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Math 112
Exam 1
October 9-12, 2017

Name:_____

Section:_____

Instructor:_____

Encode your BYU ID in the grid below.

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Instructions

A) Do not write on the barcode area at the top of each page, or near the four circles on each page.
B) Completely fill in the correct boxes for your BYU ID and your answers to the multiple choice questions.
C) Multiple choice questions are worth 4 points each.
D) For questions which require a written answer, show all your work in the space provided and justify your answer. Simplify your answers.
E) No books, notes, or calculators are allowed.
F) Please do not talk about the test with other students until after finals are over.

FERPA Permission: Please indicate whether you give permission for your exam to be returned to you by email. Please answer it correctly. No score will be assigned to this question. **Note: If you choose not to give permission, you will need to discuss with your instructor how you will get your exam.**

- ☐ No, I do not give permission.
- ☐ Yes, I give permission.

Part I: Multiple Choice Questions: *Questions marked with a* ♣ ***may*** *have more than one correct answer. Mark* ***all*** *correct answers. The other questions have one right answer. (4 points each) Choose the best answer for each multiple choice question. Fill in the box completely for the the correct answer.*

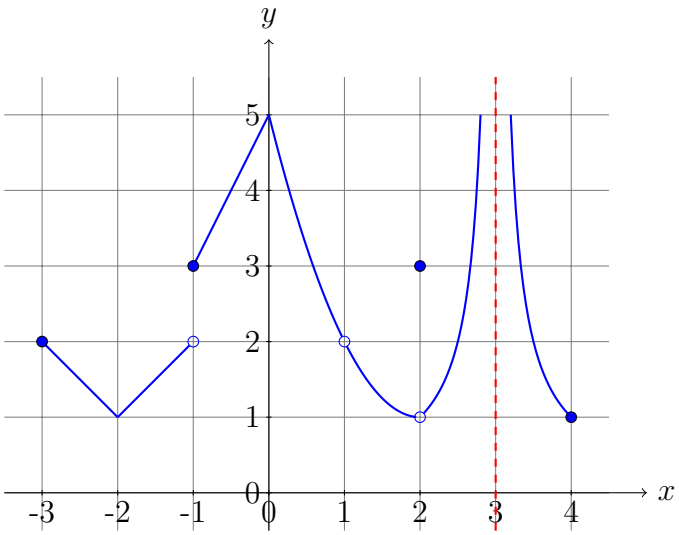
1 Find the domain of the function $f(x) = \dfrac{\sqrt{4-x^2}}{x}$.

- ☐ $(-\infty, -2] \cup [2, \infty)$
- ☐ $[-2, 2]$
- ☐ $(-2, 0) \cup (0, 2)$
- ☐ $[-2, 0) \cup (0, 2]$
- ☐ $(-2, 2)$
- ☐ $(-\infty, , -2) \cup (-2, 0) \cup (0, 2) \cup (2, \infty)$

2 Which of the following expressions is equivalent to $\cos(\tan^{-1} x)$?

- ☐ $\sin x$
- ☐ $\sqrt{1+x^2}$
- ☐ $\dfrac{x}{\sqrt{1+x^2}}$
- ☐ None of these
- ☐ $\cos^2 x$
- ☐ $\dfrac{1}{\sqrt{1+x^2}}$

3 ♣ The graph of a function $y = f(x)$ is given below. At which values of a does $\lim_{x \to a} f(x)$ fail to exist? **Mark all that apply**.



- ☐ -1
- ☐ 4
- ☐ 0
- ☐ -3
- ☐ -2
- ☐ 3
- ☐ 2
- ☐ 1

4 Evaluate $\lim_{x\to 3} \frac{\frac{1}{x}-\frac{1}{3}}{x-3}$.

- ☐ $\frac{1}{3}$
- ☐ $\frac{1}{9}$
- ☐ 1
- ☐ $-\frac{1}{3}$
- ☐ Does not exist
- ☐ $-\frac{1}{9}$
- ☐ -1

5 Evaluate the limit $\lim_{x\to -1^+} \frac{x^2+x-12}{x^2-x-2}$.

- ☐ -6
- ☐ 6
- ☐ $-\infty$
- ☐ $\frac{1}{3}$
- ☐ $-\frac{1}{3}$
- ☐ ∞
- ☐ -12
- ☐ 0

