Name:
ID:
Discussion Section:
This exam has 20 multiple choice questions:
Important:

- No graphing calculators!
- Mark your answer on the answer card.
- You are allowed a 4 × 6 note card for the exam.

1. Let \( f(x) = \sqrt{x} \) and \( g(x) = 1 - x^2 \). What is the domain of \( (f \circ g)(x) \)?

(a) \((-\infty, \infty)\)
(b) \((-\infty, -1] \cup [1, \infty)\)
(c) \((-\infty, -1) \cup (1, \infty)\)
(d) \([-1, 1]\)
(e) \((-1, 1)\)
(f) \([-1, \infty)\)
(g) \([0, \infty)\)
(h) \((0, \infty)\)
(i) \([1, \infty)\)

2. Which of the following best describes the function

\[
f(x) = \begin{cases} 
  x + 1 & \text{if } x < 0; \\
  e^x & \text{if } x \geq 0 
\end{cases}
\]

near \( x = 0 \)?

(a) Doesn't have a limit as \( x \to 0 \)
(b) Has a limit as \( x \to 0 \), but not continuous
(c) Continuous, but not differentiable
(d) Differentiable, but not continuous
(e) Continuous and differentiable
(f) Asymptote
3. Find the limit:

\[ \lim_{x \to 1} \frac{\sqrt{x} - 1}{x - 1} \]

(a) \(-1\)
(b) \(-1/2\)
(c) \(-1/3\)
(d) 0
(e) \(1/3\)
(f) \(1/2\)
(g) \(3/4\)
(h) 1
(i) DNE

4. A gardener wants to fence in a rectangular area and then divide the area in half with a fence down the middle parallel to one side (see the diagram below). If the gardener has 60m of fencing material, what is the largest possible area (in \(m^2\)) of the total fenced-in region?

(a) 60
(b) 120
(c) 150
(d) 180
(e) 225
(f) 240
(g) 250
(h) 300
(i) 500
(j) 900
5. Let \( f(x) = \sin x + \cos x \). Find the absolute minimum and maximum values of \( f(x) \) on the interval \([0, \pi]\).

(a) Minimum: \(-2\); Maximum: 2
(b) Minimum: \(-\sqrt{2}\); Maximum: \(\sqrt{2}\)
(c) Minimum: \(-1\); Maximum: 1
(d) Minimum: \(-1\); Maximum: \(\sqrt{2}\)
(e) Minimum: \(-1\); Maximum: \(\sqrt{2}/2\)
(f) Minimum: \(-1\); Maximum: 0
(g) Minimum: \(-\sqrt{2}/2\); Maximum: \(\sqrt{2}/2\)
(h) Minimum: 0; Maximum: 1
(i) Minimum: 0; Maximum: \(\sqrt{2}\)
(j) Minimum: 0; Maximum: \(\sqrt{2}/2\)

6. A rock is thrown into a pond and causes a circular ripple. If the radius of the ripple is increasing at a rate of 4 feet per second, how fast (in square feet per second) is the area changing when the radius is 10 feet?

(a) \(4\pi\)
(b) \(8\pi\)
(c) \(10\pi\)
(d) \(16\pi\)
(e) \(40\pi\)
(f) \(80\pi\)
(g) \(100\pi\)
(h) \(200\pi\)
(i) \(400\pi\)
(j) \(800\pi\)

7. The graph of \( y = \frac{4x^2 + 3x + 1}{x + 2} \) has a slant asymptote. What is the equation of the asymptote?

(a) \(y = x - 3\)
(b) \(y = x + 1\)
(c) \(y = 2x - 6\)
(d) \(y = 2x - 1\)
(e) \(y = 2x + 4\)
(f) \(y = 4x - 6\)
(g) \(y = 4x - 1\)
(h) \(y = 4x + 2\)
(i) \(y = 6x\)
8. Which of the following best describes the graph of \( y = x \ln x \) when \( x = 1/e \)?

(a) increasing, concave down  
(b) increasing, concave up  
(c) decreasing, concave down  
(d) decreasing, concave up  
(e) local maximum  
(f) local minimum  
(g) critical point, inflection point  
(h) increasing, inflection point  
(i) decreasing, inflection point  
(j) not differentiable at this point

9. The demand function for mePods is \( p = 200 - x \), where \( p \) is the price (in dollars) at which \( x \) mePods can be sold. The cost (in dollars) of producing \( x \) mePods is \( C(x) = 100 + 20x + 2x^2 \). How many mePods should be produced in order to maximize profit?

