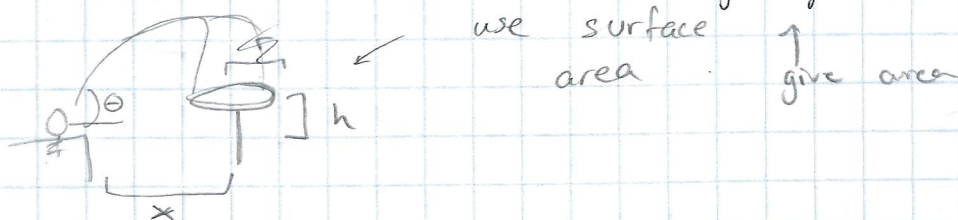


20-P-KM-AF-011

## Curvilinear Motion:

Q: An important part of game development is the physics of it. Mario typically jumps with angle  $\theta = 45^\circ$ . What is the max and minimum speed must Mario jump to make it on to the mushroom if the gravity in this game is ~~10 m/s~~ <sup>-8 m/s</sup>.



A:

$$x = x_0 + v_{0x} t$$

$$x - r = 0 + \cos(\theta) \cdot v \cdot t \Rightarrow v = \frac{x - r}{(\cos(\theta) t)}$$

$$h = 0 + v \cdot \sin(\theta) \cdot t + \frac{1}{2} (-8) t^2$$

$$h = \tan(\theta) (x - r) - 4 t^2$$

$$4 t^2 = \tan(\theta) (x - r) \Rightarrow t^2 = \frac{\tan(\theta) (x - r)}{4} \Rightarrow t = \sqrt{\frac{\tan(\theta) (x - r)}{4}}$$

$$r = \sqrt{\frac{\text{area}}{\pi}}$$

$$v = \frac{x - r}{\cos(\theta) t}$$

(use  $x + r$  for max.)