6 If $x^4 - 2x - 1 \leq f(x) \leq 3x^2 - 4x - 1$ for all $x \geq 0$, find $\lim_{x \to 1} f(x)$.

- ☐ -3
- ☐ 5
- ☐ -4
- ☐ 1
- ☐ -1
- ☐ 2
- ☐ -5
- ☐ -2
- ☐ 3
- ☐ ∞

7 Compute $\lim_{x \to -\infty} \dfrac{\sqrt{9x^6 + 2x^2 + 3}}{-3x^3 + 2x^2 - 2}$

- ☐ $-\infty$
- ☐ ∞
- ☐ 1
- ☐ -3
- ☐ 3
- ☐ -1

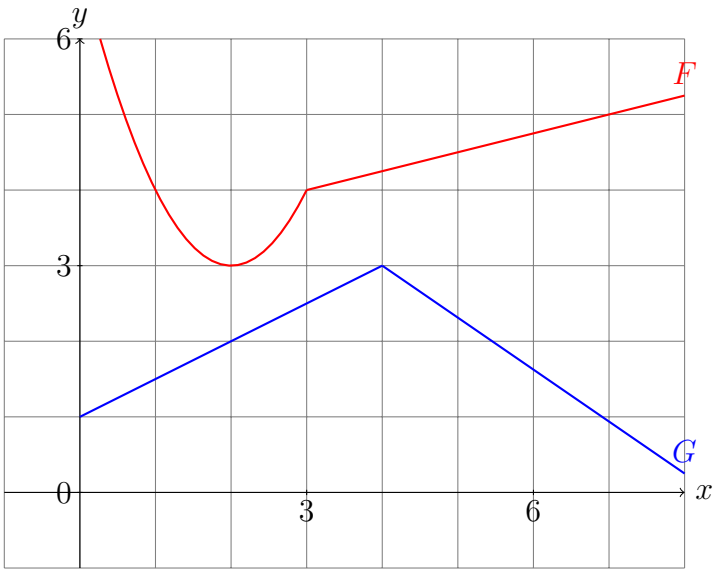
8 ♣ For which of the following functions does $\lim_{t\to\infty} h(t) = \infty$? **Select all that apply.**

- ☐ $h(t) = \ln t$
- ☐ $h(t) = \tan t$
- ☐ $h(t) = \sqrt{t}$
- ☐ $h(t) = \dfrac{2+t}{5t+2t^2}$
- ☐ $h(t) = e^{-t}$
- ☐ $h(t) = \dfrac{1}{t}$
- ☐ $h(t) = \dfrac{2+t+t^2}{3+3t}$
- ☐ $h(t) = e^{t}$

9 Let $f(x) = x^3 - \sqrt{x+2}$. Which of the following is equal to $f'(1)$?

- ☐ $\lim_{x\to 1} \dfrac{1-\sqrt{3}+h-1+\sqrt{3}}{x-1}$
- ☐ $\lim_{x\to 1} \dfrac{x^3-\sqrt{x+2}-1+\sqrt{3}}{x-1}$
- ☐ $\lim_{x\to 1} \dfrac{x^3-\sqrt{x+2}}{x-1}$
- ☐ $\lim_{x\to 1} \dfrac{(1+h)^3-\sqrt{3+h}-1+\sqrt{3}}{x-1}$
- ☐ $\lim_{x\to 1} \dfrac{1-\sqrt{3}}{x-1}$
- ☐ $\lim_{x\to 1} \dfrac{x^3-\sqrt{x+2}-1-\sqrt{3}}{x-1}$

10 Let $P(x) = F(x)G(x)$, where F and G are the functions whose graphs are shown in the diagram. Find $P'(2)$.



- ☐ 2
- ☐ 6
- ☐ 0
- ☐ 4
- ☐ $\frac{3}{2}$
- ☐ $\frac{1}{4}$
- ☐ $\frac{1}{2}$

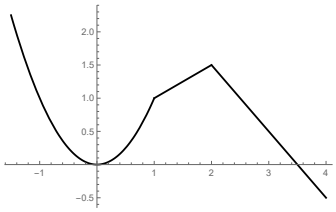
11 Suppose that $f(4) = 2$, $f'(4) = 6$, $g(4) = 5$, and $g'(4) = -3$. Let $h(x) = \dfrac{f(x)}{g(x)}$. Find $h'(4)$.

- ☐ $-\dfrac{28}{25}$
- ☐ $\dfrac{28}{25}$
- ☐ -2
- ☐ $-\dfrac{36}{25}$
- ☐ $\dfrac{36}{5}$
- ☐ $-\dfrac{36}{5}$
- ☐ $\dfrac{36}{25}$

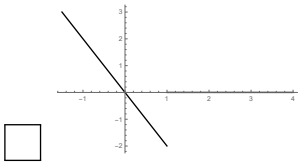
12 If $f(x) = (x^2 - x)e^x$, find $f''(x)$.

