No books, no notes, no electronic devices of any kind.
Show all your work, simplify your answer, and circle it.

Name_____

Circle your TA's name and the time of your section.

Clement, Nathan	M	11:00	1:20
Jefferis, Leland	M	1:20	2:25
Makuluni, Edson	T	8:50	9:55
Nan, Ting-Ting	T	11:00	12:05
Wang, Kejia	M	8:50	9:55
Yao, Chengjian	T	1:20	2:25
You, Qian	T	11:00	12:05
Zhao, Yongqiang	M	8:50	11:00

Hand in to your TA.

Page	Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
Total	100	

1. (10 pts) For each of the following circle your answer.

   (a) Determine the domain of the function $g(x) = \frac{x}{x^2-1}$.

   (b) Determine the domain of the function $h(x) = (x^2 - 1)(x - 3)$.

2. (10 pts) Find the points of intersection (if any) of the curves:

$$y = x^2 \text{ and } y = x + 2$$

Draw the graphs of these curves and label the points of intersection.

3. (10 pts) Find the equation for the line thru the points $(1, -2)$ and $(3, 4)$. Draw the graph of this line and label these two points and label the x and y intercepts.

4. (10 pts) For what value of A (if any) is the following function f continuous for every x? Circle your answer.

$$f(x) = \begin{cases} \frac{3}{x} & \text{if } x \geq 1 \\ x^2 + Ax - 2 & \text{if } x < 1 \end{cases}$$

5. (10 pts) Find the derivative of f using the definition of derivative. Begin by stating the definition of $f'(x)$.

$$f(x) = x^2 - 3x$$

Do **not** use differentiation rules. This problem is from Section 2.1. In all other problems you may use the differentiation rules to compute derivatives.

6. (10 pts) Find the derivative $\frac{dz}{dt}$, simplify it, and circle your answer.

$$z = \frac{3}{t^2} \quad - \quad \sqrt[5]{3t^2 - 1}$$

7. (10 pts) Find the second derivative of y with respect to x. Use the correct notation for the second derivative. Simplify your answer and circle it.

$$y = x^5 + 3x^3 - x^2 - 2x + 12$$

8. (10 pts) Suppose y is implicitely defined as a function of x by the equation:

$$y^2 + 2xy + x^3 = 13$$

(a) Find $\frac{dy}{dx}$ when $x = 2$ and $y = 1$.
(b) Use it to estimate the change in y when x is changed from 2 to $2\frac{1}{7}$.

9. (10 pts) A tumor is modeled as being roughly spherical with radius r. If the radius of tumor is currently $r = 5$ milometers and growing at the rate of $\frac{1}{2}$ milometer per month what is the corresponding rate of change of its volume $V = \frac{4}{3}\pi r^3$?

10. (10 pts) For each of these circle the best answer.

1. $\lim_{x\to 2^+} \frac{1}{x}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

2. $\lim_{x\to \infty} \frac{1}{x}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

3. $\lim_{x\to -\infty} \frac{1}{x}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

4. $\lim_{x\to -\infty} x^2 + x + 1$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

5. $\lim_{x\to 0^+} \frac{1}{x}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

6. $\lim_{x\to 0^-} \frac{1}{x}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

7. $\lim_{x\to \infty} \frac{1}{1-x^2}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

8. $\lim_{x\to 0} \frac{1}{x}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

9. $\lim_{x\to 0} \frac{1}{x^2}$
   0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

10. $\lim_{x\to 1^-} x^2 + 1$
    0 1 2 ∞ $-\infty$ doesn't-exist none-of-these

Answers

1. (a) all real numbers x except $x = 1$ and $x = -1$. (b) all real numbers

2. $(-1, 1)$ and $(2, 4)$

3. $y = 3x - 5$

4. $A = 4$

5. Define
$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$
then
$$\begin{aligned} f(x+h) - f(x) &= ((x+h)^2 - 3(x+h)) - (x^2 - 3x) \\ &= x^2 + 2hx + h^2 - 3x - 3h - x^2 + 3x \\ &= 2hx + h^2 - 3h \end{aligned}$$
so
$$\frac{((x+h)^2 - 3(x+h)) - (x^2 - 3x)}{h} = \frac{2hx + h^2 - 3h}{h} = 2x + h - 3$$
so
$$\lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \to 0} (2x + h - 3) = 2x - 3$$

6. $$\frac{dz}{dt} = -6t^{-3} - \frac{6}{5} t (3t^2 - 1)^{-\frac{4}{5}}$$

7. $$\frac{d^2y}{dx^2} = 20x^3 + 18x - 2$$

8. (a) $-\frac{7}{3}$ (b) $-\frac{1}{3}$

9. 50π

10. none-of-these 0 0 ∞ ∞ $-\infty$ $-\infty$ doesn't-exist ∞ 2