Department of Mathematics
University of Notre Dame
Math 10250 – Elem. of Calc. I

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Instructor:⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

Practice B – Exam 1

September 12, 2018

This exam is in 2 parts on 10 pages and contains 14 problems worth a total of 100 points. You have 1 hour and 15 minutes to work on it. You may use a calculator, but no books, notes, or other aid is allowed. Be sure to write your name on this title page and put your initials at the top of every page in case pages become detached. Good luck!

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Multiple Choice

1. (5 pts.) In a region, the demand for a certain iPhone is 200,000 units (on the average per week) when its price is \$630 per unit. However, when its price drops by \$50 then its demand increases by 20,000 units. Find the demand function assuming that it is linear. (Use the price p as the independent variable, and the quantity q as the dependent variable.)

(a) $q = 630p - 452,000.$

(b) $q = -50p + 220,000.$

(c) $q = 400p - 452,000.$

(d) $q = -400p + 452,000.$

(e)   None of these.

2. (5 pts.) The unemployment rate in a region, r, now stands at about 6.1 percent. If for the next few years it is modeled by a quadratic function
$$r(t) = a(t - h)^2 + k$$
and it reaches its lowest value $r = 4$ in 2 years, then predict its value 1 year from now.

(a)   5.05

(b)   5.0

(c)   5.1

(d)   4.525

(e)   None of these.

3. (5 pts.) A company determines that its profit P (in millions) when it sells its product at the price of x dollars per unit is given by the function

$$P(x) = -20(x - 40)^2 + 2000.$$

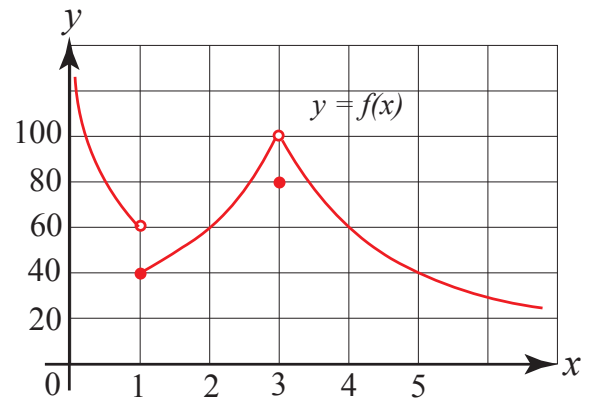Determine the range of prices for which the company makes profit (i.e. $P(x) > 0$).

(a) $40 < x < 80$

(b) $x > 30$

(c) $30 < x < 50$

(d)   None of these.

(e) $20 < x < 40$

4. (5 pts.) Compute the following limit: $\lim\limits_{h \to 0} \dfrac{4(5 + h)^2 - 100}{h}$

(a)   5

(b)   100

(c)   20

(d)   It does not exist.

(e)   40

5. (5 pts.) Let $f(x)$ be the function whose graph is shown below. Which of the following statements is **FALSE**?

(a)　$\lim\limits_{x \to \infty} f(x) = 20$

(b)　$f(x)$ is continuous at $x = 3$.

(c)　$\lim\limits_{x \to 0^+} f(x) = \infty$

(d)　$\lim\limits_{x \to 1^-} f(x) = 60$

(e)　$\lim\limits_{x \to 1^+} f(x) = 40$

6. (5 pts.) Let $f(x)$ be the function whose graph is shown above. Compute $\lim\limits_{x \to 3} \dfrac{x^2 + 10x + 1}{\sqrt{f(x)}}$.

(a)　40

(b)　$\sqrt{3}$

(c)　10

(d)　∞

(e)　4

7. (5 pts.) A company estimates that when it spends x million dollars to advertise its product, then its annual revenue R, in millions of dollars, is modeled by the function
$$R(x) = \frac{800x + 2100}{2x + 7}.$$
What is the limiting value of the revenue R if the company keeps spending more and more money in advertising?

(a)   None of these

(b)   400

(c)   2900

(d)   800

(e)   2100

8. (5 pts.) Let $f(x) = \dfrac{x - 8}{x^2 - 15x + 56}$. Which of the following statements is **FALSE**?

(a)   The x-axis (i.e. $y = 0$) is a horizontal asymptote.

(b)   The limit of $f(x)$ as $x \to \infty$ is equal to zero.

(c)   The lines $x = 7$ and $x = 8$ are vertical asymptotes.

(d)   The natural domain of $f(x)$ is the set of all real numbers except $x = 7$ and $x = 8$.

(e)   The line $x = 7$ is a vertical asymptote.

