1. $\lim_{x\varnothing -1} \dfrac{x^2 - 6x - 7}{x^2 + 3x + 2} = ?$

(A) -9 (B) 1 (C) -8 (D) $-\frac{7}{2}$ (E) ∞

2. If $\sqrt{1 + x^2} \leq x\, f(x) \leq 1 + \subseteq x \subseteq$, then $\lim_{x\varnothing\infty} f(x) = ?$

(A) 1 (B) 2 (C) ∞ (D) 0 (E) $\frac{1}{2}$

3. For $x \neq 2$, $f(x) = \dfrac{x^2 + x - 6}{x^2 + 3x - 10}$. If f is also defined and continuous at $x = 2$, then $f(2) = ?$

(A) $-\frac{3}{5}$ (B) $\frac{4}{3}$ (C) Insufficient data given

(D) 1 (E) $\frac{5}{7}$

4. If, L_1 is the tangent line to the graph of $y = \cos x$ at $\left(\frac{\pi}{2}, 0\right)$ and L_2 is the tangent line to the graph of $y = \frac{x^2 + 1}{2}$ at (1,1) then L_1 and L_2 cross at what angle?

(A) 0 (B) $\frac{\pi}{2}$ (C) $-\frac{\pi}{3}$ (D) $\frac{\pi}{4}$ (E) $-\frac{\pi}{6}$

5. If $f(x) = x^2(x + 1)(x^2 + x - 5)^3$, then $f'(1) = ?$

(A) – 49 (B) 101 (C) – 9 (D) 27 (E) 0

6. The equation of the tangent line to the curve

$$x \sin 2y = y \cos 2x$$

at the point $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$ is

(A) $y = -\frac{x}{2} + \frac{5}{8}\pi$ (B) $y = 2x$

(C) $y = x + \frac{\pi}{4}$ (D) $y = \frac{\pi}{2}$

(E) $y = -x + \frac{3}{4}\pi$

7. If $y = \tan^2 x$, then $\left.\frac{dy}{dx}\right|_{x = \pi/4} = ?$

(A) 2 (B) $\sqrt{2}$ (C) 4 (D) 1 (E) $-\frac{1}{2}$

8. If $f(x) = \left(1 + \sqrt{1 + x}\right)^{3/2}$, then $f'(8) = ?$

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

9. A point moves on the parabola $y = x^2 - 2x$. The motion is such that the rate of change of the x-coordinate is never zero (The x-coordinate never rests, not even for an instant.) Find the y-coordinate of the point on the curve at which

the rate of change of the y-coordinate is three times the rate of change of the x-coordinate.

(A) 3   (B) $-\frac{3}{4}$ (C) 0   (D) $\frac{5}{4}$ (E) 8

10. The global maximum M and the global minimum m of the function

$$f(x) = \sin^2 x + \cos x$$

on the interval $\left[-\frac{\pi}{2}, \pi\right]$ is

(A) M = 1   m = −1
(B) M = 5/4   m = 1
(C) M = 1   m = −1
(D) M = 5/4   m = 0
(E) M = 5/4   m = −1

11. The following graph is the graph of the function $y = f'(x)$
(repeat, the graph of the <u>first</u> <u>derivative</u> of f).

How many of the following statements are true?

i) the graph of f has an inflection point at $(0,0)$.

ii) $f(x)$ has a local maximum at $x = 0$.

iii) $f(x)$ has a local maximum at $x = -1$.

iv) the graph of f has an inflection point where $x = -1$.

v) the graph of f is concave downward for $-2 < x < 0$.

