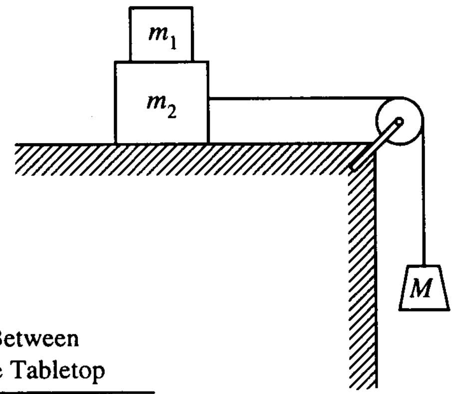
Name: Hr: AP Physics C Unit 6 Forces & Motion II Worksheet 3

To be submitted

Friction, Drag, and Circular Motion

1998#1

Block 1 of mass m_1 is placed on block 2 of mass m_2 which is then placed on a table. A string connecting block 2 to a hanging mass M passes over a pulley attached to one end of the table, as shown above. The mass and friction of the pulley are negligible. The coefficients of friction between blocks 1 and 2 and between block 2 and the tabletop are nonzero and are given in the following table.

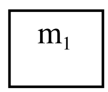


Express your answers in terms of the masses, coefficients of friction, and g, the acceleration due to gravity.

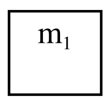
	Coefficient Between Blocks 1 and 2	Coefficient Between Block 2 and the Tabletop
Static	μ_{s1}	μ_{s2}
Kinetic	μ_{k1}	μ_{k2}

a. Suppose that the value of M is small enough that the blocks remain at rest when released. For each of the following forces, determine the magnitude of the force and draw a vector on the block provided to indicate the direction of the force if it is nonzero.

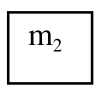
i. The normal force N_1 exerted on block 1 by block 2



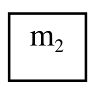
ii. The friction force f_1 exerted on block 1 by block 2



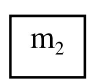
iii. The force T exerted on block 2 by the string



iv. The normal force N_2 exerted on block 2 by the tabletop



v. The friction force f_2 exerted on block 2 by the tabletop



b. Determine the largest value of M for which the blocks can remain at rest.

c. Now suppose that M is large enough that the hanging block descends when the blocks are released. Assume that blocks 1 and 2 are moving as a unit (no slippage). Determine the magnitude *a* of their acceleration.

d. Now suppose that M is large enough that as the hanging block descends, block 1 is slipping on block 2. Determine each of the following.

i. The magnitude a_1 of the acceleration of block 1

ii. The magnitude a_2 of the acceleration of block 2

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1984 #3

A small body of mass m located near the Earth's surface falls from rest in the Earth's gravitational field. Acting on the body is a resistive force of magnitude kmv, where k is a constant and v is the speed of the body.

a. On the diagram below, draw and identify all of the forces acting on the body as it falls.

b. Write the differential equation that represents Newton's second law for this situation.

c. Determine the terminal speed v_T of the body.

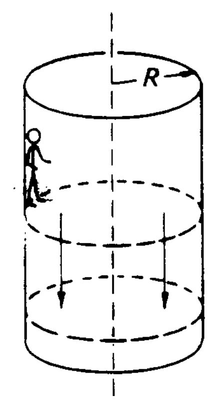
d. Integrate the differential equation once to obtain an expression for the speed v as a function of time t. Use the condition that v = 0 when t= 0.

e. On the axes provided below, draw a graph of the speed v as a function of time t.

1984#1

An amusement park ride consists of a rotating vertical cylinder with rough canvas walls. The floor is initially about halfway up the cylinder wall as shown above. After the rider has entered and the cylinder is rotating sufficiently fast, the floor is dropped down, yet the rider does not slide down. The rider has mass of 50 kilograms, the radius R of the cylinder is 5 meters, the angular velocity of the cylinder when rotating is 2 radians per second, and the coefficient of static friction between the rider and the wall of the cylinder is 0.6.

a. On the diagram below, draw and identify the forces on the rider when the system is rotating and the floor has dropped down.



b. Calculate the centripetal force on the rider when the cylinder is rotating and state what provides that force.

c. Calculate the upward force that keeps the rider from falling when the floor is dropped down and state what provides that force.

d. At the same rotational speed, would a rider of twice the mass slide down the wall? Explain your answer.