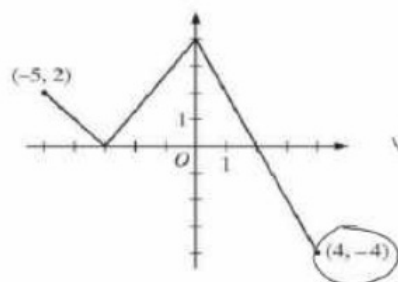


Let f be the differentiable function whose graph is shown in the figure.

The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^t f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

- a. Find the velocity of the particle at $t = 4$.



Graph of f

$$v(4) = -4$$

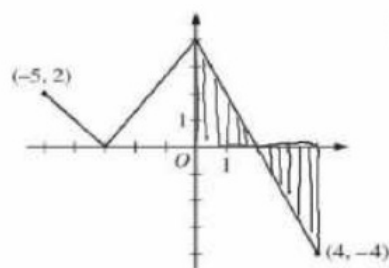
$$\text{area} \leftarrow s(t) = \int_0^t f(t) dt$$

$$\text{graph} \leftarrow v(t) = f(x)$$

$$\text{slopes} \leftarrow a(t) = f'(x)$$

Let f be the differentiable function whose graph is shown in the figure. The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^t f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

b. Find the position of the particle at $t = 4$.



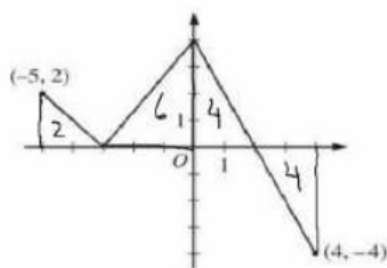
Graph of f

$$s(4) = \int_0^4 f(t) dt = 0$$

$$s(4) = 0$$

Let f be the differentiable function whose graph is shown in the figure. The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^x f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

c. At what time does $s(t)$ attain its absolute minimum and maximum value? Justify your answer.



Graph of f

critical points $f' = 0$ ($v(t) = 0$)

$$x = -3, 2$$

$$s(-5) = \int_0^{-5} f(t) dt = -8$$

$$s(-3) = \int_0^{-3} f(t) dt = -6$$

$$s(2) = \int_0^2 f(t) dt = 4$$

$$s(4) = 0$$

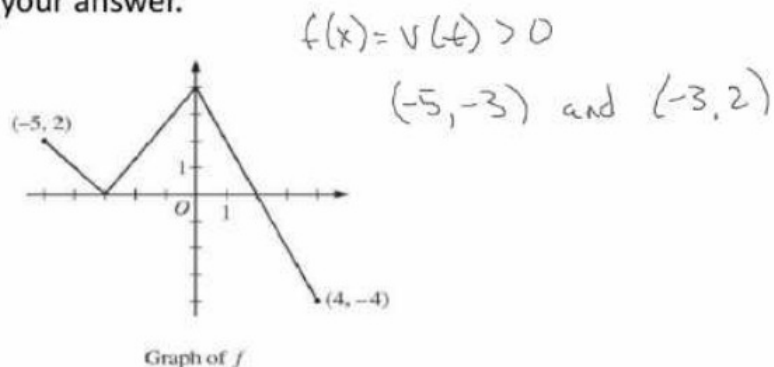
$x = -5$ Abs min

$$s(0) = 0$$

$x = 2$ Abs Max

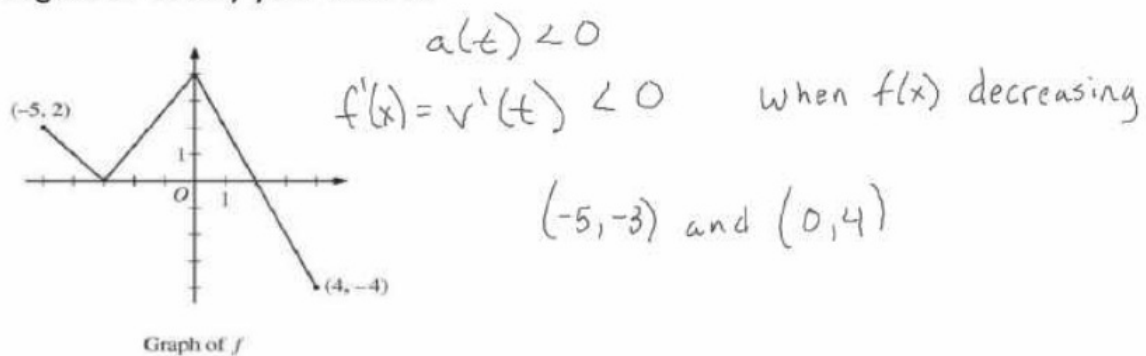
Let f be the differentiable function whose graph is shown in the figure. The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^x f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

