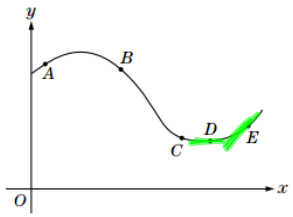
(E) The limit does not exist.

2. At which of the five points on the graph in the figure at the right are $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ both negative?

(A) A
(B) B
(C) C
(D) D
(E) E



10. $\int (x-1)\sqrt{x}\,dx =$

(A) $\frac{3}{2}\sqrt{x} - \frac{1}{\sqrt{x}} + C$

(B) $\frac{2}{3}x^{3/2} + \frac{1}{2}x^{1/2} + C$

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

(D) $\frac{2}{5}x^{5/2} - \frac{2}{3}x^{3/2} + C$

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

$\int (x-1)\cdot x^{1/2}\,dx$

$\int (x^{3/2} - x^{1/2})\,dx$

$\frac{x^{5/2}}{5/2} - \frac{x^{3/2}}{3/2} + C$

$\frac{2}{3}x^{3/2} + C$ ∴

13. If $y = 5 + \int_2^{2x} e^{-t^2}\,dt$, which of the following is true?

(A) $\frac{dy}{dx} = e^{-x^2}$ and $y(0) = 5$

(B) $\frac{dy}{dx} = e^{-x^2}$ and $y(1) = 5$

(C) $\frac{dy}{dx} = e^{-4x^2}$ and $y(1) = 5$

(D) $\frac{dy}{dx} = 2e^{-4x^2}$ and $y(0) = 5$

(E) $\frac{dy}{dx} = 2e^{-4x^2}$ and $y(1) = 5$

$y = 5 + \int_2^0 e^{-t^2}\,dt$

$y = 5 + \int_2^2 e^{-t^2}\,dt$

$\frac{dy}{dx} = \frac{d}{dx}\int_2^{2x} e^{-t^2}\,dt$

$\frac{dy}{dx} = e^{-(2x)^2} \cdot 2$ chain rule

$\frac{dy}{dx} = 2e^{-4x^2}$

16. A city is built around a circular lake that has a radius of 1 mile. The population density of the city is $f(r)$ people per square mile, where r is the distance from the center of the lake, in miles. Which of the following expressions gives the number of people who live within 1 mile of the lake?

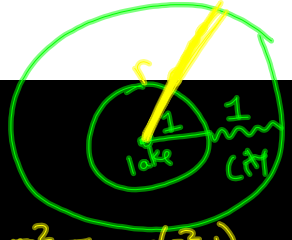
(A) $2\pi\int_0^1 r f(r)\,dr$

(B) $2\pi\int_0^1 r(1 + f(r))\,dr$

(C) $2\pi\int_0^2 r(1 + f(r))\,dr$

(D) $2\pi\int_1^2 r f(r)\,dr$

(E) $2\pi\int_1^2 r(1 + f(r))\,dr$



Big area $= \pi r^2$

area of lake $= \pi \cdot 1^2$

area of city $= \pi r^2 - \pi = \pi(r^2 - 1)$

4. Let S be the region enclosed by the graphs of $y = 2x$ and $y = 2x^2$ for $0 \le x \le 1$. What is the volume of the solid generated when S is revolved about the line $y = 3$?

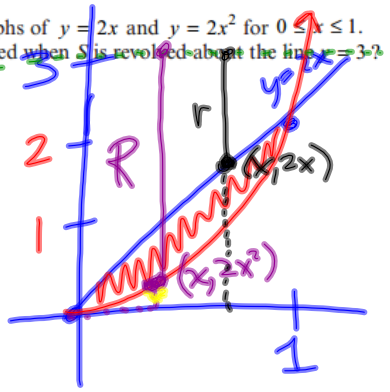
(A) $\pi\int_0^1 \left((3-2x^2)^2 - (3-2x)^2\right)dx$

(B) $\pi\int_0^1 \left((3-2x)^2 - (3-2x^2)^2\right)dx$

(C) $\pi\int_0^1 \left(4x^2 - 4x^4\right)dx$

(D) $\pi\int_0^2 \left(\left(3-\frac{y}{2}\right)^2 - \left(3-\sqrt{\frac{y}{2}}\right)^2\right)dy$

(E) $\pi\int_0^2 \left(\left(3-\sqrt{\frac{y}{2}}\right)^2 - \left(3-\frac{y}{2}\right)^2\right)dy$



$R = 3-2x^2$ $\quad r = 3-2x$

$$\pi\int_0^1 \left((3-2x^2)^2 - (3-2x)^2\right)dx$$

3. The slope of the tangent to the curve $y^3x + y^2x^2 = 6$ at $(2, 1)$ is

Implicit Differentiation

$$y^3\cdot\frac{dx}{dx} + 3y^2\frac{dy}{dx}\cdot x + y^2\cdot 2x\cdot\frac{dx}{dx} + 2y\cdot\frac{dy}{dx}\cdot x^2 = 0$$

$$y^3 + 3xy^2\cdot\frac{dy}{dx} + 2xy^2 + 2x^2y\cdot\frac{dy}{dx} = 0$$

$(2,1)$

$$1 + 3\cdot2\cdot1\cdot\frac{dy}{dx} + 2\cdot2\cdot1 + 2\cdot2^2\cdot1\cdot\frac{dy}{dx} = 0$$

$$1 + 6\frac{dy}{dx} + 4 + 8\frac{dy}{dx} = 0$$

$$14\frac{dy}{dx} = -5$$

$$\frac{dy}{dx} = -\frac{5}{14}$$

7. Which of the following is the solution to the differential equation $\frac{dy}{dx} = \frac{4x}{y}$, where $y(2) = -2$?

(A) $y = 2x$ for $x > 0$

(B) $y = 2x - 6$ for $x \neq 3$

(C) $y = -\sqrt{4x^2 - 12}$ for $x > \sqrt{3}$

(D) $y = \sqrt{4x^2 - 12}$ for $x > \sqrt{3}$

(E) $y = -\sqrt{4x^2 - 6}$ for $x > \sqrt{1.5}$

$\int y\,dy = \int 4x\,dx$

$y(2) = -2$

$\frac{y^2}{2} = 2x^2 + C$

$y^2 = 4x^2 + 2C$

$y = -\sqrt{4x^2 + 2C}$

$4x^2 - 12 \geq 0$

$-2 = -\sqrt{4 \cdot 2^2 + 2C}$

$2 = \sqrt{16 + 2C}$

$4 = 16 + 2C$

$-12 = 2C$

$C = -6$

$y = -\sqrt{4x^2 - 12}$