

1. $\int \cos(3x) \, dx =$

(A) $-3\sin(3x) + C$

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

(C) $\frac{1}{3}\sin(3x) + C$

(D) $\sin(3x) + C$

(E) $3\sin(3x) + C$

$\frac{1}{3} \sin 3x + C$

2. $\lim_{x \rightarrow 0} \frac{2x^6 + 6x^3}{4x^5 + 3x^3}$ is

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

$$\frac{12x^5 + 18x^2}{20x^4 + 9x^2}$$

$$\frac{60x^4 + 36x}{80x^3 + 18x}$$

$$\frac{240x^3 + 36}{240x^2 + 18}$$

$$2$$

$$f(x) = \begin{cases} x^2 - 3x + 9 & \text{for } x \leq 2 \\ kx + 1 & \text{for } x > 2 \end{cases}$$

3. The function f is defined above. For what value of k , if any, is f continuous at $x = 2$?

(A) 1

(B) 2

(C) 3

(D) 7

(E) No value of k will make f continuous at $x = 2$.

$$7 = 2k + 1$$

$$k = 3$$

4. If $f(x) = \cos^4(4x)$ then $f'(x) =$

(A) $3\cos^2(4x)$

(B) $-12\cos^2(4x)\sin(4x)$

(C) $-3\cos^2(4x)\sin(4x)$

(D) $12\cos^2(4x)\sin(4x)$

(E) $-4\sin^3(4x)$

$$[3\cos^2 4x] [-\sin 4x] (4)$$

$$-12\cos^2 4x \sin 4x$$

5. The function f given by $f(x) = 2x^3 - 3x^2 - 12x$ has a relative minimum at $x =$

- (A) -1 (B) 0 (C) 2 (D) $\frac{3 - \sqrt{105}}{4}$ (E) $\frac{3 + \sqrt{105}}{4}$

$$f'(x) = 6x^2 - 6x - 12$$

$$\begin{aligned} x^2 - x - 2 &= 0 \\ (x - 2)(x + 1) &= 0 \\ x &= 2 \quad x = -1 \end{aligned}$$

$$f''(x) = 12x - 6$$

$$f''(2) = 24 - 6 > 0 \text{ CU } \underline{\text{MIN}}$$

$$f''(-1) = -12 - 6 < 0 \text{ CD } \underline{\text{MAX}}$$



6. Let f be the function given by $f(x) = (2x - 1)^5(x + 1)$. Which of the following is an equation for the line tangent to the graph of f at the point where $x = 1$?

(A) $y = 21x + 2$

(B) $y = 21x - 19$

(C) $y = 11x - 9$

(D) $y = 10x + 2$

(E) $y = 10x - 8$

$$f(1) = (1)(2) = 2$$

$$f'(x) = (2x-1)^5 + (x+1)5(2x-1)^4(2)$$

$$f'(1) = 1 + (2)(5)(1)(2) = 21$$

$$y - 2 = 21(x - 1)$$

$$y - 2 = 21x - 21$$

$$y = 21x - 19$$

7. $\int \frac{e^{\sqrt{x}}}{\sqrt{x}} dx =$

(A) $2e^{\sqrt{x}} + C$

(B) $\frac{1}{2}e^{\sqrt{x}} + C$

(C) $e^{\sqrt{x}} + C$

(D) $2\sqrt{x}e^{\sqrt{x}} + C$

(E) $\frac{1}{2} \frac{e^{\sqrt{x}}}{\sqrt{x}} + C$

$$u = \sqrt{x}$$

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

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

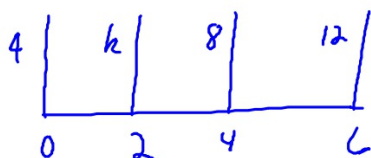
$$2 \int e^u du = 2e^u + C = 2e^{\sqrt{x}} + C$$

x	0	2	4	6
$f(x)$	4	k	8	12

8. The function f is continuous on the closed interval $[0, 6]$ and has the values given in the table above.

The trapezoidal approximation for $\int_0^6 f(x) dx$ found with 3 subintervals of equal length is 52. What is the value of k ?

- (A) 2 (B) 6 (C) 7 (D) 10 (E) 14



$$\frac{1}{2}(4+k)(2) + \frac{1}{2}(k+8)(2) + \frac{1}{2}(8+12)(2) = 52$$

$$4 + k + k + 8 + 8 + 12 = 52$$

$$2k + 32 = 52$$

$$k = 10$$

9. A particle moves along the x -axis so that at any time $t > 0$, its velocity is given by $v(t) = 4 - 6t^2$. If the particle is at position $x = 7$ at time $t = 1$, what is the position of the particle at time $t = 2$?

