KU Physics Department
PHYS 101 Laboratory

Quiz #4 Key

Groups a, b, d and f:

Q1. *What's the purpose of the experiment "Dynamics of Motion"?*

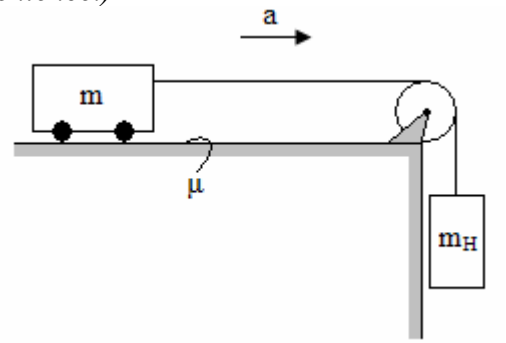
The purpose of the experiment is to verify Newton's 2nd Law, measuring the acceleration of a cart while subject to varying net applied forces.

Group a (Thu B1):

Q2. *Briefly describe the experimental setup.*

The cart is pulled along a horizontal surface (track) by a string that passes over a pullay and is attached to a hanger, upon which masses can be placed. A photogate is one photogate overhanging the track and a picket fence on the cart.

Q3. *Calculate the coefficient of friction, μ, for the system shown below, if m=0.8kg, m_H=0.5kg and acceleration of the system, a=2m/s^2.*
(Take g=10m/s^2 for convenience.)



$$F_{net,string} = M \cdot a$$

$$m_H \cdot g - \mu \cdot m \cdot g = (m + m_H) \cdot a$$

$$\mu \cdot m \cdot g = m_H \cdot g - (m + m_H) \cdot a$$

$$\mu = \frac{m_H \cdot g - (m + m_H) \cdot a}{m \cdot g}$$

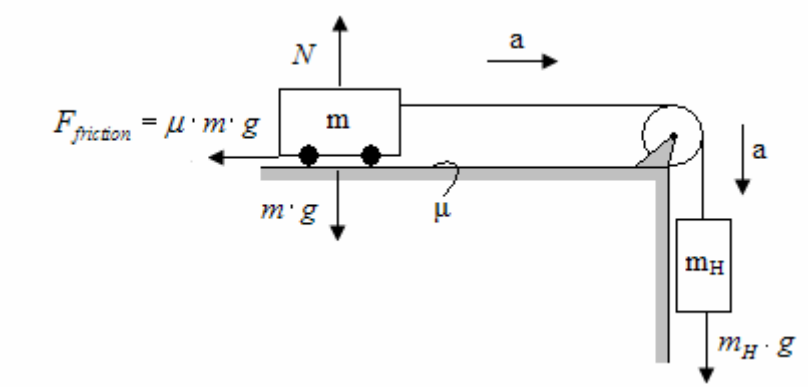
$$\mu = \frac{(0.5kg \cdot 10m/s^2) - (0.8kg + 0.5kg) \cdot (2m/s^2)}{(0.8kg \cdot 10m/s^2)}$$

$$\mu = \frac{5kg \cdot m/s^2 - 2.6kgm/s^2}{8kg \cdot m/s^2} = \frac{2.4}{8} \Rightarrow \mu = 0.3$$

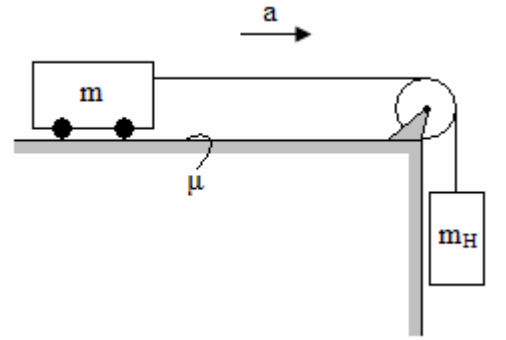
Group b (Thu B2):

Q2. *Draw the force diagram of the system.*

The force diagram of the system can be drawn as follows:



