MA 113 Calculus I Exam	Spring 2019 Tuesday, 5 March 2019 Feb

Name: \_

Section:

# Last 4 digits of student ID #: \_

This is a two-hour exam. This exam has 12 multiple choice questions (five points each) and 4 free response questions (ten points each). Additional blank sheets are available if necessary for scratch work. No books or notes may be used. Turn off your cell phones and do not wear ear-buds during the exam. You may use a calculator, but not one which has symbolic manipulation capabilities.

On the multiple choice problems:

- Select your answer by placing an X in the appropriate square of the multiple choice answer box on the front page of the exam.
- Carefully check your answers. No credit will be given for answers other than those indicated on the *multiple choice answer* box.

#### On the free response problems:

- Clearly indicate your answer and the reasoning used to arrive at that answer (unsupported answers may not receive credit),
- Give exact answers, rather than decimal approximations to the answer (unless otherwise stated).

Each free response question is followed by space to write your answer. Please write your solutions neatly in the space below the question.

### Multiple Choice Answers

Question					
1	A	B	Uffi,	D	Е
2		В	С	D	E
3	A		С	D	Е
4 .	(lli)	В	С	D	Е
5	A	В	C	188U	Е
6	A	В	С	D	M
7	A	В	C	UH a	E
- 8	A	Ħ	С	D	Е
9	A	В	14	D	Е
10	M	В	C	D	Е
11	A		С	D	Ε.
12	A	M	C	D	Е

## Exam Scores

Question	Score	Total
MC		60
13		10
14		10
15		10
16		10
Total		100

## Free Response Questions: Show your work!

#14 KEY \* #14 KEY \* #14 KEY \* #14 KEY

(5 pts) 14. Find the limits or state that the limit does not exist. In each case, justify your answer. (Students who guess the answer based on a few values of the function will not receive full credit.)

> (a)  $\lim_{x \to 2} \frac{x^3 - 8}{x - 2}$   $\lim_{X \to 2} \frac{x^3 - 8}{x - 2} = \lim_{X \to 2} \frac{(x - 2)(x^2 + 2x + 4)}{(x - 2)}$  (A) Factoring  $= \lim_{X \to 2} \frac{(x - 2)(x^2 + 2x + 4)}{(x - 2)}$  (A) Factoring  $= \lim_{X \to 2} \frac{(x^2 + 2x + 4)}{(x - 2)}$  (A) Factoring  $= (2^2 + 2(2) + 4)$  (A) Factoring

45 pts if (b)  $\lim_{x \to \pi/2} \cos(x) \cos(\tan(x))$ (Spts)  $(f) \begin{cases} \text{then } |\cos(x) \cos(\tan(x))| \leq |\cos(x)| \\ \text{or } -|\cos(x)| \leq \cos(x) \cos(\tan(x)) \leq |\cos(x)| \end{cases}$ lim X=Ty2 Cos(x) cos(tan(x))=C  $\frac{SO}{X \rightarrow T/2} - |\cos(x)| \leq \lim_{X \rightarrow T/2} \cos(x) \cos(\tan(x)) \leq \lim_{X \rightarrow T/2} |\cos(x)|$ 41  $0 \leq \lim_{x \to T_{b}} \cos(x) \cos(\tan(x)) \leq 0$ Thus, by the Squeeze Theorem, 8 +1  $\lim_{x \to T_{2}} \cos(x) \cos(\tan(x)) = 0$ 

. Table of values : 215 ? Potential Special Cases: · Mult by 1/2 in (a) up correct expl. 5/5 · Correct use of "highest power rule": 215 Free Response Questions: Show your work!

15. Find the limits or state that the limit does not exist. In each case, justify your answer. (Students who guess the answer based on a few values of the function will not receive full credit.)

