For questions 1 through 25, mark your answer choice on the answer sheet provided. After completing items 1 through 25, answer each of the tiebreaker items. Be sure that your name is printed on each of the tiebreakers.

1. What value could be k such that f (x) is continuous at x = 0, where f(x) is given by the following: $f(x) = \begin{cases} \frac{\sin(kx)}{x}, x > 0 \\ k^2 + x - 2, x \leq 0 \end{cases}$.

(A) 0
(B) 1
(C) 2
(D) 4
(E) None of the Above.

2. Which of the following are true about a particle that starts at t = 0 and moves along a number line if its position at time t is given by $s(t)=(t-2)^3(t-6)$?

I. The particle is moving to the right for t > 5.
II. The particle is at rest at t = 2 and t = 6.
III. The particle changes direction at t = 2.

(A) only I is true
(B) only II is true
(C) only III is true
(D) only I and III are true
(E) None of the statement is true

3. Give the slope of the equation of the normal line to the graph of $y = x\sqrt{x^2 + 16} + 2$ at the point (0, 2).

(A) $\frac{1}{4}$
(B) $-\frac{1}{4}$
(C) 4
(D) -4
(E) None of the Above

4. Find $\lim_{x\to\infty} x\sin(\frac{4}{x}) =$

(A) 0
(B) ∞
(C) $-\infty$
(D) 4
(E) Does Not Exist.

5. $\lim_{x\to 0^+}(x+1)^{\frac{2}{tanx}}$

(A) 1
(B) e
(C) e^2
(D) $\frac{\pi}{2}$
(E) $\frac{\pi}{4}$

6. The slope of an equation of the line tangent to the graph of $4x^2 + cx - 2e^y = -2$ at the point where $x = 0$ is 4. Give the value of c.

(A) -2
(B) 4
(C) 8
(D) -4
(E) -8

7. For what value(s) of x is the tangent line to the graph of $f(x) = \frac{x-2}{x+1}$ parallel to $y = 3x + 5$?

(A) x=0, 2
(B) x=0,-2
(C) x=1, 2
(D) x=2
(E) x= 1, -2

8. Evaluate $\int e^{2x}\sqrt{e^x+1}dx$.

(A) $\frac{2}{5}(e^x+1)^{\frac{5}{2}}-\frac{2}{3}(e^x+1)^{\frac{3}{2}}+C$

(B) $e^{2x}(e^x+1)^{\frac{3}{2}}+C$

(C) $\frac{2}{5}e^{\frac{5}{2}x}-5e^{\frac{3}{2}x}+C$

(D) $-\frac{2}{5}(e^x+1)^{\frac{5}{2}}-3(e^x+1)^{\frac{3}{2}}+C$

(E) $-\frac{2}{5}(e^x+1)^{\frac{5}{2}}+3(e^x+1)^{\frac{3}{2}}+C$

9. Suppose $0 < x < \frac{\pi}{2}$. If $f(x) = (\sin x)^x$, then $f'(x) =$

(A) $x\ ln\ x(\sin x)$
(B) $(\sin x)^x\ \cos x$
(C) $x(\sin x)^{x-1}(\cos x)$
(D) $(\sin x)^x(x\ \cos x + \sin x)$
(E) $(\sin x)^x(x\ \cot x + ln\ (\sin x))$

10. What is the average value of the function $f(x) = (2x+3)^2$ from x=-3 to x=-1.

(A) 5
(B) -4
(C) $\frac{7}{3}$
(D) $\frac{14}{3}$
(E) $\frac{4}{3}$

11. Evaluate $\int_1^2 \frac{1}{\sqrt{4-t^2}}dt$

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{2}$ (E) π

12. Give a value of c that satisfies the conclusion of the Mean Value Theorem for Derivatives for the function $f(x) = x^2 - x - 1$ on [1, 3].

(A) $\frac{3}{2}$ (B) $\frac{5}{4}$ (C) $\frac{9}{4}$ (D) $\frac{1}{2}$ (E) 2

13. A particle's acceleration for $t \geq 0$ is given by $\alpha(t) = 12t + 4$. The particle's initial position is 2 and its velocity at $t = 1$ is 5. What is the position of the particle at $t = 2$?

(A) 20 (B) 10 (C) 4 (D) 16 (E) 12

14. Which of the following functions is continuous at x = 0 but not differentiable at x = 0?

(A) $f(x)=x^{-4/5}$ (B) $f(x)=x^{-3/2}$ (C) $f(x)=x^{3/4}$ (D) $f(x)=x^{5/3}$ (E) $f(x)=x^2$

15. Determine the derivative of $f(x) = (\cos(3x + 2))^3$ at $x = \pi/3$.

(A) $-9(\cos(\pi + 2))^2 \sin(\pi + 2)$
(B) $-9(\cos(\pi + 2))^2$
(C) $27(\cos(\pi + 2))^2 \sin(\pi + 2)$
(D) $27(\cos(\pi + 2))^2$
(E) None of the above

