

1. If $y = \cos 2x$, then $\frac{dy}{dx} =$

(A) $-2\sin 2x$

(B) $-\sin 2x$

(C) $\sin 2x$

(D) $2\sin 2x$

(E) $2\sin x$

$-2\sin 2x$

2. $\int x^2 (x^3 - 1)^{10} dx =$

(A) $\frac{x^3}{3} \left(\frac{x^4}{4} - x \right)^{10} + C$

(B) $\frac{(x^3 - 1)^{11}}{11} + C$

(C) $\frac{x^2 (x^3 - 1)^{11}}{11} + C$

(D) $\frac{(x^3 - 1)^{11}}{33} + C$

(E) $\frac{x^3 (x^3 - 1)^{11}}{33} + C$

$$u = x^3 - 1$$

$$du = 3x^2 dx$$

$$\frac{1}{3} du = x^2 dx$$

$$\frac{1}{3} \int u^{10} du = \frac{1}{3} \frac{1}{11} (x^3 - 1)^{11} + C$$

3. $\lim_{x \rightarrow \infty} \frac{\sqrt{9x^4 + 1}}{4x^2 + 3}$ is

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

$\frac{N}{D}$

$$\frac{\sqrt{9}x^2}{4x^2} = \frac{3}{4}$$

4. If $y = \left(\frac{x}{x+1}\right)^5$, then $\frac{dy}{dx} =$

(A) $5(1+x)^4$

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

(C) $\frac{5x^4}{(x+1)^4}$

(D) $\frac{5x^4}{(x+1)^6}$

(E) $\frac{5x^4(2x+1)}{(x+1)^6}$

$$\frac{dy}{dx} = 5 \left(\frac{x}{x+1}\right)^4 \left[\frac{(x+1) - x}{(x+1)^2} \right]$$

$$= 5 \left(\frac{x}{x+1}\right)^4 \left[\frac{1}{(x+1)^2} \right]$$

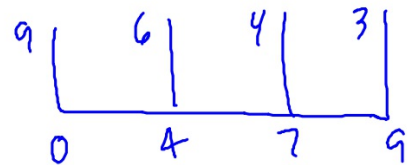
$$= \frac{5x^4}{(x+1)^6}$$

t (minutes)	0	4	7	9
$r(t)$ (gallons per minute)	9	6	4	3

5. Water is flowing into a tank at the rate $r(t)$, where $r(t)$ is measured in gallons per minute and t is measured in minutes. The tank contains 15 gallons of water at time $t = 0$. Values of $r(t)$ for selected values of t are given in the table above. Using a trapezoidal sum with the three intervals indicated by the table, what is the approximation of the number of gallons of water in the tank at time $t = 9$?

(A) 52 (B) 57 (C) 67 (D) 77 (E) 79

$$15 + \int_0^9 r(t) dt$$



$$15 + \left[\frac{1}{2}(15)(4) + \frac{1}{2}(10)(3) + \frac{1}{2}(7)(2) \right]$$

$$15 + 30 + 15 + 7$$

$$67$$

6. The slope of the line tangent to the graph of $y = \ln(1 - x)$ at $x = -1$ is

(A) -1

(B) $-\frac{1}{2}$

(C) $\frac{1}{2}$

(D) $\ln 2$

(E) 1

$$\frac{dy}{dx} = \frac{-1}{1-x}$$

$$\left. \frac{dy}{dx} \right|_{x=-1} = \frac{-1}{1-(-1)} = -\frac{1}{2}$$

$$D_x[\ln \star] = \frac{\star'}{\star}$$

7. For which of the following pairs of functions f and g is $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)}$ infinite?

(A) $f(x) = x^2 + 2x$ and $g(x) = x^2 + \ln x$

(B) $f(x) = 3x^3$ and $g(x) = x^4$

(C) $f(x) = 3^x$ and $g(x) = x^3$

(D) $f(x) = 3e^x + x^3$ and $g(x) = 2e^x + x^2$

(E) $f(x) = \ln(3x)$ and $g(x) = \ln(2x)$

$$\frac{x^2 + 2x}{x^2 + \ln x} \quad 1$$

$$\frac{3x^3}{x^4} \quad 0$$

$$\frac{3^x}{x^3} \quad \infty$$

$$\frac{N}{D}$$

$$\frac{2^x}{x^{10000}}$$

8. $\int_0^4 \frac{x}{\sqrt{x^2+9}} dx =$

- (A) -2 (B) $-\frac{2}{15}$ (C) 1 (D) 2 (E) 5

$$u = x^2 + 9$$

$$du = 2x dx$$

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

$$x=0 \rightarrow u=9$$

$$x=4 \rightarrow u=25$$

$$\frac{1}{2} \int_9^{25} u^{1/2} du = \left[\frac{1}{2} \cdot 2 u^{1/2} \right]_9^{25}$$

$$= 5 - 3$$

$$= 2$$

$$\frac{u^{1/2}}{1/2}$$

9. Let f be the function with derivative given by $f'(x) = \frac{-2x}{(1+x^2)^2}$. On what interval is f decreasing?

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

(B) $(-\infty, 0]$ only

(C) $\left[-\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right]$ only

(D) $(-\infty, \infty)$

(E) There is no such interval.

$$f'(x) < 0$$

$$-2x < 0$$

$$x > 0$$