Name:______________________________________

Student ID:____________________________________

Section:______________________________________

Instructor: Paul Gustafson

Math 131 (Principles of Calculus)
Final Exam A

RED

Instructions:

- For questions which require a written answer, show all your work. Full credit will be given only if the necessary work is shown justifying your answer.
- Simplify your answers.
- Calculators are allowed.
- Should you have need for more space than is allocated to answer a question, use the back of the exam.
- Please do not talk about the test with other students until exams are handed back.
- **Honor Code:**

  An Aggie does not lie, cheat, or steal or tolerate those who do.

  ____

  Signature

For Instructor use only.

#	Possible	Earned
MC	135	
Sub	135	

#	Possible	Earned
Sub	0	
Total	135	

Multiple Choice (5 points each) *Mark the correct answer on the bubble sheet.*

For questions 1-4, use the following graph of $f(x)$:

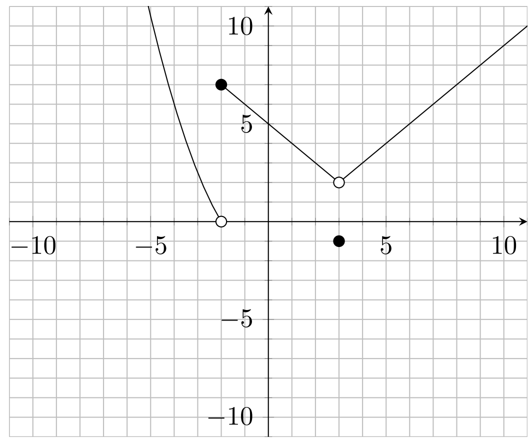

Figure 1: $f(x)$

1. According to the graph of $f(x)$, the $\lim_{x\to 3} f(x)$ equals which of the following.

   a) 8 b) 2 c) -1

   d) -3 e) The limit does not exist.

2. According to the graph of $f(x)$, the $\lim_{x\to -2^-} f(x)$ equals which of the following.

   a) 7 b) 0 c) -2

   d) -5 e) The limit does not exist.

3. According to the graph of $f(x)$, the $\lim_{x\to 5} f(x)$ equals which of the following.

   a) 8 b) 4 c) 0

   d) -1 e) The limit does not exist.

4. According to the graph of $f(x)$, the function $f(x)$ is not continuous at $x = 3$ because

   a) $f(x)$ is not defined at $x = 6$. b) there is a removable discontinuity at $x = 6$ c) $\lim_{x\to 6} f(x)$ does not exist.

   d) there is a horizontal asymptote at $x = 6$. e) there is a vertical asymptote at $x = 6$.

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5. The graph of $g(x)$ is given below.

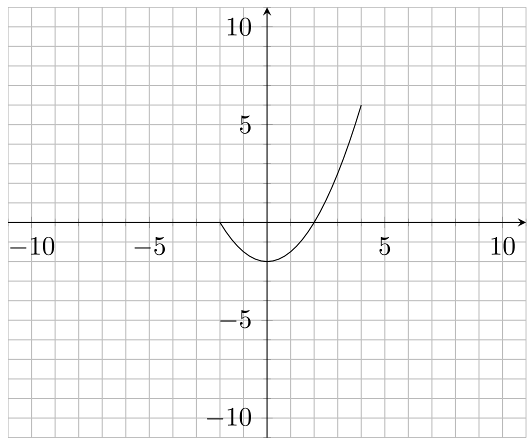

Figure 2: $g(x)$

According to the graph above, the domain and range of $g(x)$ are

a) Domain: $[-4, 4]$, Range: $[-4, 2]$

b) Domain: $[-6, 4]$, Range: $[-2, 6]$

c) Domain: $[-6, 2]$, Range: $[-2, 4]$

d) Domain: $[-4, 4]$, Range: $[-6, 2]$

e) Domain: $[-2, -6]$, Range: $[-2, 4]$

6. Find the domain of $f(x) = \dfrac{1}{x^2 - 16}$.

a) $(-2, 2) \cup (2, \infty)$

b) $(-\infty, -4) \cup (-4, 4) \cup (4, \infty)$

c) $(-\infty, -4) \cup (0, \infty)$

d) $(-\infty, -2) \cup (-2, 2) \cup (2, \infty)$

e) $[-2, 2)$

7. Let $f(x) = \sqrt{4 - x^2}$ and $g(x) = \ln(x)$. What is the domain of $f(x) * g(x)$?

a) $(0, 2]$

b) $[-1, 2)$

c) $[-2, \infty)$

d) $(0, \infty)$

e) $[-2, 2]$

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8. Given a function $f(x)$, then the graph of $2f(3-x)$ will be

   a) the graph of $f(x)$ shrunk horizontally by a factor of 2, shifted 4 units up, then reflected across the x-axis.

