

1988 Q10: [DE]

(a)

$$\frac{dx}{dt} = \sqrt{100 - 4x^2}$$

$$\Rightarrow \int \frac{dx}{\sqrt{100 - 4x^2}} = \int dt + A$$

$$\Rightarrow \int \frac{dx}{\sqrt{4} \sqrt{25 - x^2}} = t + A$$

$$\Rightarrow \frac{1}{2} \int \frac{dx}{\sqrt{25 - x^2}} = t + A$$

$$\Rightarrow \frac{1}{2} \sin^{-1} \frac{x}{5} = t + A$$

$$\Rightarrow \frac{1}{2} \sin^{-1} \left( \frac{x}{5} \right) = 0 + A$$

$$\Rightarrow \frac{1}{2} \left( \frac{\pi}{2} \right) = A$$

$$\Rightarrow \frac{\pi}{4} = A$$

$$\Rightarrow \frac{1}{2} \sin^{-1} \frac{x}{5} = t + \frac{\pi}{4}$$

$$\Rightarrow \sin^{-1} \frac{x}{5} = 2t + \frac{\pi}{2}$$

$$\Rightarrow \boxed{x = 5 \sin \left( 2t + \frac{\pi}{2} \right)}$$

(b) Position:

+ ↑

- stops  $x = H$  greatest height

$v = 0$

$t = T$ , time to reach greatest height

Force:

$(m \cdot 0.98) \downarrow mg$

- Initial  $x = 0$

$v = 120 \text{ ms}^{-1}$

$t = 0$

NII  $\Rightarrow ma = \vec{F}$

$$\Rightarrow ma = -m(0.098v^2 - mg)$$

$$\Rightarrow a = -0.098v^2 - 9.8 \quad [g = 9.8]$$

kinig v ad t:

$$\left[ a = \frac{dv}{dt} \right]$$

$$\Rightarrow \frac{dv}{dt} = -9.8 [0.1v^2 + 1]$$

$$\Rightarrow \frac{dv}{dt} = -0.098 [v^2 + 100]$$

[Ball free]! 10m

$$\Rightarrow \int_{120}^0 \frac{dv}{v^2 + 100} = \int_0^T -0.098 dt$$

$$\frac{1}{10} \tan^{-1} \left( \frac{v}{10} \right) \Big|_{120}^0 = -0.098 \Big|_0^T$$

$$\frac{1}{10} [\tan^{-1}(0) - \tan^{-1}(12)] = -0.098 T$$

$$\frac{1}{10} [0 - 1.487655] = -0.098 T$$

$$-0.1487655 = -0.098 T$$

$$+ \left( \frac{0.1487655}{0.098} \right) = T$$

$$\boxed{1.5 \text{ secs} = T}$$

[EASY QUESTION]