- (A) -10 (B) -5 (C) -3 (D) 3 (E) 17

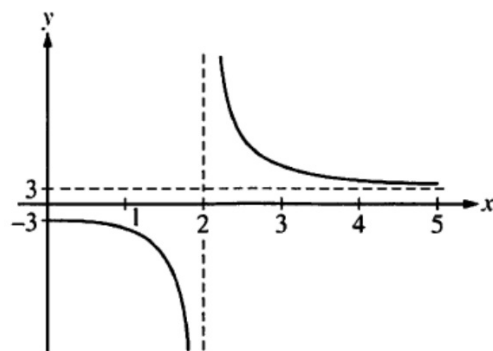
$$7 + \int_1^2 (4 - 6t^2) dt$$

$$7 + [4t - 2t^3]_1^2$$

$$7 + [(8 - 16) - (4 - 2)]$$

$$7 + [-8 - 2]$$

$$-3$$



HA $y = 3$

$$\lim_{x \rightarrow \infty} \frac{ax^2 + 12}{x^2 + b} = 3$$

$$a = 3$$

10. The function f is given by $f(x) = \frac{ax^2 + 12}{x^2 + b}$. The figure above shows a portion of the graph of f . Which of the following could be the values of the constants a and b ?

(A) $a = -3, b = 2$

(B) $a = 2, b = -3$

(C) $a = 2, b = -2$

(D) $a = 3, b = -4$

(E) $a = 3, b = 4$

VA at $x = 2$

$$\lim_{x \rightarrow 2} \frac{3x^2 + 12}{x^2 + b} = \frac{c}{0}$$

$$4 + b = 0$$

$$b = -4$$

11. What is the slope of the line tangent to the graph of $y = \frac{e^{-x}}{x+1}$ at $x = 1$?

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

$$\frac{dy}{dx} = \frac{(x+1)(-e^{-x}) - (e^{-x})}{(x+1)^2}$$

$$\left. \frac{dy}{dx} \right|_{x=1} = \frac{(2)(-e^{-1}) - e^{-1}}{4}$$

$$= \frac{-2e^{-1} - e^{-1}}{4}$$

$$= -\frac{3e^{-1}}{4} = -\frac{3}{4e}$$

12. If $f'(x) = \frac{2}{x}$ and $f(\sqrt{e}) = 5$, then $f(e) =$

- (A) 2 (B) $\ln 25$ (C) $5 + \frac{2}{e} - \frac{2}{e^2}$ (D) 6 (E) 25

$$\int_{\sqrt{e}}^e \frac{2}{x} dx = f(e) - f(\sqrt{e})$$
$$1 = f(e) - 5$$
$$6 = f(e)$$

$$2 \int_{\sqrt{e}}^e \frac{1}{x} dx = 2 \ln|x| \Big|_{\sqrt{e}}^e$$
$$= 2 \ln e - 2 \ln \sqrt{e}$$
$$= 2 - 1 = 1$$

$$2 \ln \sqrt{e}$$
$$2 \ln e^{\frac{1}{2}}$$
$$\left(\frac{1}{2}\right) 2 \ln e$$

13. $\int (x^3 + 1)^2 dx =$

(A) $\frac{1}{7}x^7 + x + C$

(B) $\frac{1}{7}x^7 + \frac{1}{2}x^4 + x + C$

(C) $6x^2(x^3 + 1) + C$

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

(E) $\frac{(x^3 + 1)^3}{9x^2} + C$

$$\int (x^6 + 2x^3 + 1) dx$$

$$= \frac{1}{7}x^7 + \frac{2}{4}x^4 + x + C$$

$$u = x^3 + 1$$

$$du = 3x^2 dx$$

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

14. $\lim_{h \rightarrow 0} \frac{e^{(2+h)} - e^2}{h} =$ $f'(2)$ $f(x) = e^x$
(A) 0 (B) 1 (C) $2e$ (D) e^2 (E) $2e^2$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - \underbrace{f(x)}}{h}$$

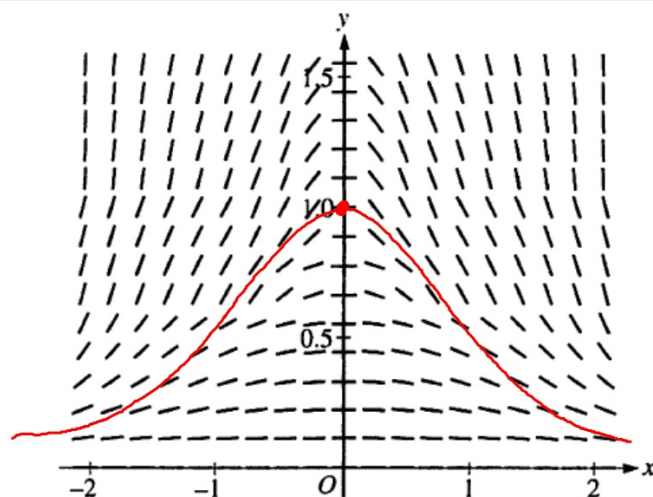
$$f(x) = e^x$$

$$f(2) = e^2$$

$$- \underbrace{f(2)}$$

$$f'(x) = e^x$$

$$f'(2) = e^2$$



15. The slope field for a certain differential equation is shown above. Which of the following could be a solution to the differential equation with the initial condition $y(0) = 1$?

