

Name: _____

DISC: _____

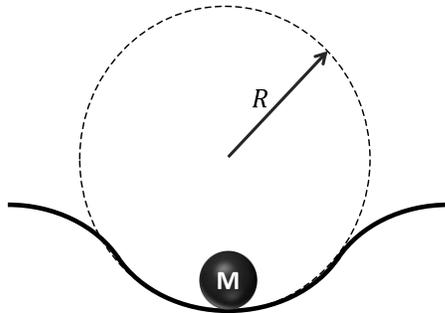
Score: ____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers.

| | | | |
|----|----|----|----|
| Q1 | Q2 | Q3 | Q4 |
| | | | |
| 10 | 10 | 5 | 5 |

1. A bolder rolls down a hill into a valley. Let's approximate the hill-valley combination as part of a circle of radius R as shown in the figure:



| | |
|-------|-------|
| M | R |
| 80 kg | 160 m |

Table 1: Useful Information

- On the figure complete the free-body diagram of the bolder at the bottom of the valley.
- As the bolder travels in its path down the hill and back up the other side, it undergoes *uniform circular motion*. For *uniform circular motion* the acceleration of a rotating object is $a = \frac{v^2}{r}$. The bolder moves at a constant *speed*, why is there an acceleration?
- At the bottom of the valley, the normal force on the bolder is measured to be 1010 N. What is the acceleration of the bolder? (Use $g = 9.8 \frac{m}{s^2}$, and the information in the table.)
- What is the speed of the bolder?

Diagram (2pts):

Explanation (3 pts):

Acceleration (3 pts):

Speed (2 pts):

2. You are traveling on a train with a velocity of $\vec{v} = 30 \text{ m/s}$ due East. You drop (*not throw*) a baseball out of the window. The window is 2 m from the ground.
- a. You observe the baseball from the window as it travels to the ground. Answer the following questions about the *path you see* as the baseball travels:

- i. With what velocity do you see the baseball travel in the eastward direction?

v_{East} (2 pt):

$$v_{East} =$$

Ball position (2 pt):

- ii. When the baseball hits the ground which part of the train is it near (select the correct option from the list):

1. A window in front of yours
2. A window behind yours
3. Your window

- b. Your friend is on the ground observing the baseball's path. Answer the following questions about the *path your friend sees* the baseball travels:

- i. With what velocity does your friend see the baseball travel in the eastward direction?

v_{East} (2 pt):

$$v_{East} =$$

Ball position (2 pt):

- ii. When the baseball hits the ground which part of the train is it near (select the correct option from the list):

1. Your window
2. A window behind yours
3. A window in front of yours

Speed (2 pts):

- iii. Find the vertical speed of the baseball when it hits the ground.