

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

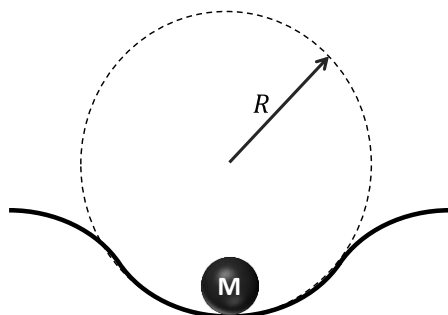
10

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
75 kg	150 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 880 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  $\vec{v} = 30 \text{ m/s}$  due East. You drop a baseball out of the window. The window is  $2 \text{ m}$  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):

Speed (2 pts):

- 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

- 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  $v = v_0 + at$