d. For what values of t is the particle moving to the right? Justify your answer.



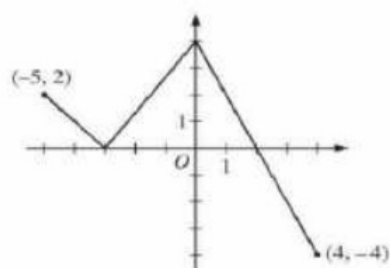
Let f be the differentiable function whose graph is shown in the figure. The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^x f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

e. Approximately when is the acceleration of the particle negative? Justify your answer.



Let f be the differentiable function whose graph is shown in the figure. The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^x f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

f. Write the equation of the line tangent to $s(t)$ at $t = 4$.



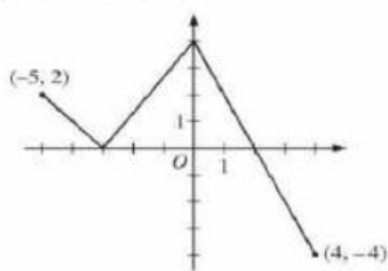
Graph of f

$$s(4) = 0 \quad s'(t) = f(4) = -4$$

$$y = 0 - 4(x - 4)$$

Let f be the differentiable function whose graph is shown in the figure. The position, in meters, at time t (sec) of a particle moving along a horizontal coordinate axis is given by $s(t) = \int_0^t f(t) dt$. Use the graph of $f(x)$ below to answer the questions.

g. Determine any points of inflection for the graph of $s(t)$. Justify your answer.



Graph of f

slopes of $f(x)$ change sign
(max and mins of $f(x)$)

$$x = -3 \text{ and } x = 0$$

Solve the initial value problem given below

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

$$\text{and } y(0) = 1$$

$$\int 3y \, dy = \int (2-x^2) \, dx$$

$$\frac{3y^2}{2} = 2x - \frac{1}{3}x^3 + C$$

$$\frac{3}{2} = C$$

$$2 \left(\frac{3}{2} y^2 = 2x - \frac{1}{3}x^3 + \frac{3}{2} \right)$$

$$\frac{3y^2}{3} = \frac{4x}{3} - \frac{2x^3}{3} + \frac{3}{3}$$

$$y^2 = \frac{4}{3}x - \frac{2}{9}x^3 + 1$$

$$y = \sqrt{\frac{4}{3}x - \frac{2}{9}x^3 + 1}$$

Solve the initial value problem given below

$$\frac{dy}{dx} = y+2 \quad \text{and } y(0)=2$$
$$\int \frac{dy}{y+2} = \int 1 dx$$

$$\ln|y+2| = x + C$$
$$\ln 4 = C$$

$$\ln|y+2| = x + \ln 4$$

$$y+2 = e^{x + \ln 4}$$
$$y = e^{x + \ln 4} - 2$$

$$y = 4e^x - 2$$

Find the general solution to the differential equation given below

$$\frac{dy}{dx} = x^2 + \frac{1}{x^5}$$

$$\int dy = \int x^2 + x^{-5} dx$$

$$y = \frac{1}{3}x^3 - \frac{1}{4}x^{-4} + C$$

Find the general solution to the differential equation given below p. 327 #1

$$\frac{dy}{dx} = 5x^4 - \sec^2 x$$
$$\int dy = \int (5x^4 - \sec^2 x) dx$$
$$y = x^5 - \tan x + C$$

