Test 1
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Math 111

No work = no credit

No Symbolic Calculators

Name: ___Key___

Why are numbers beautiful? It's like asking why is Beethoven's Ninth Symphony beautiful. If you don't see why, someone can't tell you. I know numbers are beautiful. If they aren't beautiful, nothing is.

Paul Erdos (1913 - 1996)
Hungarian mathematician

Warm-ups (1 pt each): $1 + 1 = \underline{2}$ $-1^2 = \underline{-1}$ $\dfrac{1}{0} = \underline{\text{undefined}}$

1.) (1 pt) Based upon the quote above, how did Erdos explain the beauty of numbers? Answer using complete English sentences.

Some things can't be explained.

2.) (4 pts) Find the exact solution to: $\dfrac{3x}{4} - \dfrac{1}{3} = 1 - \dfrac{2}{3}\left(x - \dfrac{1}{6}\right)$

$$\Rightarrow \frac{3x}{4} - \frac{1}{3} = 1 - \frac{2}{3}x + \frac{2}{18}$$

$$\Rightarrow 27x - 12 = 36 - 24x + 4$$

$$\Rightarrow 51x = 52$$

$$\Rightarrow x = \frac{52}{51}$$

3.) (4 pts) Find and <u>interpret</u> market equilibrium for the following supply and demand functions: $D: p = 220 - 4q$ and $S: p = 15q + 30$. Use algebraic methods.

Solve $22d - 4q = 15q + 30$

$$\Rightarrow 190 = 19q$$

$$\Rightarrow q = 10$$

and $p = 180$

We reach market equilibrium when 10 units are sold for $180 ea.

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4.) (4 pts) Suppose a manufacturer models its monthly costs with $C(x) = 45x + 7200$ where x is in <u>hundreds of units</u> produced in a month and C is in dollars.

a.) Find and interpret the C-intercept.

The fixed costs are 7200.

b.) Find and interpret the slope.

It costs $45 to produce 100 units

5.) (4 pts) The table gives the annual in-state tuition (including fees) at the University of Washington over the last 20 years. Years are listed by their start date (1995-1996 is listed as 1995).

a.) Find a cubic model $f(x)$ for the data where x is given in years since 1900. Give your answer to three decimal places.

$$f(x) = 1.673x^3 - 488.290x^2$$
$$+ 47668.940x - 1553271.056$$

Year	Tuition ($)
1995	3019
1997	3366
1999	3638
2001	3983
2003	4968
2005	5610
2007	6385
2009	7692
2011	10574
2013	12397

b.) Find and interpret $f(116)$

$f(116) = 17549.47$

Tuition @ UW in 2016
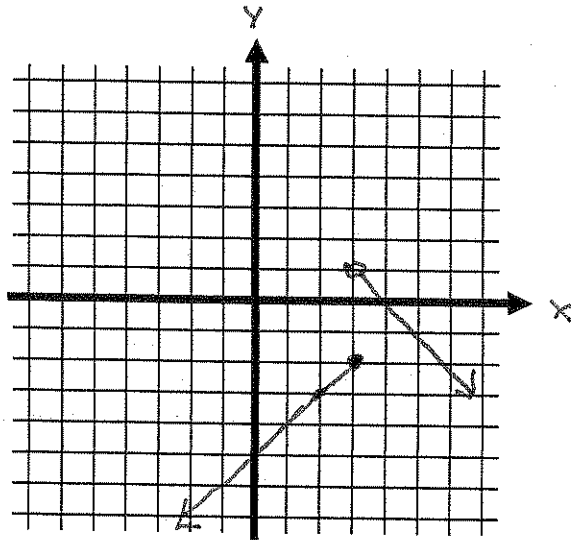will be around $17549.47
(according to this model).

$x = 0$ @ 0 AD: $f(x) = 1.67x^3 - 10025x^2 + 20023645x - 1.33 \times 10^{10}$

$Y = 0$ @ 1990 AD: $f(x) = 1.67x^3 - 36x^2 + 434.9x + 1586$

6.) (4 pts) Consider $g(x) = \begin{cases} x-5, & x \le 3 \\ 4-x, & x > 3 \end{cases}$

   a.) Evaluate $g(6) = -2$

   b.) Carefully sketch a graph of $g(x)$

7.) (4 pts) Find a good viewing window for $h(x) = 0.02x - 5000$

$$y\text{-int} = -5000$$

$$x\text{-int}: \quad 0 = 0.02x - 5000$$

$$\Rightarrow x = \frac{5000}{.02} = 250,000$$

window $[-25,000, 275,000] \times [-5500, 500]$

8.) (4 pts) Solve $3x^2 = -6x - 2$ using any algebraic method. Give the exact answer(s).

$$3x^2 + 6x + 2 = 0$$

$$x = \frac{-6 \pm \sqrt{36 - 4(3)(2)}}{2(3)}$$

$$= \frac{-6 \pm \sqrt{12}}{6}$$

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9.) (8 pts) A certain company has fixed costs of \$15,000 for its product and variable costs given by $35 + 0.1x$ dollars per unit, where x is the total number of units. The selling price of the product is given by $285 - 0.9x$ dollars per unit.

a.) Formulate the functions for total cost, revenue, and profit.

$$C(x) = (35 + 0.1x)x + 15000 = 0.1x^2 + 35x + 15000$$

$$R(x) = (285 - 0.9x)x = -0.9x^2 + 285x$$

$$P(x) = -1.0x^2 + 250x - 15000$$

b.) <u>Algebraically</u> find and <u>interpret</u> the break even points.

Solve
$$0 = -x^2 + 250x - 15000$$
$$= x^2 - 250x + 15000$$
$$= (x - 100)(x - 150)$$
$$\Rightarrow x = 100 \quad \text{or} \quad x = 150$$

The company breaks even when 100 or 150 units are sold.

c.) <u>Algebraically</u> find and <u>interpret</u> the level of production and maximum profit.

$$x = -\frac{250}{2(-1)} = 125$$

$$P(125) = 625$$

The max profit is \$625 when 125 units are sold.

d.) Find and <u>interpret</u> the selling price for the item when profit is maximized.

Sell @ \$172.50 to max profit.

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