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

12. The graph of $y = \dfrac{x^3 + x - 2}{x^2 - x}$ most closely resembles which of the following?

(A)

(B)

(C)

(D)

(E)

13. Which one of the following functions has exactly one vertical asymptote and exactly one horizontal asymptote?

(A) $\frac{2x^2 + 3x + 1}{x^2 + x + 6}$ (B) $\frac{x + 1}{x^2 + 1}$ (C) $\frac{x^3}{x^2 - 1}$

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

14. The slope of the curve $y = 6x^2 - x^3$ varies as x varies. What is the maximum possible slope?

(A) 5 (B) 12 (C) 9 (D) 3 (E) 6

15. Use linear approximation (the tangent line method) to approximate the value of

$$(2.03)^4 - (2.03)^2$$

(A) 12.82 (B) 12.83 (C) 12.84
(D) 12.85 (E) 12.86

16. If $F(x)$ is an anti derivative of $10x\,(x^2 - 2)^4$ and $F(2) = 30$, then $F(1) =$

(A) -3 (B) 4 (C) $-\frac{1}{5}$ (D) $\frac{4}{3}$ (E) 0

17. $$\int_{1}^{2} \frac{2-x}{\sqrt{4x-3-x^2}}\,dx = ?$$

(A) $\frac{1}{2}$ (B) $\sqrt{2}$ (C) $\frac{3}{2}$ (D) 1 (E) $\sqrt{3}$

18. The following table gives some values of a continuous function f. Use these values and the Trapezoid Rule to approximate

$$\int_{2}^{3.5} f(x)\,dx.$$

x	2.0	2.25	2.50	2.75	3.03.25	3.50
f(x)	1	2 −1		1 0	3	−3

(A) 0.75 (B) 1.25 (C) 0.625 (D) 1.667 (E) 1

19. Let the function F(x) be defined on $(-\infty, \infty)$ by the equation

$$F(x) = \int_0^x \frac{t^2 - 1}{t^2 + 1}\, dt.$$

Then F(x)

(A) has a local minimum at $x = 1$.

(B) is a decreasing function.

(C) has a point of inflection at $x = 1$.

(D) is always concave down.

(E) is always positive.

20. Let f be a function defined on the interval [– 2,3]. If

$$\sum_{k=1}^{5} f(c_k)\ \Delta x_k$$

is a Riemann Sum for f using a partition having subintervals of equal length then, of the numbers listed below, which one is the only possibility for c_4?

(A) $\frac{17}{8}$ (B) $\frac{3}{4}$ (C) $-\frac{1}{2}$ (D) $\frac{4}{3}$ (E) -2

21. Let $S = \sum_{k=1}^{n} \left(3c_k - c_k^2\right) \Delta x_k$ for some partition P of [0,3]. Which of the following numbers can we make S arbitrarily close to by choosing the norm of P, $\|P\|$, to be sufficiently small?

(A) 5 (B) $\frac{9}{2}$ (C) 4 (D) $\frac{14}{3}$ (E) $\frac{25}{6}$

22. The volume of the solid generated by revolving the triangle bounded by the lines

$$y = -\frac{1}{4}x + 2, \quad y = \frac{1}{4}x + 2 \quad \text{and} \quad x = 4$$

about the line $y = -1$ is

(A) 18π

(B) 36π

(C) 28π

(D) 30π

(E) 24π

23. The volume obtained by revolving the region bounded by $y = 6x - 3x^2$ and the y-axis about the line $x = 2$ is

(A) 6π
(B) $\frac{15}{2}\pi$
(C) 8π
(D) $\frac{25}{3}\pi$
(E) 9π

24. The y-coordinate of the centroid of a thin plate of constant (uniform) density covering the region defined in problem 23 is

(A) $\frac{6}{5}$ (B) $\frac{5}{4}$ (C) $\frac{7}{6}$ (D) $\frac{4}{3}$ (E) $\frac{9}{7}$

25. How much work (in ft-lbs) does it take to pump gasoline from a three-quarters full upright cylinder tank of radius 4 ft. and height 8 ft. to a level 4 ft. above the top of the tank? (Gasoline weighs 42 lbs. per cubic foot.)

(A) 45,360 π

(B) 26,880 π

(C) 43,008 π

(D) 48,384 π

(E) 36,288 π