9. (5 pts.) The following table lists the temperature $H(t)$ at Notre Dame during a day in September at certain times from 2:00 AM till 12:00 Noon.

t	2	4	6	8	10	12
$H(t)$	63	54	51	61	70	79

Assuming that the temperature $H(t)$ is a **continuous** function of t, in which of the following time intervals can you be sure that the temperature $H(t)$ attained the value of 62?

(a) $[2, 4]$ and $[8, 10]$ only.

(b) $[2, 4]$ and $[6, 8]$ only.

(c) $[2, 4]$ and $[10, 12]$ only.

(d) $[2, 4]$ only.

(e) $[6, 8]$ and $[8, 10]$ only.

10. (5 pts.) The inverse of the function

$$f(x) = \frac{x + 5}{x - 3}$$

is given by the following function $g(x)$:

(a) $g(x) = \dfrac{x + 3}{x - 5}$

(b) $g(x) = \dfrac{x + 5}{x - 1}$

(c) $g(x) = \dfrac{3x + 5}{x - 1}$

(d) None of these

(e) $g(x) = \dfrac{5 - x}{3 - x}$

Partial Credit
You must show your work on the partial credit problems to receive credit!

11. (12 pts.) [**Show your work!**]
   (A) The demand for a certain item is $q = -0.2x + 100$, where q denotes the units of quantity sold and x the price per unit in dollars. Also, the cost function is given by $C(q) = 5q + 2500$.

(i) (4 pts.) Find the revenue R as a function of the price x, i.e. $R = R(x)$.

   Answer: _____

(ii) (4 pts.) Find the profit P as a function of the price x, i.e. $P = P(x)$.

   Answer: _____

(B) (Independent of A.) (4 pts.) When the price per unit of a Flash Drive is $10 then 5000 units are sold. However, when the price is increased to $15, its demand is decreased to 3500 units. Find its demand $q = D(p)$ assuming that it is modeled by a linear function.

   Answer: _____

12. (12 pts.) [**Show your work!**]

(A) (7 pts.) Find the limit: $\displaystyle\lim_{h\to 0}\frac{\sqrt{16+h}-4}{h}$ (Show your work!)

Answer: _____

(B) (Independent of A.) (5 pts.) The federal debt now is about \$17.76 trillion. How much will it become (future value) in 10 years if no additional debt is added during this period, and the federal government pays 4% annual interest rate compounded **continuously**?

Answer: _____

Partial Credit
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13. (13 pts.) [**Show your work!**]
(A) Assume that the height of a rock thrown up-wards from the ground at time t is modeled by the quadratic function
$$H(t) = -16t^2 + 1600\,t,$$
where the time t is measured in seconds and the height H in feet.

(i) (6 pts.) By completing the square, write $H(t)$ in the form $H(t) = a(t - h)^2 + k$. Show clearly all your steps.

Answer: _____

(ii) (3 pts.) Find the maximum height it reaches and the time that this happens.

Answer: _____

(B) (Independent of A.) (4 pts.) A certain animal population grows exponentially, that is according to the model $P(t) = P_0 b^t$, where t is in years and P is in thousands of animals. Initially, this population was 10 thousand and 5 years later it became 320 thousand. Find a formula expressing this population as a function of time.
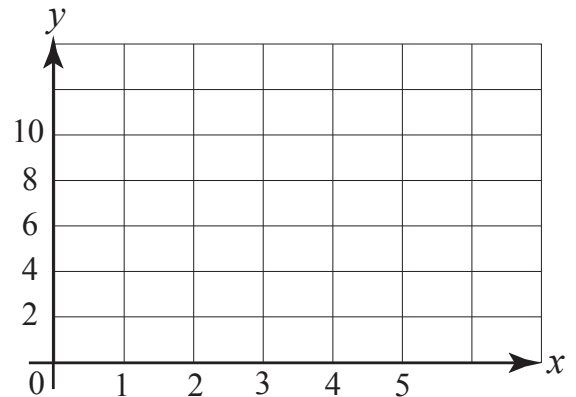
Answer: _____

14. (13 pts.) [**Show your work!**]
   A.) (7 points) Determine the constant c so that the following function is continuous:

$$f(x) = \begin{cases} \dfrac{x^2 + x - 20}{x - 4}, & x \neq 4 \\ c, & x = 4. \end{cases}$$

   Answer: _____

(B) (Independent of A.) (6 pts.) Draw the graph of a function $f(x)$ defined in the interval $[0, 5]$ such that:

   (i) It is continuous everywhere except at $x = 1$ and $x = 4$,

   (ii) has no limit only at one point,

   (iii) and it does not take the value 6.

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