Q3. *Calculate mass, m, for the system shown below, if m_H=0.5kg, coefficient of friction, μ=0.2 and acceleration of the system, a=3m/s^2.*
(Take g=10m/s^2 for convenience.)



$$F_{net,string} = M \cdot a$$

$$m_H \cdot g - \mu \cdot m \cdot g = (m + m_H) \cdot a$$

$$m_H \cdot (g - a) = m \cdot (a + \mu \cdot g)$$

$$m = \frac{m_H \cdot (g - a)}{a + \mu \cdot g}$$

$$m = \frac{(0.5kg) \cdot (10m/s^2 - 3m/s^2)}{3m/s^2 + (0.2 \cdot 10m/s^2)} = \frac{3.5kg \cdot m/s^2}{5m/s^2}$$

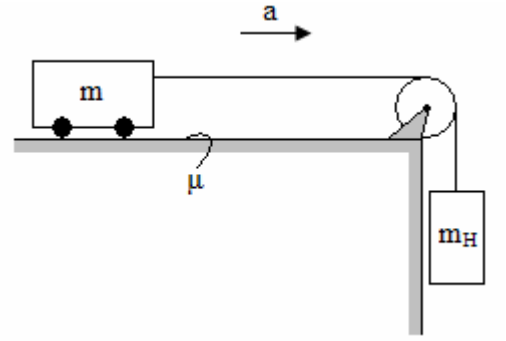
$$m = 0.7kg$$

Group d (Thu B4):

Q2. *What's the condition for the total mass and net force applied in part A? in part B?*

In part A, the total mass in the system is kept constant while various net forces are applied (Constant Total Mass and Varying Net Force). In part B, the total mass will be changed and various net forces will be applied (Variable Total Mass and Varying Net Force).

Q3. *Calculate mass, m_H, for the system shown below, if m=0.6kg, coefficient of friction, μ=0.25 and acceleration of the system, a=4m/s^2.*
(Take g=10m/s^2 for convenience.)



$$F_{net,string} = M \cdot a$$
$$m_H \cdot g - \mu \cdot m \cdot g = (m + m_H) \cdot a$$
$$m \cdot (a + \mu \cdot g) = m_H \cdot (g - a)$$
$$m_H = \frac{m \cdot (a + \mu \cdot g)}{g - a}$$
$$m_H = \frac{(0.6kg) \cdot (4m/s^2 + (0.25 \cdot 10m/s^2))}{10m/s^2 - 4m/s^2} = \frac{3.9kg \cdot m/s^2}{6m/s^2}$$
$$m_H = 0.65kg$$

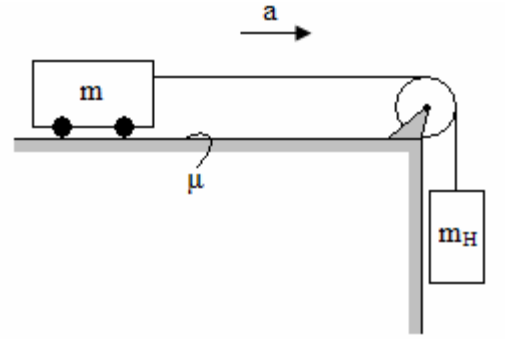
Group f (Thu B6):

Q2. *What's the equipment needed?*

The equipment needed is:

- A Macintosh computer,
- A signal interface,
- One photogate,
- A mass set and a mass hanger,
- A small cart,
- A metal track.

Q3. *Calculate the acceleration, a, of the system shown below, if m_H=0.3kg ,m=0.5kg and coefficient of friction, μ=0.12.*
(Take g=10m/s^2 for convenience.)



$$F_{net,string} = M \cdot a$$

$$m_H \cdot g - \mu \cdot m \cdot g = (m + m_H) \cdot a$$

$$a = \frac{(m_H - \mu \cdot m) \cdot g}{m + m_H}$$

$$a = \frac{(0.3kg - 0.12 \cdot 0.5kg) \cdot 10m/s^2}{0.5kg + 0.3kg} = \frac{2.4kg \cdot m/s^2}{0.8kg} \Rightarrow a = 3m/s^2$$