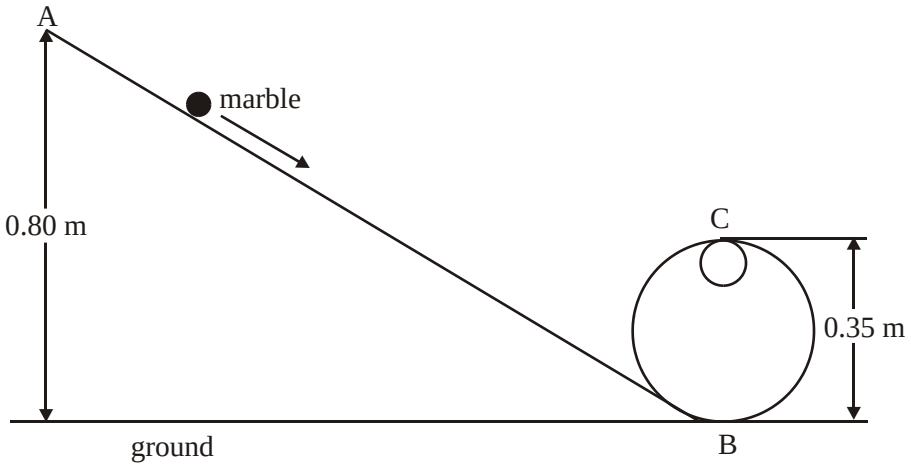
Name: _____ Phys 12

Year End Review: Circular Motion

1) In the diagram below, a marble (small glass sphere) rolls down a track, the bottom part of which has been bent into a loop. The end A of the track, from which the marble is released, is at a height of 0.80 m above the ground. Point B is the lowest point and point C the highest point of the loop. The diameter of the loop is 0.35 m.



The mass of the marble is 0.050 kg. Friction forces and any gain in kinetic energy due to the rotating of the marble can be ignored. The acceleration due to gravity, g = 10 m/s^2.

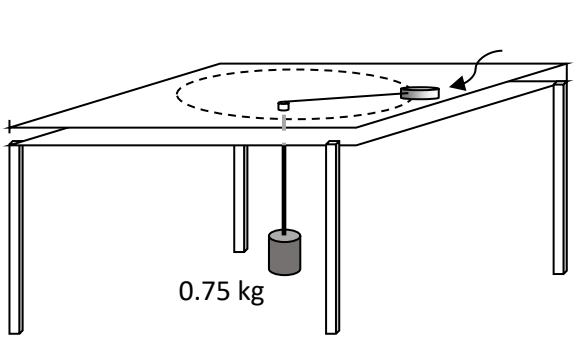
Consider the marble when it is at point C.

a) State the names of the **two** forces acting on the marble.

b) Deduce that the speed of the marble is 3.0 m/s.

c) Determine the resultant force acting on the marble and hence determine the reaction force of the track on the marble.

2) A flat puck is rotated in a circular path of radius 0.45 m on a horizontal frictionless table, and is held in this orbit by a string attached to a 0.75 kg mass through a hole in the table as shown. The puck completes 5 rotations in 6.4 s.



a) Find the speed of the puck.

b) Find the centripetal acceleration.

c) Find the maximum mass of the puck.

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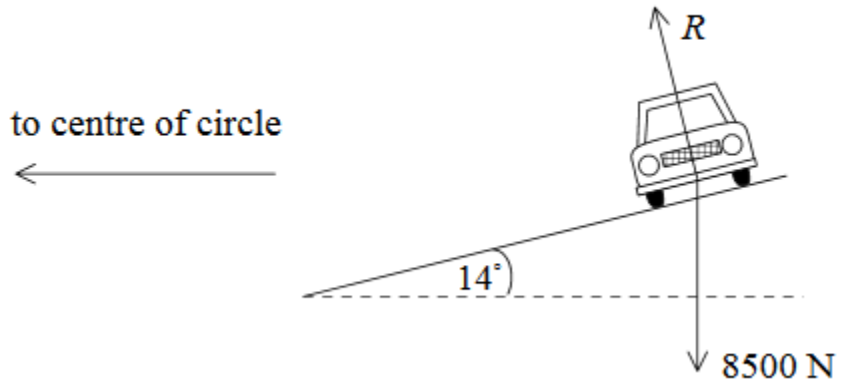
3) The Moon travels round the Earth in a circular orbit of radius 3.8×10^8 m with a period of 27.3 days. The mass of the Moon is 7.4×10^{22} kg.
   a. Calculate the Moon's velocity.
   b. Determine the force required to keep the Moon moving in its orbit.
   c. Determine the mass of the Earth.
   d. What is the escape velocity of the Moon at this distance away from the Earth?

4) A car of weight 8500 N is traveling a constant speed along a road that is an arc of a circle. In order that the car may travel more easily round the arc, the road is banked at 14^o to the horizontal, as shown below.



At one particular speed *v* of the car, there is no frictional force at 90^o to the direction of travel of the car between the tires and the road surface. The reaction force of the road on the car is *R*.

   a. Deduce that the horizontal component of the force *R* is approximately 2100 N.
   b. Determine the speed *v* of the car at which it travels round the car of radius 150 m without tending to slide.

Answer key

1)
   a. Weight, Normal force
   b. 3.0 m/s
   c. 2.1 N

2)
   a. 2.2 m/s
   b. 10.8 m/s^2
   c. 0.68 kg

3)
   a. 1.0×10^3 m/s
   b. 2.0×10^{20} N
   c. 5.8×10^{24} kg
   d. 1.4×10^3 m/s

4)
   a. 2100 N
   b. 19 m/s