16. Evaluate $\int 4x^2\sqrt{x^3 + 4}dx$

(A) $\frac{8}{3}(x^3 + 4)^{\frac{3}{2}} + C$

(B) $\frac{16}{9}(x^3 + 4)^{\frac{3}{2}} + C$

(C) $\frac{8}{9}(x^3 + 4)^{\frac{3}{2}} + C$

(D) $\frac{4}{3}\frac{1}{\sqrt{x^3+4}} + C$

(E) $\frac{8}{3}\frac{1}{\sqrt{x^3+4}} + C$

17. Given that $5x^3 - 3xy - 2y^2 = 1$. Determine the change in *y* with respect to *x*.

(A) $\frac{15x^2-3}{3x+4y}$ (B) $\frac{15x^2-3y}{3+4y}$ (C) $\frac{15x^2-3y}{3x+4y}$ (D) $\frac{15x^2-3}{3+4y}$ (E) $\frac{10x-3y}{3x+2}$

18. Which of the following functions has a vertical asymptote at *x* = -1 and a horizontal asymptote at *y* = 2?

(A) $f(x) = \ln(2x + 2)$
(B) $f(x) = \frac{2x^2+1}{x^2-1}$
(C) $f(x) = e^{x-1} + 2$
(D) $f(x) = \arctan(x - 1) + 2 - \frac{\pi}{2}$
(E) None of the above

19. The function $f(x) = \begin{cases} Ax^3 - x, x > 1 \\ Bx^2 + 5, x \leq 1 \end{cases}$ is differentiable everywhere. What is *A*?

(A) -17 (B) -14 (C) 13 (D) -9 (E) -11

20. Compute the derivative of *f(x)* = $\int_0^{x^2} \ln(t^2 + 1)dt$.

(A) $\ln(x^4 + 1)$

(B) $2x \ln(x^4 + 1)$

(C) $\frac{2x}{x^4+1}$

(D) $2x \ln(x^2 + 1)$

(E) None of the above

21. A solid is generated by rotating the region enclosed by the graph of $y = \sqrt{x}$, the lines x=1, x=2 and y=1 about the *x*-axis. Which of the following integrals gives the volume of the solid?

(A) $\int_1^2 \pi(x-1)dx$

(B) $\int_1^2 \pi(x-1)^2 dx$

(C) $\int_1^2 \pi(\sqrt{x}-1)^2 dx$

(D) $\int_1^2 \pi(2-x)^2 dx$

(E) None of the above

22. Let $y = 2^{sinx}$. Evaluate $\frac{dy}{dx}$.

(A) $\frac{dy}{dx} = \ln 2 \cdot \cos x$

(B) $\frac{dy}{dx} = 2^{\sin x} \cdot \ln 2 \cdot \cos x$

(C) $\frac{dy}{dx} = 2^{\sin x} \cdot \cos x$

(D) $\frac{dy}{dx} = 2^{\sin x}\left[\ln 2 \cdot \cos x + \frac{1}{2}\sin x\right]$

(E) None of the above

23. $\lim_{x\to-\infty} \frac{5x^2+7x-3}{2+3x-11x^2} =$

(A) $-\infty$ (B) -5/11 (C) 0 (D) ∞ (E) Does Not Exist.

24. Give the value of x where the function $f(x) = x^3 + 6x^2 + 9x$ has a relative (local) maximum.

(A) 1 (B) 3 (C) -1 (D) -2 (E) -3

25. Evaluate $\lim_{h\to0^-} \frac{\frac{1}{x^2}-\frac{1}{(x-h)^2}}{h}$

(A) -1

(B) 1

(C) 0

(D) $-\infty$

(E) None of the above

Name:_____

Tiebreaker 1

Solve the following integration problem.

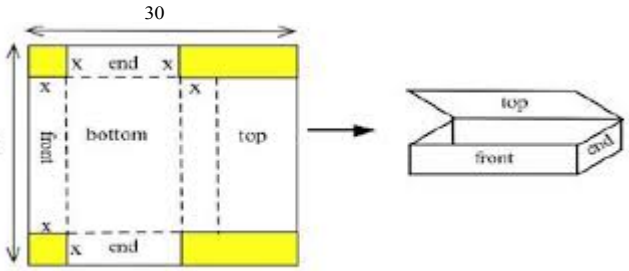
$$\int \frac{x^5-2x^4+x^3+x+5}{(x^2+1)(x-2)}dx$$

Name: _____

Tiebreaker 2

You have a 30 inch by 30 inch piece of cardboard which you plan to cut and fold to form a box with a top. Find the dimensions of the box which has the largest volume.

Your answer should include appropriate units.



Name:_____

Tiebreaker 3

Use the definition of a horizontal asymptote to determine all horizontal asymptotes for

$$f(x) = \frac{4x^3 - 5x + 2}{2x^3 + \sqrt{16x^6 - 7x^5}}$$

ACTM STATE 2016 FOR CALCULUS (KEY)

1. C
2. A
3. B
4. D
5. C
6. C
7. B
8. A
9. E
10. C
11. C
12. E
13. D
14. C
15. A
16. C
17. C
18. B
19. E
20. B
21. A
22. B
23. B
24. E
25. E

Tiebreaker 1: $\frac{1}{3}x^3 - \frac{1}{2}\ln(x^2+1) + 3ln(x-2) - \arctan(x) + C$

Tiebreaker 2: $5\ in \times 10\ in \times 20\ in$

Tiebreaker 3: y=-2, 2/3