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

(A) $-2\sin 2x$ (B) $-\sin 2x$ (C) $\sin 2x$ (D) $2\sin 2x$ (E) $2\sin x$

$$\frac{dy}{dx} = -2\sin 2x$$

$$-\sin \star \, \star'$$

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

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

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

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

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

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

$u = x^3 - 1$

$du = 3x^2 \, dx$

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

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

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

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

$$\frac{\sqrt{9}\,x^2}{4\,x^2}$$

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

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

(A) $5(1+x)^4$ (B) $\dfrac{x^4}{(x+1)^4}$ (C) $\dfrac{5x^4}{(x+1)^4}$ (D) $\dfrac{5x^4}{(x+1)^6}$ (E) $\dfrac{5x^4(2x+1)}{(x+1)^6}$

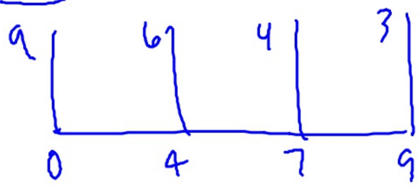
$$\frac{dy}{dx} = 5\left(\frac{x}{(x+1)}\right)^4 \left[\frac{\overset{1}{\cancel{(x+1)-x}}}{(x+1)^2}\right]$$

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

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



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

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

$$15 + 30 + 15 + 7$$

$$67$$

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

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

$$\frac{-1}{1 - -1}$$

$$-\frac{1}{2}$$

$$\ln \bigstar \rightarrow \frac{\bigstar'}{\bigstar}$$

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

$\frac{N}{D}$

(A) $f(x) = x^2 + 2x$ and $g(x) = x^2 + \ln x$ 1

(B) $f(x) = 3x^3$ and $g(x) = x^4$ 0

(C) $f(x) = 3^x$ and $g(x) = x^3$ —— $\frac{3^x}{x^3}$ ∞

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

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

$\frac{2^x}{x^{10000}}$ ∞

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

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

$u = x^2 + 9$

$du = 2x\,dx$

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

$x = 0 \rightarrow u = 9$

$x = 4 \rightarrow u = 25$

$\displaystyle\frac{1}{2}\int_9^{25} u^{-\frac{1}{2}}\,du = \cancel{\frac{1}{2}}\,\cancel{2}u^{1/2}\Big|_9^{25}$

$= 5 - 3$

$= 2$

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

9. Let f be the function with derivative given by $f'(x) = \frac{-2x}{\left(1+x^2\right)^2}$. 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.

$f'(x) < 0$

$-2x < 0$

$x > 0$