Find the general solution to the differential equation given below p. 327 #3

$$\frac{dy}{dx} = \sin x - e^{-x} + 8x^3$$

$$\int dy = \int (\sin x - e^{-x} + 8x^3) dx$$

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

Find the general solution to the differential equation given below

$$\frac{dy}{dx} = \frac{1}{1+x^2} - \frac{1}{\sqrt{x}}$$

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

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

Find the general solution to the differential equation given below

p. 326 7

$$\frac{dy}{dx} = 3x^2 \cos(x^3)$$

$$\int dy = \int 3x^2 \cos(x^3) dx$$

$$y = \sin(x^3) + C$$

$$\frac{dy}{dx} = \cos(x^3) \cdot 3x^2$$

Find the general solution to the differential equation given below

p. 326 10

$$\frac{dy}{dx} = 4(\sin x)^3 \cos x$$

$$\frac{dy}{dx} = 4(\sin x)^3 \cos x$$

$$dy = 4(\sin x)^3 \cos x \, dx$$

$$\frac{dy}{dx} = 4(\sin x)^3 \cos x$$

$$y = (\sin x)^4 + C$$

Solve the initial value problem p. 326 12

$$\frac{dy}{dx} = 2e^x - \cos x \quad \text{and } y(0) = 3$$

$$\int dy = \int (2e^x - \cos x) dx$$

$$y = 2e^x - \sin x + C$$

$$3 = 2e^0 - \sin(0) + C$$

$$3 = 2 + C$$

$$1 = C$$

$$y = 2e^x - \sin x + 1$$

Solve the initial value problem p. 326 13

$$\frac{dy}{dx} = 7x^6 - 3x^2 + 5 \quad \text{and } y(1) = 1$$

$$\int dy = \int (7x^6 - 3x^2 + 5) dx$$

$$y = x^7 - x^3 + 5x + C$$

$$1 = 1 - 1 + 5 + C$$

$$1 = 5 + C$$

$$y = x^7 - x^3 + 5x - 4$$

Solve the initial value problem p. 326 13

$$\frac{dy}{dx} = \frac{-1}{x^2} - \frac{3}{x^4} + 12 \quad \text{and } y(1) = 3$$

$$\int dy = \int -x^{-2} - 3x^{-4} + 12 \, dx$$

$$y = x^{-1} + x^{-3} + 12x + C$$

$$y = \frac{1}{x} + \frac{1}{x^3} + 12x + C$$

$$3 = 1 + 1 + 12 + C$$

$$3 = 14 + C$$

$$-11 = C$$

$$y = \frac{1}{x} + \frac{1}{x^3} + 12x - 11$$

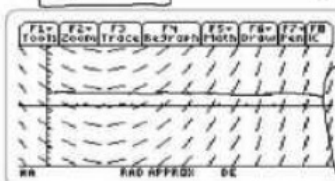
Multiple-Choice Questions

A graphing calculator is required for some questions.

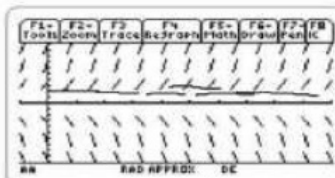
1. Which is the slope field for the differential equation

$$\frac{dy}{dx} = 2y - 4?$$

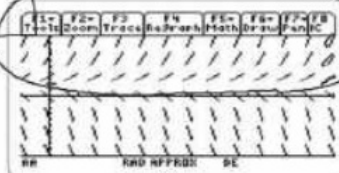
(A)



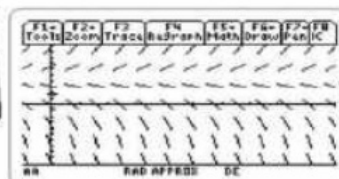
(B)



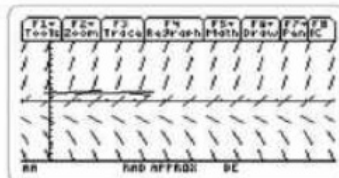
(C)



(D)



(E)



$$2y - 4 = 0$$

$$y = 2$$

$y > 2$
slopes pos

slopes neg
 $y < 2$