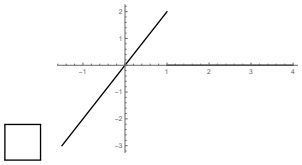
- ☐ $e^x(2x - 1)$
- ☐ $e^x(x^2 + x - 1)$
- ☐ $2xe^x$
- ☐ $xe^x(x + 3)$
- ☐ $2e^x$
- ☐ $e^x(2x + 1)$
- ☐ $xe^x(x - 3)$

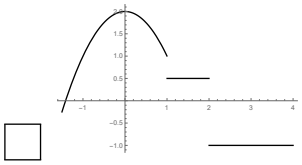
13 Consider the graph of the function $g(x)$:

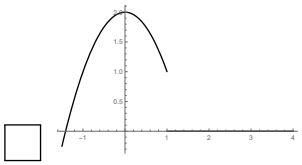


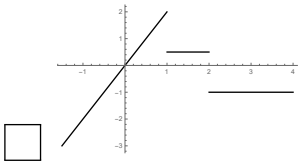
Which of the following could be the graph of $g'(x)$?

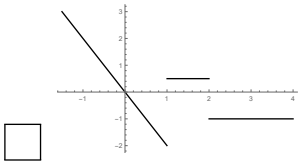












14 Given $f(x) = \dfrac{x - \sqrt{x}}{\sqrt{x}}$, find $f'(x)$.

- ☐ $\dfrac{x^2 - x}{x\sqrt{x} + x}$
- ☐ $\dfrac{1}{\sqrt{x}}$
- ☐ $2\sqrt{x} - 1$
- ☐ $2\sqrt{x}$
- ☐ 0
- ☐ $\dfrac{1}{2\sqrt{x}}$
- ☐ $1 - 2\sqrt{x}$

Part II: Free Response Questions: *Neatly write complete solutions for these problems directly on the exam paper. Work on scratch paper will not be graded.*

15 ☐**0** ☐**1** ☐**2** ☐**3** ☐**4** ☐**5** ☐**6** *Administrative Use Only*

(6 points) Find all values of x in the interval $[0, 2\pi]$ that satisfy the equation

$$\cos x - \sin 2x = 0.$$

16 ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 *Administrative Use Only*

(8 points) Let $f(x) = 2e^{x+1}$.

(a) Find the domain and range of f.

(b) Find $f^{-1}(x)$.

(c) Find $f(0)$.

(d) Solve $f^{-1}(x) = 0$.

17 ☐**0** ☐**1** ☐**2** ☐**3** ☐**4** ☐**5** ☐**6** *Administrative Use Only*

(6 points) Use the definition of continuity to prove that

$$f(x) = \begin{cases} x^3 - 3x^2 - 6x + 11 & \text{if } x < 2 \\ \dfrac{-15}{x+1} & \text{if } x \leq 2 \end{cases}$$

is continuous at $x = 2$.

18 ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 *Administrative Use Only*

(6 points) Show that $e^x = 5x^2 - 2$ has a solution in the interval $(0, 1)$. Identify any theorems that you use and justify their use.

19 ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 *Administrative Use Only*

(6 Points) Let $f(x) = \sqrt{x}$. Use the definition of the derivative to find the derivative of f. (No credit will be given for using the power rule).

20 ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 *Administrative Use Only*

(6 points) Given $f(x) = \dfrac{x^2 - 1}{x^2 + x + 1}$, find the equation of the tangent line to the curve $y = f(x)$ at the point $(1, 0)$.

21 ☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 *Administrative Use Only*

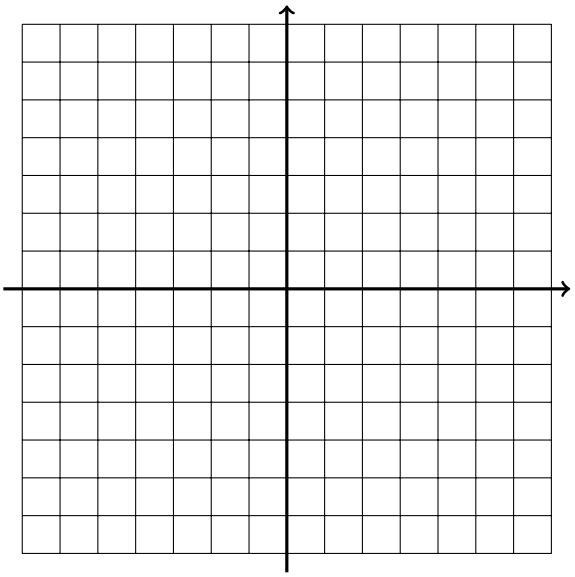
(6 Points) Use transformations to graph $f(x) = 1 - \dfrac{1}{x+1}$ on the axes provided. List all vertical asymptotes, horizontal asymptotes, and x- and y-intercepts.

Vertical asymptotes: _____

Horizontal asymptotes: _____

x-intercepts: _____

y-intercepts: _____



This page can be used for scratch paper. It will not be seen by the grader.