(a) 
$$\lim_{x \to \infty} \frac{3x^3 - 7x + 2}{\pi x^2 + 14} = \lim_{k \to \infty} \frac{1/x}{1/x^2} (3x^3 - 7x + 2)$$
 (1) mult  $\frac{1/x^2}{1/x^7}$   

$$= \lim_{k \to \infty} \frac{3x - 7/x + 2/x^2}{\pi + 14/x^2}$$
 (1) simp.  

$$\lim_{k \to \infty} \frac{3x - 7/x + 2/x^2}{\pi + 14/x^2} = \pi,$$

$$\lim_{k \to \infty} \pi + \frac{1}{4/x^2} = \pi,$$

$$\lim_{k \to \infty} \frac{3x - 7/x + 2/x^2}{\pi + \frac{1}{4/x^2}} = \lim_{k \to \infty} \frac{1}{2} (2) \exp 1.$$
Since the denominator is approaching a constant while the numerator increases without bound,  

$$\lim_{k \to \infty} \frac{3x - 7/x + 2/x^2}{\pi + \frac{1}{4/x^2}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5}} (2x^6 + 3x)$$
(b) 
$$\lim_{x \to \infty} \frac{\sqrt{2x^{10} + 3x}}{6x^5} = \lim_{k \to \infty} \frac{1/x^5}{\sqrt{x^5 + 6x^5}}$$
 (1) mult  $\frac{1/x^5}{\sqrt{x^5}}$   

$$= \lim_{k \to \infty} \frac{\sqrt{2x^{10} + 3x}}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} (2) \operatorname{mult} \frac{1/x^5}{\sqrt{x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1}{\sqrt{x^5 + 6x^5}} = \lim_{k \to \infty} \frac{1}{\sqrt{x^5 + 6x^5}} \frac{1$$

6

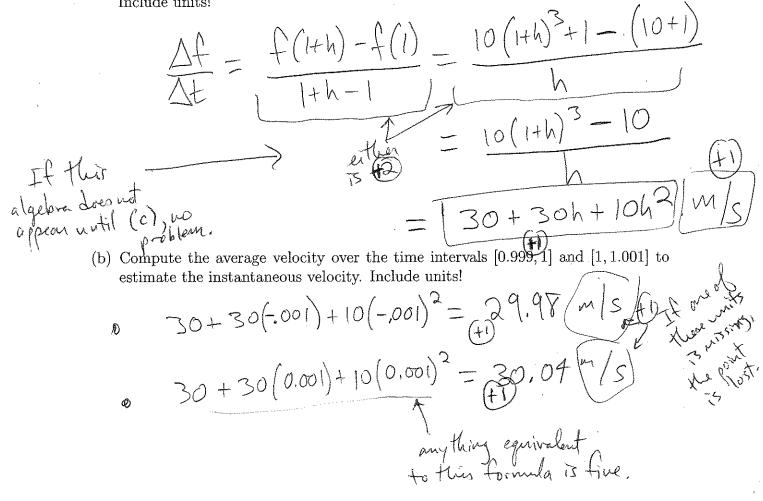
Free Response Questions: Show your work! 16. (a) State the Intermediate Value Theorem. () Assume flux) is continuous on Ea,b]. Assume flux) is continuous on Ea,b]. If N is a number between () f(a) and f(b) then there is a c with a < c < b f(a) = N.

(b) Let  $f(x) = x^5 - x^4 + 2x^2 - \frac{1}{4}$ . Use the Intermediate Value Theorem to show that there must exist a solution to  $f(x) = \frac{1}{2}$  in the interval [0, 1].

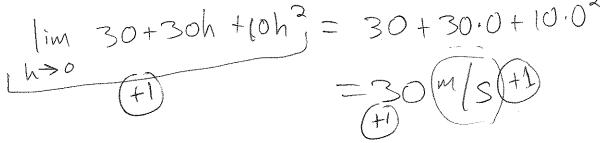
(1)  $f(0) = -\frac{1}{4}$ (1)  $f(0) = 1 - \frac{1}{2} - \frac{1}{4}$ ,  $= 1\frac{3}{4}(=\frac{7}{4})$ .

(1) f is continuous on [0,1] since f is a polynomial. (1) f is there is a  $\mathbb{Z}$  with weth f so thus there is a  $\mathbb{Z}$  with  $\mathbb{Z}$ f by  $f(z) = -\frac{1}{2}$ ,  $\frac{1}{2}$ ,  $\frac{1$ 

- 13. Assume that the position of an object after t seconds is given by  $f(t) = 10t^3 + 1$  meters.
  - (a) Write an expression for the average velocity of the object on the interval [1, 1+h]. Include units!



(c) Take the limit as h approaches 0 of the expression you found in part (a) to find the instantaneous velocity of the object at time t = 1 seconds. Include units!



7