EXAM 2 **TQS 211** Fall 2010

Key

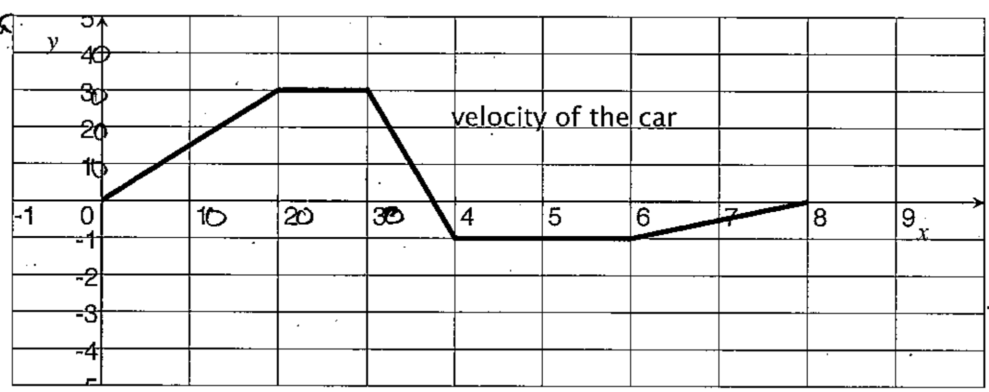
Show your work for the following problems. The correct answer with no supporting work will receive NO credit.

1. A truck delivery business asked their employees to record the speedometer every ten minutes while on their routes. Bob didn't catch every ten minutes after he left the garage like he was suppose to but he did record the direction (north or south) in addition to the speedometer at the 20, 30, 40, 60, and 80 minute mark. Bob recorded the velocity as positive if he was headed south and negative if he was headed north. He then connected the dots with lines so that it looked like he checked more often. The resulting graph is below where the units on the y-axis are measured in tens of miles per hour and the x-axis is measured in ten minute intervals.

m/hr

south ↑

north ↓



minutes

(a) [3] How fast was the car going 20 minutes in? Was it going north or south?

(+1) 30 mi/hr south (+1) magnitude (+1)

(b) [3] Does the car ever come to a stop? Justify your answer.

Yes around 38 min (+1) + 80 min (+1) in the route

b/c the velocity function is returning a zero (+1)

(c) [3] Use the graph to estimate the time that the car changed directions. Justify your answer.

(+1) started
(+1) reasoning

around 38 min (+1)

the car changed from south bound to northbound.

(d) [4] About when is the truck the farthest distance from the garage? Justify your answer.

about 38 min (+1)

(+1) started
(+1) reason
(+1) sense

The truck was traveling north the entire first 38 min & thus inc. the dist from the garage. The dist. won't be reduced until the truck turns around.

13

2. The total cost to produce x *hundred units* is $C(x) = -(1-x)^3 e^{.04x} + 3$ measured in thousands of dollars.

magnitudes (+1)

(a) [4] Find the average cost of producing 150 units.

Total Cost of 150 units $= 3.1327$

$= -(1-1.5)^3 e^{.04 \cdot 1.5} + 3$

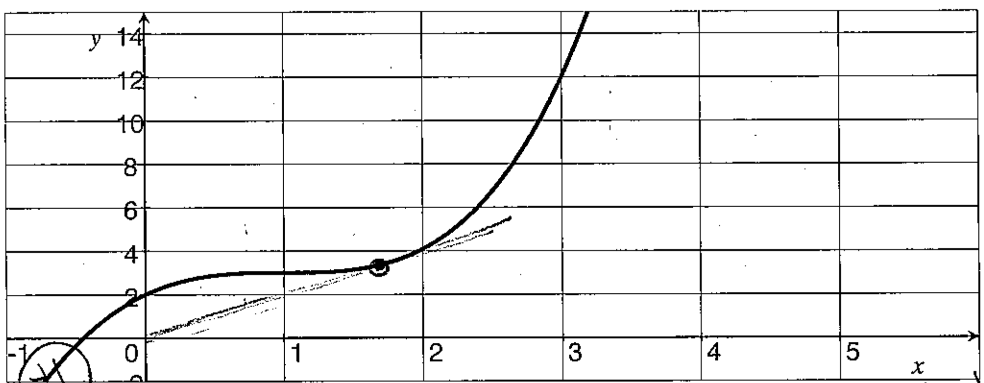
$= .125 e^{.06} + 3$

or (+1) \$13,132.7

(+1) Ave cost $\frac{3132.7}{150}$

(+1) so \$20.88

(b) [4] The following is a graph of C where the x-axis is measured in hundreds of units. Use the graph to estimate the quantity x that would minimize your average cost and explain why.



