

Now use kinematics to compute time it takes to slide from P to Q:

$$\text{dist} = v_0 t + \frac{1}{2} a t^2$$

$$2R \cos \theta = \frac{1}{2} (g \cos \theta) t^2$$

$$t^2 = \frac{4R}{g}$$

$$\rightarrow \boxed{t = 2 \sqrt{\frac{R}{g}}}$$

Note time does not depend on angle θ

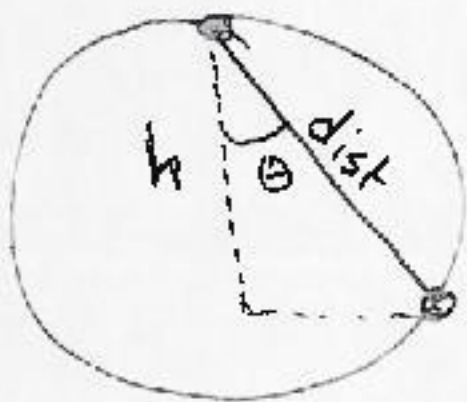
b) Speed at point Q can be found via kinematics, or via conservation of energy.

$$\text{Kinematics: } v_f^2 = v_0^2 + 2a(\text{dist})$$

$$= 2(g \cos \theta)(2R \cos \theta)$$

$$= 4gR \cos^2 \theta$$

$$\rightarrow \boxed{v_f = 2 \cos \theta \sqrt{gR}}$$



$$\text{energy } \frac{1}{2} m v_f^2 = mgh = mg(2R \cos \theta) \cos \theta$$
$$= 2mgR \cos^2 \theta$$

$$\rightarrow v_f^2 = 4gR \cos^2 \theta$$

$$\boxed{v_f = 2 \cos \theta \sqrt{gR}}$$