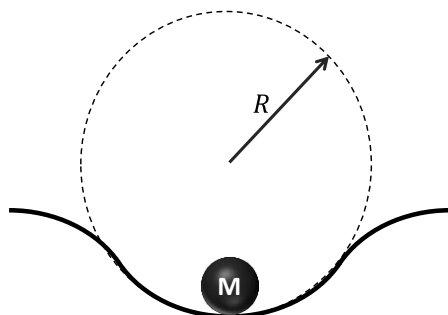Name: _____   DISC: _____   Score: _____ / 20

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 in to a valley. Let's approximate the hill-valley combination as the arc of a circle of radius R as shown in the figure:

M	R
$100\ kg$	$200\ m$

Table 1: Useful Information

Diagram (2pts):

a. On the figure complete the free-body diagram of the bolder at the bottom of the valley.

b. 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?

Explanation (3 pts):

c. At the bottom of the valley, the bolder rolls across a scale. The scale reads $1010\ N$. What is the acceleration of the bolder? (Use $g = 9.8\frac{m}{s^2}$, and the information in the table.)

Acceleration
 (3 pts):

d. What is the speed of the bolder?

Speed (2 pts):

2. You are traveling on a train with a velocity of $\vec{v} = 20\ m/s$ due East. You drop 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 does 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 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):

Speed (2 pts):

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

        iii. Using one or both of these expressions, find the vertical speed of the baseball when it hits the ground: $v^2 = v_0^2 + 2\,a\,\Delta y$ and/or $v = v_0 + at$