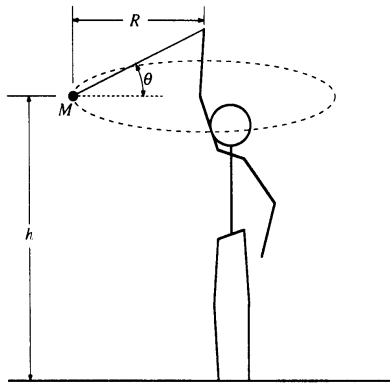


Name _____ Date _____ Period _____



3. An object of mass M on a string is whirled with increasing speed in a horizontal circle, as shown above. When the string breaks, the object has speed v_0 and the circular path has radius R and is a height h above the ground. Neglect air friction.

a. Determine the following, expressing all answers in terms of h , v_0 , and g .

i. The time required for the object to hit the ground after the string breaks

$$v_{iy} = 0 \text{ so we have } h = \frac{1}{2}gt^2 \text{ which gives } t = \sqrt{\frac{2h}{g}}$$

ii. The horizontal distance the object travels from the time the string breaks until it hits the ground

$$x = v_0t = v_0\sqrt{\frac{2h}{g}}$$

iii. The speed of the object just before it hits the ground

$$v_x = v_0; v_y = v_{iy} + gt = \sqrt{2gh}$$

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{v_0^2 + 2gh}$$

b. On the figure below, draw and label all the forces acting on the object when it is in the position shown in the diagram above.



c. Determine the tension in the string just before the string breaks. Express your answer in terms of M , R , v_0 , & g .

Horizontal forces: $T \cos \theta = Mv_0^2/R$; Vertical forces: $T \sin \theta = Mg$. Squaring and adding the equations gives

$$T = M \sqrt{g^2 + \frac{v_0^4}{R^2}}$$