1. $\lim_{x \to 2} \frac{x^2 + x - 6}{x^2 - 4}$ is

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

$$\frac{2x+1}{2x} \qquad \frac{5}{4}$$

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

(A) 10 (B) 9 (C) 7 (D) 5 (E) 3

$f'(x) = 3x^2 - 2x + 1$

$f'(2) = 12 - 4 + 1$

$= 9$

3. Which of the following definite integrals has the same value as $\int_0^4 xe^{x^2}\,dx$ ?

(A) $\frac{1}{2}\int_0^4 e^u\,du$

(B) $\frac{1}{2}\int_0^{16} e^u\,du$

(C) $2\int_0^2 e^u\,du$

(D) $2\int_0^4 e^u\,du$

(E) $2\int_0^{16} e^u\,du$

$u = x^2$

$du = 2x\,dx$

$\frac{1}{2}du = x\,dx$

$x = 0 \rightarrow u = 0$

$x = 4 \rightarrow u = 16$

$$\frac{1}{2}\int_0^{16} e^u\,du$$

4. Which of the following is an equation of the line tangent to the graph of $\boxed{x^2 - 3xy = 10}$ at the point $(1, -3)$ ?

(A) $y + 3 = -11(x - 1)$

(B) $y + 3 = -\frac{7}{3}(x - 1)$

(C) $y + 3 = \frac{1}{3}(x - 1)$

(D) $y + 3 = \frac{7}{3}(x - 1)$

(E) $y + 3 = \frac{11}{3}(x - 1)$

$$2x - 3\left[x\frac{dy}{dx} + y\right] = 0$$

$$2x - 3x\frac{dy}{dx} - 3y = 0$$

$$\frac{dy}{dx} = \frac{3y - 2x}{-3x}$$

$$= \frac{2x - 3y}{3x}$$

$$\left.\frac{dy}{dx}\right|_{(1,-3)} = \frac{2+9}{3} = \frac{11}{3}$$

$$y + 3 = \frac{11}{3}(x - 1)$$

5. If $g$ is the function given by $g(x) = \frac{1}{3}x^3 + \frac{3}{2}x^2 - 70x + 5$, on which of the following intervals is $g$ decreasing?

(A) $(-\infty, -10)$ and $(7, \infty)$

(B) $(-\infty, -7)$ and $(10, \infty)$

(C) $(-\infty, 10)$

(D) $(-10, 7)$

(E) $(-7, 10)$

$g'(x) = x^2 + 3x - 70$

$= (x + 10)(x - 7)$

$x = -10$ or $x = 7$

$+ \quad - \quad +$

$-10 \quad 7$

$(-10, 7)$

6. $\int_2^4 \frac{dx}{5-3x} =$

$u = 5 - 3x$

(A) $-\ln 7$ (B) $-\frac{\ln 7}{3}$ (C) $\frac{\ln 7}{3}$ (D) $\ln 7$ (E) $3\ln 7$

$$-\frac{1}{3}\ln\left|5-3x\right|\Big|_2^4$$

$$\left(-\frac{1}{3}\ln 7\right) - \cancel{\left(-\frac{1}{3}\ln 1\right)}$$

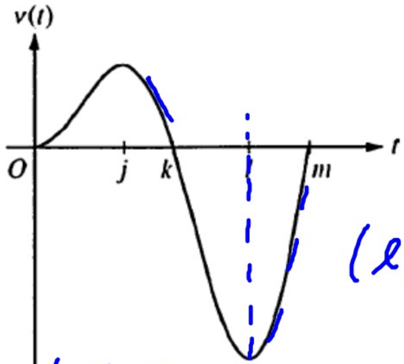
7. Let $f$ be the function given by $f(x) = x^3 - 6x^2 + 8x - 2$. What is the instantaneous rate of change of $f$ at $x = 3$?

(A) $-5$ (B) $-\frac{15}{4}$ (C) $-1$ (D) $6$ (E) $17$

$f'(x) = 3x^2 - 12x + 8$

$f'(3) = 27 - 36 + 8$

$= -1$




V

"a" is slope of tan to v.

(j, k)

(l, m)

$j \le t \le k$

and $l \le t \le m$

8. A particle moves along a straight line. The graph of the particle's velocity $v(t)$ at time $t$ is shown above for $0 \le t \le m$, where $j$, $k$, $l$, and $m$ are constants. The graph intersects the horizontal axis at $t = 0$, $t = k$, and $t = m$ and has horizontal tangents at $t = j$ and $t = l$. For what values of $t$ is the speed of the particle decreasing?

(A) $j \le t \le l$

(B) $k \le t \le m$

(C) $j \le t \le k$ and $l \le t \le m$

(D) $0 \le t \le j$ and $k \le t \le l$

(E) $0 \le t \le j$ and $l \le t \le m$

Need a & v to have diff. signs

9. Let $f$ be the function given by $f(x) = \frac{(x-2)^2(x+3)}{(x-2)(x+1)}$. For which of the following values of $x$ is $f$ not continuous?

(A) $-3$ and $-1$ only

(B) $-3$, $-1$, and 2

(C) $-1$ only

(D) $-1$ and 2 only

(E) 2 only

$f(2) \nexists$

$f(-1) \nexists$

10. A particle moves along the $x$-axis with velocity given by $v(t) = 3t^2 - 4$ for time $t \geq 0$. If the particle is at position $x = -2$ at time $t = 0$, what is the position of the particle at time $t = 3$?

(A) 13 (B) 15 (C) 16 (D) 17 (E) 25

$$-2 + \int_0^3 (3t^2 - 4)\,dt$$

$$-2 + \left[t^3 - 4t\right]_0^3$$

$$-2 + \left[(27 - 12) - (0)\right]$$

$$-2 + 15$$

$$13$$

11. Let $f$ be the function defined by $f(x) = \int_0^x \left(2t^3 - 15t^2 + 36t\right) dt$. On which of the following intervals is the graph of $y = f(x)$ concave down?

(A) $(-\infty, 0)$ only

(B) $(-\infty, 2)$

(C) $(0, \infty)$

(D) $(2, 3)$ only

(E) $(3, \infty)$ only

$f'(x) = 2x^3 - 15x^2 + 36x$

$f''(x) = 6x^2 - 30x + 36$

$6(x^2 - 5x + 6)$

$6(x-2)(x-3)$

$x = 2 \quad x = 3$

$+ \quad - \quad +$

$2 \quad 3$

12. For which of the following does $\lim_{x \to \infty} f(x) = 0$?

Denom to grow faster

I. $f(x) = \frac{\ln x}{x^{99}}$

II. $f(x) = \frac{e^x}{\ln x}$

III. $f(x) = \frac{x^{99}}{e^x}$

(A) I only

(B) II only

(C) III only

(D) I and II only

(E) I and III only

13. Let $f$ be a differentiable function such that $f(0) = -5$ and $f'(x) \le 3$ for all $x$. Of the following, which is not a possible value for $f(2)$ ?

(A) $-10$ (B) $-5$ (C) 0 (D) 1 (E) 2

$$\frac{f(2) - f(0)}{2 - 0} \le 3$$

$$\frac{f(2) + 5}{2} \le 3$$

$$f(2) + 5 \le 6$$

$$f(2) \le 1$$