(A) ~~$y = \cos x$~~

(B) ~~$y = 1 - x^2$~~

(C) ~~$y = e^x$~~

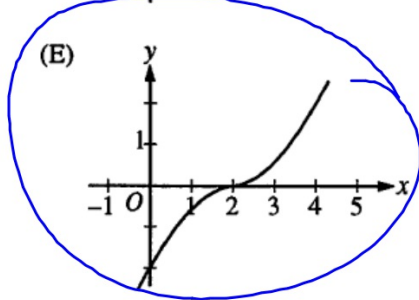
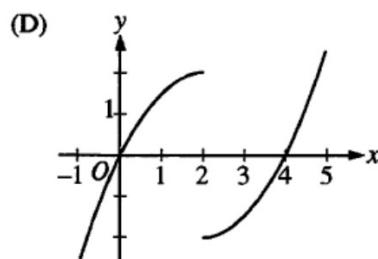
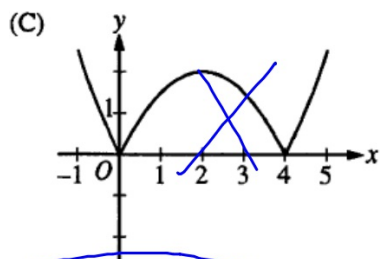
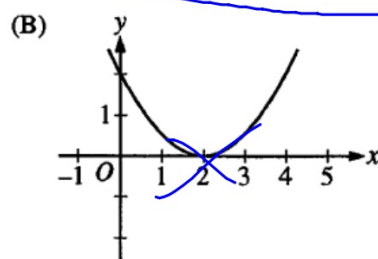
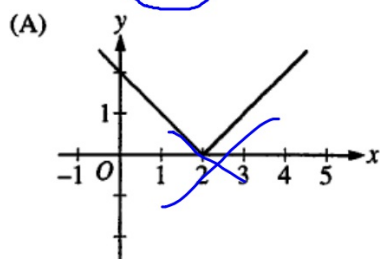
(D) ~~$y = \sqrt{1 - x^2}$~~

(E) $y = \frac{1}{1 + x^2}$

$$y^2 = 1 - x^2$$

$$x^2 + y^2 = 1$$

16. If $f'(x) = |x - 2|$, which of the following could be the graph of $y = f(x)$?



$f' > 0 \Rightarrow f \uparrow$
 $f'(2) = 0 \Rightarrow \text{not a point}$

17. What is the area of the region enclosed by the graphs of $f(x) = x - 2x^2$ and $g(x) = -5x$?

(A) $\frac{7}{3}$

(B) $\frac{16}{3}$

(C) $\frac{20}{3}$

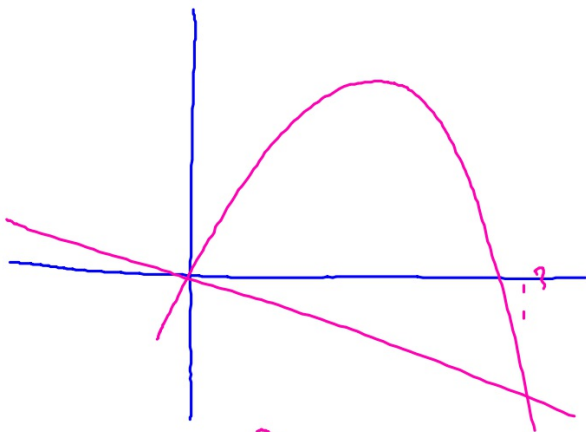
(D) 9

(E) 36

$\frac{2}{3} \cdot 27$

$x(1-2x)$

$x=0 \quad x=\frac{1}{2}$



$x - 2x^2 = -5x$

$0 = 2x^2 - 6x$

$0 = 2x(x-3)$

0 3

$$\int_0^3 [(x-2x^2) - (-5x)] dx = \int_0^3 (6x-2x^2) dx = \left[3x^2 - \frac{2}{3}x^3 \right]_0^3$$

$= (27 - 18) - (0)$

$= 9$