1.[2 points] Find the equation of the tangent line to the curve $y = \ln(x^2 - 3)$ at the point $(2, 0)$.

A. $y = x - 2$ **B**. $y = 4x - 8$ **C**. $y = 2x - 4$
D. $y = -3x + 6$ **E**. $y = 0$ **F**. $y = \frac{1}{2}x - 1$

2.[2 points] Find the slope of the tangent line to the curve $x^2y^2 + xy = 2$ at $(1, 1)$.
A. 2.01 **B**. -2.01 **C**. 1 **D**. -1 **E**. 0 **F**. 3.14

3.[2 points] Suppose $F(x) = f(g(x))$, $g(1) = 3$, $g'(1) = 4$, $f'(1) = 6$, $f'(3) = 5$. Find $F'(1)$.
A. 20 **B**. 24 **C**. 12 **D**. 30 **E**. 18 **F**. 15

4.[2 points] The rate of change of the radius of a balloon is 2 cm/min. Assuming that the balloon is a perfect sphere (and given that the volume of a sphere is $V = \frac{4}{3}\pi r^3$), what is the rate of change of the volume of the balloon (in cm^3/min) when the radius is 5 cm?
A. π **B.** 200π **C.** 8π **D.** $\frac{200}{3}\pi$ **E.** $\frac{4}{3}\pi$ **F.** 25π

5.[2 points] On what subinterval(s) of $[0, 2\pi]$ is the function $y = 3\cos(2x) + 4x$ concave up?

6.[2 points] Find the derivative of $f(x) = \arcsin(3x^2)\ln(x)$.

7.[2 points] Newton's Method is being used to find a root of $f(x) = x^3 - 3x + 1$ with $x_1 = 0$. What is the value of x_3 ?

A. 0.3333 **B.** -1.0694 **C.** 0.3472
D. -0.4028 **E.** -0.3333 **F.** 0.3519

8.[2 points] Albert and Gertrude start walking from the same point. Albert walks due north at a rate of 4m/s, while Gertrude walks due east at a speed of 3m/s. At what rate is the distance between Albert and Gertrude increasing 30 seconds later?

A. 5.86m/s **B.** 12.12m/s **C.** 13.67m/s
D. 16.83m/s **E.** 5m/s **F.** 0.68m/s

9.[2 points] Which of the following statements is true about the graph of the function $f(x) = x^2 e^{-x}$ on the interval $[1, 2]$?

A. It is increasing and concave up.
B. It is decreasing and concave up.
C. It is increasing and concave down.
D. It is decreasing and concave down.
E. It is increasing and changes concavity.
F. It is decreasing and changes concavity.

10.[2 points] If $\int_{-1}^{5} f(x)\,\mathrm{d}x = 3.7$ and $\int_{-1}^{3} f(x)\,\mathrm{d}x = 3.2$, what is the value of $\int_{3}^{5} (3f(x) + 2x)\,\mathrm{d}x$?

A:	16.5	**B**:	14.9	**C**:	17.5
D:	16.0	**E**:	12.7	**F**:	none of these

11.[2 points] What is the absolute maximum value attained by the function $f(x) = x^3 - 6x^2 + 9x - 6$ on the interval $[0, 4]$?

12.[2 points] Find $F''(1)$ if $F(x) = \int_1^x f(t)\,dt$ and $f(t) = \int_1^{2t} \sqrt{1+u^3}\,du$.

A. 0 **B.** $\sqrt{2}$ **C.** 3 **D.** 6 **E.** $\sqrt{8}$ **F.** 9

13.[2 points] Evaluate $\displaystyle\int_1^e \frac{dx}{x\sqrt{1+\ln x}}$.

A. $\ln(1+e)$ **B.** $e\,\ln(1+e)$ **C.** $2\sqrt{2}-2$

D. $2e^{1/2}-e$ **E.** $2e^{1/2}-2$ **F.** $\dfrac{1}{\sqrt{1+e}}$

14.[2 points] Estimate the value of $\displaystyle\int_1^2 \cos(\ln(x))\,dx$ by subdividing $[1,2]$ into 4 small intervals and using the **midpoint method**.

15.[2 points] Evaluate the integral $\int \frac{1+2x}{\sqrt{1-x^2}}dx$.

Answer:

16.[2 points] Evaluate the integral $\int x^2 \ln x \, dx$.

Answer:

17.[2 points] Find $\int \frac{x^4}{x+1} dx$.

18.[2 points] Evaluate the integral $\int x \cos\left(3x + \frac{\pi}{4}\right) dx$.

Answer:

19.[2 points] Evaluate the following integral.
$\int \dfrac{3x+29}{x^2+x-6}\,dx.$

20.[2 points] Let $y = x^{\tan(x)}$. Find dy/dx.

Answer:

21.[5 points] A piece of wire 1 m long is cut into two pieces to make a square and a circle. How should the wire be cut so that the total area enclosed is (a) a minimum and (b)a maximum? *Provide a detailed solution and draw a box around each answer.*

22.[5 points] Analyze the graph of the $f(x) = e^{-x} \sin x$ for $0 \leq x \leq 2\pi$. Label local maxima/minima and inflection points (with their coordinates) *on your graph.* Indicate concavity (up/down).

23.[5 points] Identify each of the following statements as either true or false:

1. the inverse function of $f(x) = \ln(3x)$ is $f^{-1}(x) = e^{-3x}$
2. the inverse function of $f(x) = \sin(x)$ is $f^{-1}(x) = \csc(x)$
3. an inflection point of a curve is where the second derivative is zero
4. a critical point of a curve is where the derivative is either zero or does not exist
5. the extreme value theorem says that a function $f(x)$ defined on an interval $[a, b]$ will attain its absolute maximum and absolute minimum at the critical points of $f(x)$
6. the Fundamental Theorem of Calculus says that $\int_a^b g'(x)\, dx = g(x)$
7. the Fundamental Theorem of Calculus says that $\frac{d}{dx} \int_a^b g(x)dx = g(x)$
8. the formula for the Riemann sum which estimates $\int_0^1 f(x)\, dx$ using the right endpoint rule is $\sum_{i=1}^n f(x_i)\delta x$ where $x_i = i(\delta x)$ and $\delta x = \frac{1}{n}$
9. if $h(x) = g(x) + 4$ and $g'(x) = f(x)$, then $h'(x) = f(x)$
10. if a is a critical point of f such that $f'(a) = 0$ and $f''(a) > 0$ then a is a local minimum of f