   b) the graph of $f(x)$ stretched vertically by a factor 3, shifted 2 units up, then reflected across the y-axis.

   c) the graph of $f(x)$ stretched vertically by a factor of 2, shifted 3 units to the right, then reflected across the y-axis.

   d) the graph of $f(x)$ stretched vertically by a factor of 2, shifted 3 units to the left, then reflected across the y-axis.

   e) the graph of $f(x)$ shrunk horizontally by a factor of 3, shifted 4 units to the right, then reflected across the x-axis.

9. A bacteria population doubles every 47 minutes. If the initial population is 1000 bacteria, how many bacteria will there be after 5 hours?

   a) 4.2×10^4 b) 3.2×10^3 c) 4.3×10^3

   d) 1.2×10^3 e) 8.3×10^3

10. Find the derivative of the function $f(x) = \dfrac{3}{x^3} - 4x^2 + 3$.

   a) $-\dfrac{15}{x^2} - 8x$ b) $-\dfrac{15}{x^2} + 3$

   c) $-\dfrac{9}{x^4} - 8x$ d) $-\dfrac{9}{x^4} - 4$

   e) $-\dfrac{10}{x} - 3$

For the next two questions, use the following graph of $f'(x)$:

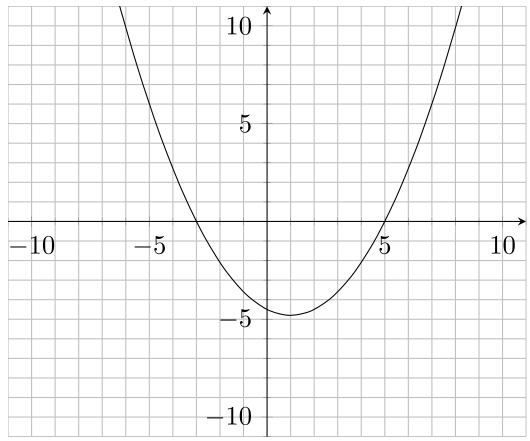

Figure 3: $f'(x)$

11. According to the graph of $f'(x)$, the original function $f(x)$ has a local maximum at

a) -5 b) -3 c) 0

d) 1 e) 5

12. According to the graph of $f'(x)$, the original function $f(x)$ is concave upward in which interval(s)?

a) $(-\infty, \infty)$ b) $(-\infty, -3) \cup (1, 5)$

c) $(1, \infty)$ d) $(-\infty, -3)$

e) The original function $f(x)$ is never concave up.

13. A vertical spring is released at time $t = 0$ seconds and begins to oscillate in a straight vertical line. The height of its endpoint above the ground in meters is given by the function

$$h(t) = 3 - 0.2\cos(2t)$$

To two decimal places, what is the velocity (in meters/second) of the spring's endpoint at time $t = 3$?

a) -0.11 b) -0.06 c) 0.12

d) 2.12 e) 2.84

14. Find the linear approximation to $\sqrt{x^2+8}$ at $x = 1$

a) $3x + \sqrt{8}$

b) $x + \sqrt{8}$

c) $\frac{1}{6}x + 3$

d) $\frac{2}{3}x + 3$

e) $\frac{1}{3}x + 3$

15. We are given an unknown function $f(x)$ such that $f'(2) > 0$ and $f''(2) < 0$. We can conclude that at $x = 2$, the function $f(x)$ has

a) a local min.

b) a local max.

c) an inflection point.

d) an undefined derivative.

e) none of the above.

