UNIVERSITY OF MANITOBA

DATE: February 26, 2009

MIDTERM EXAM

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COURSE: MATH 1520

TIME: 1 hours

EXAMINATION: Intro. Calc. for Mgmt & Soc. Sci.

EXAMINER: Various

PART A: Multiple Choice Questions

Answer each question by putting one of the letters A, B, C, D, E in the appropriate answer box below (2 point each).

Question #	1	2	3	4	5	6	7	8
Answer								

1. What is the domain of the function $f(x) = \dfrac{x-2}{\sqrt{3x-1}}$?

   A. $(-\infty, \frac{1}{3}) \cup (\frac{1}{3}, \infty)$;

   B. $(\frac{1}{3}, \infty)$;

   C. $[\frac{1}{3}, \infty)$;

   D. $(-\infty, \frac{1}{3})$;

   E. None of the above.

2. Let $f(x) = x^2 + 3x - 3$. What is the equation of the tangent line to the curve $y = f(x)$ at the point $(1, 1)$ given that $f'(x) = 2x + 3$?

   A. $y = 5x - 4$;

   B. $y = 5x$;

   C. $y = 2x - 1$;

   D. $x = 5y - 4$;

   E. None of the above.

Questions 3, 4, and 5 refer to the following scenario:

The Naive Company produces and sells bottled spring water. The marginal cost of producing a bottle of water is $2, and it costs $50 to produce 20 bottles of water. Each bottle of water is sold for $3.

3. What is a linear cost function for producing x bottles of water?

   A. $C(x) = 3x - 10$;

   B. $C(x) = x + 30$;

   C. $C(x) = \dfrac{1}{2}x + 40$;

   D. $C(x) = 2x + 10$;

   E. None of the above.

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[2] 4. What is their profit if they sell 15 bottles?

  A. $0;

  B. $-\$5$;

  C. $15;

  D. $5;

  E. None of the above.

[2] 5. How many bottles must they sell in order to break even?

  A. $\dfrac{3}{10}$;

  B. $\dfrac{10}{3}$;

  C. 10;

  D. 5;

  E. None of the above.

[2] 6. A particle's position is given by the function $s(t) = \dfrac{1}{3}t^2 + 5t + \dfrac{e}{2}$. What is its velocity when $t = 0$?

  A. $\dfrac{17}{3}$;

  B. 5;

  C. $\dfrac{e}{2}$;

  D. $5 + \dfrac{e}{2}$;

  E. None of the above.

[2] 7. The function

$$\ln(x - 2) + \frac{1}{3}\ln x - \ln(1 + x^2)$$

can be expressed as a single logarithm as follows:

  A. $\ln\left(\dfrac{1 + x^2}{(x - 2)x^{1/3}}\right)$;

  B. $\ln\left(\dfrac{(x - 2)\frac{x}{3}}{1 + x^2}\right)$;

  C. $\ln\left(\dfrac{(x - 2)x^{1/3}}{1 + x^2}\right)$;

  D. $\ln(x - 2 + x^{1/3} - (1 + x^2))$;

  E. None of the above.

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[2] 8. How long will it take for an investment of $100 to grow to $300 in an account making interest at an annual rate of 12% compounded quarterly?

A. $t = \dfrac{\ln 3}{4\ln(1.03)}$;

B. $t = \dfrac{4\ln(1.03)}{\ln 3}$;

C. $t = \dfrac{3\ln(1.04)}{\ln 3}$;

D. $t = \dfrac{\ln 3}{3\ln(1.12)}$

E. None of the above.

PART B: Short Answer Questions

9. Write your final answers for this question on the lines provided below. Only your final answers will be marked!
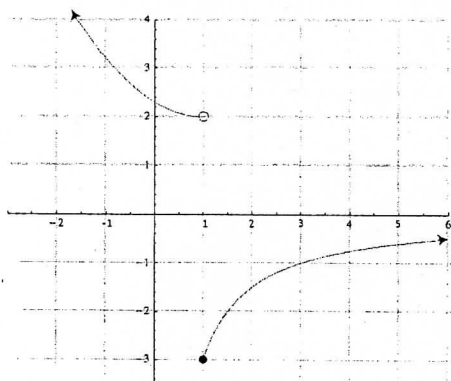
The above is the graph of the function $f(x)$. The graph goes up without bound as it approaches the line $x = -2$, and it approaches the x-axis to the right.

Use the graph to find the value of the quantities below. If a limit does not exist, indicate whether it tends to $+\infty$, $-\infty$, or neither.

[1] (a) $\lim\limits_{x \to 1^-} f(x) = $ _____ .

[1] (b) $\lim\limits_{x \to 1^+} f(x) = $ _____ .

[1] (c) $\lim\limits_{x \to 1} f(x) = $ _____ .

[1] (d) $\lim\limits_{x \to \infty} f(x) = $ _____ .

[1] (e) $\lim\limits_{x \to -2^+} f(x) = $ _____ .

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PART C: Long Answer Questions

Please show your work clearly.

If necessary, you may continue your work on the reverse sides of the pages of this exam or on the blank pages at the end—but please indicate clearly where your work may be found.

10. The half-life of a radioactive substance is 3 years.

   (a) Find the decay constant, that is, the number r such that the function e^{rt} describes the decay of the radioactive substance.

   (b) If a sample of this substance had an initial mass of 80g, find the **exact value** of the mass remaining after 9 years.

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11. Let $f(x) = \dfrac{1}{x^2}$.

[7]   (a) Find $f'(x)$ for $x \neq 0$ using the definition of the derivative.

[1]   (b) Is $f(x)$ differentiable at $x = 0$? (No marks for an unexplained answer!)

[2]   , (c) Find the equation of the tangent line to the graph of $y = f(x)$ at $(\frac{1}{2}, f(\frac{1}{2}))$.

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12. Find the following limits. If they do not exist, state whether they are ∞ or $-\infty$ if possible.

[6] (a) $\lim\limits_{x \to \infty} \sqrt{2x^2 - 3x} - \sqrt{2x^2 + 2}$

[3] (b) $\lim\limits_{x \to 2} e^{\frac{-1}{x^2 - 4}}$

[3] (c) $\lim\limits_{x \to \sqrt{2}} \dfrac{(x - \sqrt{2})(x^2 + 3x + 2)}{x^2 - 2}$

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13. Let $f(x) = \begin{cases} 3x^2 + Kx & \text{if } x < 1 \\ 5 & \text{if } x = 1 \\ K^2x + \dfrac{2x-2}{x^2-1} & \text{if } x > 1. \end{cases}$

[5]   (a) Find both values of K such that $\lim\limits_{x \to 1} f(x)$ exists.

[4]   (b) Find a value of K (if it exists) such that $f(x)$ is continuous at $x = 1$.

END OF EXAM