(a) 20  
(b) 25  
(c) 30  
(d) 35  
(e) 40  
(f) 45  
(g) 50  
(h) 55  
(i) 60

10. Find the slope of the graph of \( 2x^2 + y^2 = 3xy \) at the point (1, 2).

(a) \(-1/2\)  
(b) \(-1/4\)  
(c) 0  
(d) 2/5  
(e) 3/8  
(f) 1/4  
(g) 1/2  
(h) 1  
(i) 2  
(j) 5/2
11. The half-life of a certain radioactive element is 100 days. How many days will it take for a 100mg sample to decay to 10mg? Choose the closest answer.

(a) 100
(b) 200
(c) 240
(d) 270
(e) 300
(f) 330
(g) 370
(h) 400
(i) 420
(j) 1000

12. Find the slope of the graph of \( y = x^{1/2} \) when \( x = 2 \). Choose the closest answer.

(a) 0
(b) 0.1
(c) 0.2
(d) 0.3
(e) 0.4
(f) 0.5
(g) 0.6
(h) 0.8
(i) 1
(j) 1.2

13. Find the area enclosed by the parabolas \( y = x^2 \) and \( y = 8 - x^2 \).

(a) 0
(b) 1/3
(c) 1
(d) 4/3
(e) 8/3
(f) 16
(g) 32/3
(h) 64/3
(i) 32
14. Suppose that the demand equation for corn is \( p = 200 - x \), where \( p \) is the price (in dollars per ton) at which \( x \) tons of corn are demanded. Suppose that the supply equation is \( p = \frac{x^2}{100} \). If corn is being sold at the equilibrium price, what is the total economic surplus in the corn market? Choose the closest answer.

(a) $1,667
(b) $3,333
(c) $5,000
(d) $6,667
(e) $8,333
(f) $10,000
(g) $11,667
(h) $13,333
(i) $15,000
(j) $20,000

15. Suppose money is contributed to a retirement account at an annual rate of $5,000. If the rate of return for the investment is 10% compounded continuously, approximately how much will the account be worth after 20 years?

(a) $100,000
(b) $178,000
(c) $233,000
(d) $289,500
(e) $319,500
(f) $362,000
(g) $419,500
(h) $504,000
(i) $739,000
16. What is 
\[ \int_0^2 \sqrt{4 - x^2} \, dx \, ? \]
Choose the closest answer.
(a) 1 
(b) 2 
(c) 3 
(d) 4 
(e) 5 
(f) 6 
(g) 7 
(h) 8 
(i) 9 

17. What is the area below the graph of \( y = \sin x \) between \( x = 0 \) and \( x = \pi \)?
(a) 0 
(b) \( \sqrt{2}/2 \) 
(c) \( \sqrt{3}/2 \) 
(d) 1 
(e) \( \sqrt{2} \) 
(f) \( \pi/2 \) 
(g) \( \sqrt{3} \) 
(h) 2 
(i) \( \pi \) 

18. Compute
\[ \int_1^2 \frac{x^2 + 1}{x} \, dx. \]
Choose the closest answer,
(a) 1 
(b) 1.19 
(c) 1.38 
(d) 2.19 
(e) 2.5 
(f) 2.65 
(g) 2.78 
(h) 3.14 
(i) 3.33 
(j) 3.69
19. Use a Riemann sum with $n = 4$ and left endpoints to estimate the area under the graph of $f(x) = e^{-x^2}$ between $x = 0$ and $x = 1$. Choose the closest answer.

(a) 0.82 
(b) 0.99 
(c) 1.18 
(d) 1.35 
(e) 1.51 
(f) 1.68 
(g) 1.77 
(h) 2.13 
(i) 3.29 

20. Find the function $f(x)$ for which $f'(x) = \sqrt{x}$ and $f(1) = 1$. What is $f(4)$?

(a) 1/4 
(b) 3/8 
(c) 1 
(d) 17/16 
(e) 4/3 
(f) 2 
(g) 5/2 
(h) 4 
(i) 17/3