Started (+1)

Knew ave cost (+1) on picture

sense (+1)

about 175 units. The ave cost is represented as the slope of the line connecting (0,0) to points on the curve of C. When x = 1.75 that line is as non steep as I can get it

(c) [4] Use the graph to estimate the quantity x that would minimize your marginal cost and explain why.

Started (+1)

Knew MC on picture (+1)

sense (+1)

Marginal cost is the slope of the line tangent at a. at quantity a

The slope of the tangent line gets pretty flat looking at "x=1," or 100 units (+1)

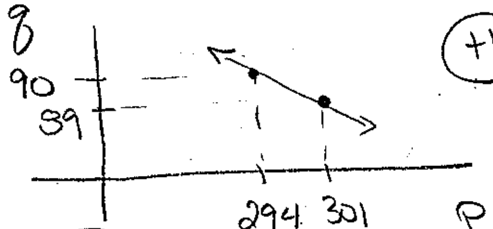
12

3. The manager of a large apartment complex knows from experience that 90 units will be occupied if the rent is 294 dollars per month. A market survey suggests that, on the average, one additional unit will remain vacant for each 7 dollar increase in rent. Similarly, one additional unit will be occupied for each 7 dollar decrease in rent.

(a) [2] Let q be the number of units that are occupied and p be the price per unit. Find a function that describes the revenue of the hotel in terms of p and q.

$\text{Rev} = p \cdot q$

(b) [4] The relationship between p and q is linear. Find it.



+1 $\frac{-1}{7}$ = slope

so

$q = -\frac{1}{7}p + b$

$\Rightarrow 90 = -\frac{1}{7}(294) + b$

$90 + 42 = 90 + \frac{294}{7} = b$ +1

so

$q = -\frac{1}{7}p + 132$

use pt on line +1

+.5 started

+.5 looking for line

$7\overline{)294}$ = 42, 28, 14

(c) [2] Find a rule for the revenue of the hotel that is only a function of one variable.

$\text{Rev} = p(-\frac{1}{7}p + 132)$

(d) [5] What rent should the manager charge to maximize revenue?

$\text{Rev} = -\frac{1}{7}p^2 + 132p$ → parabola opening down

=> critical point will be a max.

$(\text{Rev})' = -\frac{2}{7}p + 132$ +1

CP @ +1 $0 = -\frac{2}{7}p + 132$

$132 = \frac{2}{7}p$ alg +1

$7 \cdot 66 = \frac{7}{2} \cdot 132 = p$

$\$462 = p$ will maxi

+.5 started

+1 got it

+.5 sense

65, 7, 155

13

4. A truck has a minimum speed of 9 mph in high gear. When traveling x mph, the truck burns diesel fuel at the rate of

$$0.0039350\left(\frac{676}{x}+x\right)\frac{\text{gal}}{\text{mile}}$$

Assuming that the truck can not be driven over 63 mph and that diesel fuel costs \$1.44 a gallon, find the following.

(a) [5] The steady speed that will minimize the cost of the fuel for a 570 mile trip.

Cost of fuel: $570\,\text{mi}\left(.0039350\left(\frac{676}{x}+x\right)\right)\frac{\text{gal}}{\text{mi}}\cdot 1.44\,\frac{\$}{\text{gal}}$

looking for cost (+).5

(+1)

$= 3.229848\left(\frac{676}{x}+x\right)$

$= 2183.38\,x^{-1} + 3.229848\,x$

(+1) $(\text{Cost of fuel})' = -2183.38\,x^{-2} + 3.229848$ alg (+1)

(+1) CP@ $0 = -2183.38\,x^{-2} + 3.229848$

$\Rightarrow \frac{1}{x^2} = 2183.38 \quad \Rightarrow x = 26\ \text{mi/hr.}$ got it (+.5)

(b) [7] The steady speed that will minimize the total cost of the trip if the driver is paid \$13 an hour.

Cost = fuel cost + driver cost (+1)

$= \underbrace{\left(2183.38\,x^{-1} + 3.229848\,x\right)}_{+.5} + \underbrace{13\,\frac{\$}{\text{hr}}\cdot 570\,\text{mi}\cdot\frac{1\,\text{hr}}{x\,\text{mi}}}_{+1.5}$

started (+.5)

$= 2183.38\,x^{-1} + 3.229848\,x + \frac{7410}{x}$

$= 9593.38\,x^{-1} + 3.229848\,x$

(+1) $(\text{Cost})' = -9593.38\,x^{-2} + 3.229848$ alg (+1)

(+1) CP@ $0 =$ " "

12

$\Rightarrow \frac{1}{x^2} = .00033667 \quad \Rightarrow x = 54.5\ \text{mi/hr.}$ got it (+.5)