where t is the time in seconds.

(a) Find the time of one complete cycle of the rod.

(b) What is the lowest point reached by the end of the rod on the y-axis?

(c) Find the speed of the y-axis endpoint when the x-axis endpoint is $\left(\frac{1}{4}, 0\right)$.

32. **Machine Design** Repeat Exercise 31 for a position function of $x(t) = \frac{3}{5} \sin \pi t$. Use the point $\left(\frac{3}{10}, 0\right)$ for part (c).

38. **Angle of Elevation** A balloon rises at a rate of 4 meters per second from a point on the ground 50 meters from an observer. Find the rate of change of the angle of elevation of the balloon from the observer when the balloon is 50 meters above the ground.

43 . (Calculator)

A missile rises vertically from a point on the ground75,000 feet from a radar station. If the missile is rising at the rate of 40,000 feet per minute at the instant when it is 100,000 feet high, what is the rate of change, in radians per minute, of the missile's angle of elevation from the radar station at this instant?

(A) $\frac{18}{25}$ (B) $\frac{8}{15}$ (C) $\frac{24}{125}$ (D) $\frac{18}{125}$ (E) $\frac{8}{25}$

where t is the time in seconds.

(a) Find the time of one complete cycle of the rod.

(b) What is the lowest point reached by the end of the rod on the y-axis?

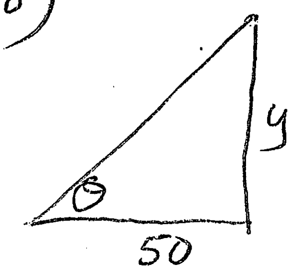
(c) Find the speed of the y-axis endpoint when the x-axis endpoint is $\left(\frac{1}{4}, 0\right)$.

32. Machine Design Repeat Exercise 31 for a position function of $x(t) = \frac{3}{5}\sin \pi t$. Use the point $\left(\frac{3}{10}, 0\right)$ for part (c).

[redacted]

38. Angle of Elevation A balloon rises at a rate of 4 meters per second from a point on the ground 50 meters from an observer. Find the rate of change of the angle of elevation of the balloon from the observer when the balloon is 50 meters above the ground.

38)



$$\frac{dy}{dt} = 4\,m/s$$

$$\frac{d\theta}{dt} = \_\_\_$$

$$y = 50$$

$$\tan\theta = \frac{y}{50}$$

$$\tan\theta = \frac{1}{50}y$$

$$\sec^2\theta \cdot \frac{d\theta}{dt} = \frac{1}{50}\cdot\frac{dy}{dt}$$

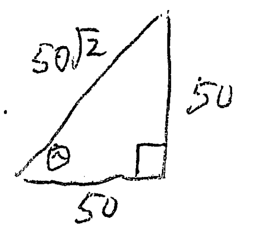
$$\frac{1}{\sec^2\theta}\left(\sec^2\theta\cdot\frac{d\theta}{dt}\right) = \left(\frac{1}{50}\cdot\frac{dy}{dt}\right)\frac{1}{\sec^2\theta}$$

$$\frac{d\theta}{dt} = \frac{1}{50}\cdot\frac{dy}{dt}\cdot\cos^2\theta$$

$$\frac{d\theta}{dt} = \frac{1}{50}\cdot(4)\cdot\left(\frac{1}{\sqrt{2}}\right)^2$$

$$= \frac{4}{50}\cdot\frac{1}{2} = \frac{4}{100}$$

$$\boxed{\frac{d\theta}{dt} = \frac{1}{25}\ rad/s}$$



$$\cos\theta = \frac{50}{50\sqrt{2}}$$

$$\cos\theta = \frac{1}{\sqrt{2}}$$

The function f is given by $f(x) = x^4 + x^2 - 2$. On which of the following intervals is f increasing?

$*$ 1^{st} derivative test, use sign line

(A) $\left(-\frac{1}{\sqrt{2}}, \infty\right)$

(B) $\left(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

$\boxed{\text{(C)}}$ $(0, \infty)$

(D) $(-\infty, 0)$

(E) $\left(-\infty, -\frac{1}{\sqrt{2}}\right)$

$f'(x) = 4x^3 + 2x$

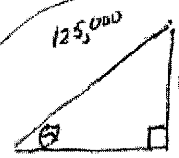
$f'(x) = x(4x^2+2)$

$0 = x(4x^2+2)$

$x = 0$ | $4x^2+2=0$, $\sqrt{x^2} = \sqrt{\frac{-2}{4}}$ No critical pts.

$f'(x)$: $-$ | $+$ at 0

$f(x)$ increasing on $(0, \infty)$ b/c $f'(x) > 0$



$\frac{dy}{dt} = 40{,}000$ ft/min

$y = 100{,}000$

$x^2 + y^2 = z^2$

$75{,}000^2 + 100{,}000^2 = z^2$, $z = 125{,}000$

$\tan\theta = \frac{y}{75{,}000}$

$\sec^2\theta\left(\frac{d\theta}{dt}\right) = \frac{1}{75{,}000}\left(\frac{dy}{dt}\right)$

43) (calculator)

A missile rises vertically from a point on the ground75,000 feet from a radar station. If the missile is rising at the rate of 40,000 feet per minute at the instant when it is 100,000 feet high, what is the rate of change, in radians per minute, of the missile's angle of elevation from the radar station at this instant?

(A) $\frac{18}{25}$ (B) $\frac{8}{15}$ $\boxed{\text{(C)}}$ $\frac{24}{125}$ (D) $\frac{18}{125}$ (E) $\frac{8}{25}$

$\frac{d\theta}{dt} = \frac{1}{\sec^2\theta} \cdot \frac{1}{75{,}000} \cdot \frac{dy}{dt}$

$\frac{d\theta}{dt} = (\cos\theta)^2 \left(\frac{1}{75{,}000}\right)\left(\frac{dy}{dt}\right)$

$\frac{d\theta}{dt} = \left(\frac{75{,}000}{125{,}000}\right)^2 \left(\frac{1}{75{,}000}\right)(40{,}000) = 0.192 = \frac{192}{1000} = \frac{24}{125}$

$\cos\theta = \frac{adj}{hyp}$

$$\boxed{\frac{d\theta}{dt} = \frac{24}{125} \text{ rad/min.}}$$