(q) = 150,000 + 100q$

(b) The total revenue, $R(q) = 400q$

(c) The total profit, $\pi(q) = R(q) - C(q) = 300q - 150,000.$

(d) What are the marginal cost, marginal revenue, and marginal profit?

- Marginal Cost = 100
- Marginal Revenue = 400
- Marginal Profit = 300

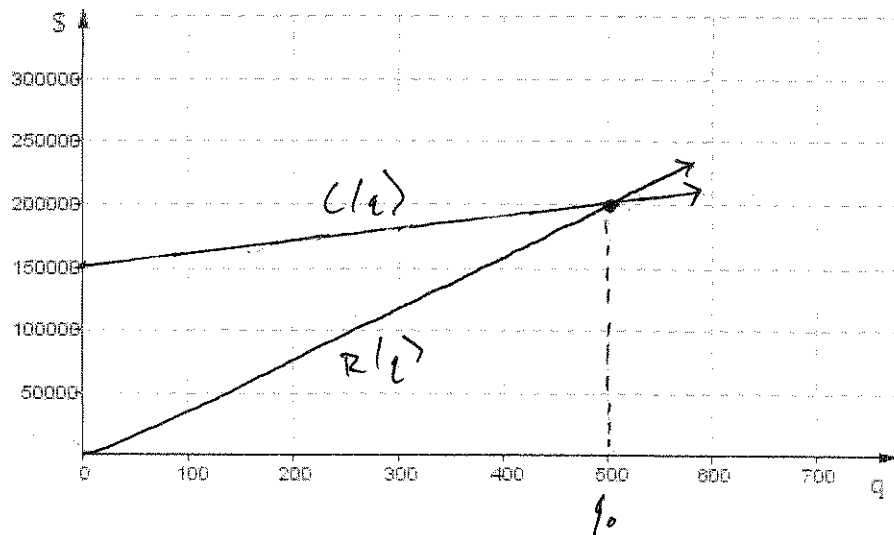
(e) Find the break-even quantity q_0 .

$$\pi(q) = 0 : 300q - 150,000 = 0$$

$$\Rightarrow 300q = 150,000$$

$$\Rightarrow q_0 = 500 \text{ bikes}$$

(f) Graph the Cost and Revenue functions $C(q)$ and $R(q)$ on the graph below AND label the break-even point.



8. At time t , in seconds, a particle's distance $s(t)$, in cm, from a point is given in the table. What is the average velocity of the particle from $t = 5$ to $t = 20$? Give units in your answer. [5]

t	0	5	10	15	20	25
$s(t)$	90	100	120	50	55	60

$$\frac{s(20) - s(5)}{20 - 5} = \frac{55 - 100}{15} = \boxed{-3 \text{ cm/sec}}$$

9. If you deposit \$10,000 in an account earning interest at an 8% interest rate compounded continuously, how much money is in the account after 5 years? Round your answer to two decimal places. [8]

$$A(t) = 10,000 e^{0.08t}$$

$$A(5) = 10,000 e^{0.08 \cdot 5}$$

$$= 10,000 e^{0.4}$$

$$\approx \boxed{\$14,918.25}$$