16. Calculate the equation of the tangent line to $y = \frac{1}{x}$ at $x = 2$

a) $y = -\frac{1}{4}x + \frac{1}{2}$

b) $y = x + \frac{1}{2}$

c) $y = -\frac{1}{2}x + 2$

d) $y = -\frac{1}{2}x + \frac{1}{2}$

e) $y = -\frac{1}{4}x + 2$

17. Find the absolute maximum and minimum values for the function $f(x) = \ln(x^2 + 1)$ on the interval $[-1, 3]$

a) maximum value = 2.30, minimum value = 1.1

b) maximum value = 3.62, minimum value = 1.1

c) maximum value = 2.30, minimum value = 0

d) maximum value = 3.62, minimum value = 0

e) maximum value = 1.32, minimum value = 1

18. Find the derivative of the function $\tan(xe^x)$.

a) $(1+x)e^x\sec^2(xe^x)$

b) $e^x\sec^2(xe^x)$

c) $(1+x)e^x\tan(xe^x)$

d) $e^x\cos^2(xe^x)$

e) $\sec^2(xe^x)$

19. If $f'(x) = \dfrac{1}{2\sqrt{x}}$ and $f(9) = 5$

a) $f(x) = \dfrac{3}{4}x^{-3/2} + \dfrac{11}{4}$

b) $f(x) = \sqrt{x} + \dfrac{7}{2}$

c) $f(x) = \dfrac{1}{2}\sqrt{x} + 3$

d) $f(x) = \dfrac{1}{2}\sqrt{x} + \dfrac{7}{2}$

e) $f(x) = \sqrt{x} + 2$

20. A particle moves along a wire with velocity $v(t) = 4\cos(2t)$. Find the net change in position between time $t = 0$ and $t = \pi$

a) $1+\pi$

b) 2π

c) 4π

d) 0

e) $\dfrac{\pi}{2}$

21. Calculate the indefinite integral $\displaystyle\int \frac{1}{x} + \sec(3x)\tan(3x)\,dx$

a) $\ln|x| + 3\sec(3x) + C$

b) $\dfrac{2}{x^2} + \dfrac{1}{3}\sec(3x) + C$

c) $\ln|x| + \dfrac{1}{3}\sec(3x) + C$

d) $-\dfrac{2}{x^2} + \dfrac{1}{3}\tan(3x) + C$

e) $\ln|x| + \dfrac{1}{3}\cot(3x) + C$

22. Use the fundamental theorem of calculus to find the derivative of $f(x) = \int_1^{x^2} \sin(\cos(t))\, dt$

a) $\sin(\cos(x^2))$

b) $x^2 \sin(\cos(x^2))$

c) $(x^2 - 1)\sin(\cos(x^2))$

d) $2x\sin(\cos(x^2))$

e) $(2x - 1)\sin(\cos(x)$

23. Use the geometric shape of the graph to find the integral $\int_{-3}^{2} f(x)$ where

$$f(x) = \begin{cases} 5, & x \le 0 \\ \sqrt{4 - x^2}, & x > 0 \end{cases}$$

a) 2π

b) $\frac{15}{2} + \frac{1}{4}\pi$

c) $15 + \pi$

d) $15 + 2\pi$

e) $10 + \frac{\pi}{2}$

24. The acceleration of a particle is given by $a(t) = 6\sin(t)$. The position of the particle at times $t = 0$ is $s(0) = 3$. The initial velocity of the particle is $v(0) = -7$. The position function for the particle is

a) $s(t) = -3t^2 + 5t + 3$

b) $s(t) = -6\sin(t) - t + 3$

c) $s(t) = -6\cos(t) - t + 6$

d) $s(t) = -6\cos(t) - 13t + 3$

e) $s(t) = -6\sin(t) - 13t + 3$

25. Calculate $\int_1^{e^3} \frac{(\ln(x))^2}{x}\, dx$.

a) 9

b) $\frac{1}{3}e^3 - 1$

c) $2e^{-3}$

d) $\frac{1}{3}$

e) 8

26. Calculate the area between the curves $y = x$ and $y = x^2$.

a) $\frac{1}{3}$

b) $\frac{1}{6}$

c) $\frac{2}{3}$

d) 1

e) $-\frac{1}{2}$

27. What is the average value of the function $f(x) = \sin(x)$ on $[0, \pi]$

a) 2

b) -2π

c) $-\frac{\pi}{2}$

d) π

e) $\frac{2}{\pi}$

END OF EXAM