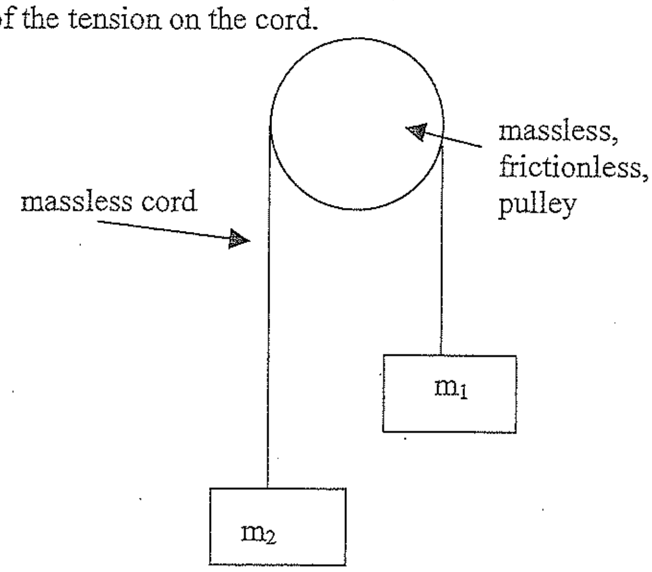
Physics 12 Practice Quiz Name: KEY

Express all numerical answers to the correct number of significant digits, and with appropriate units.

1. All parts of this question refer to the pulley system shown below.
   a. Do not include numerical values in any of the following tasks *(i.e. represent measurable values using only their symbols, such as "m", F_T, etc)*.
      i. Draw the free body diagram for m_1. Show all forces, and indicate the sign convention *(show which direction you have chosen to be positive, and which is negative)*
      ii. Draw the free body diagram for m_2. Show all forces, and indicate the sign convention *(show which direction you have chosen to be positive, and which is negative)*
      iii. Show the Newton's second law relationship *(ΣF equation)* for m_1.
      iv. Show the Newton's second law relationship *(ΣF equation)* for m_2.
      v. Develop the equation to determine the acceleration of the system
      vi. Use the relationship you developed for m_1 to develop an expression *(equation)* for the force of tension in the cord.

   b. For the next 2 steps, solve the problems using numerical values. You may use equations that you developed in part "a" of this question.
      i. Calculate the acceleration *(direction and magnitude)* of m_1.
      ii. Calculate the value of the tension on the cord.

$m_1 = 0.50$ kg
$m_2 = 0.35$ kg



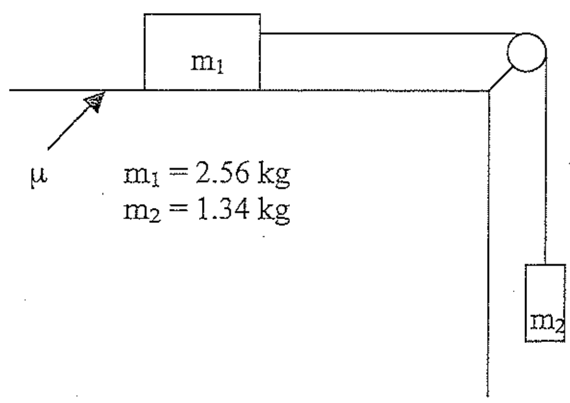
2. All parts of this question refer to the system of masses shown below.

a. Do not include numerical values in any of the following tasks *(i.e. represent measurable values using only their symbols, such as "m", F_T, etc).*

i. Draw the free body diagram for m_1. *Show all forces, and indicate the sign convention*
ii. Draw the free body diagram for m_2. *Show all forces, and indicate the sign convention*
iii. Show the Newton's second law relationship for m_1.
iv. Show the Newton's second law relationship for m_2.
v. Develop the equation to determine the acceleration of the system (show steps)
vi. Use the relationship you developed for m_1 to develop an expression for the force of tension (F_T) in the cord.
vii. Develop the equation to determine the minimum value of the coefficient of static friction (μ_s) for which the system will remain at rest.

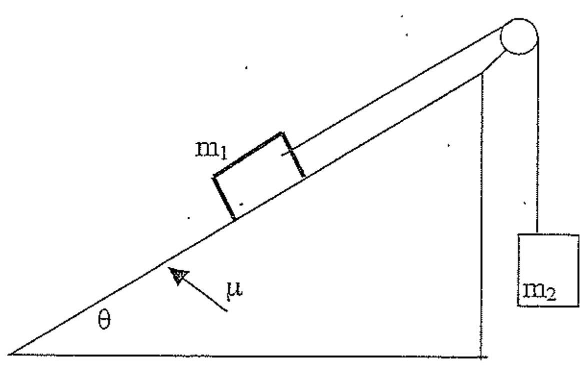
b. For the next 4 steps, solve the problems using numerical values. You may use equations that you developed in part "a" of this question.

i. Calculate the acceleration of the system if the table surface is greased, making $\mu \approx 0$.
ii. Calculate the minimum value of μ_s for which the system will remain at rest.
iii. Calculate the acceleration of the system if $\mu_k = 0.256$
iv. If $\mu_s = 0.655$, what is the maximum value of m_2 for which the system will remain at rest?



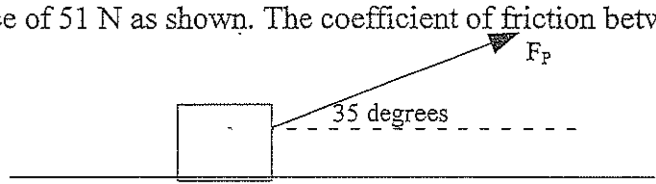
3. All parts of this question refer to the system of masses shown below.
   a. Do not include numerical values in any of the following tasks *(i.e. represent measurable values using only their symbols, such as "m", F_T, etc).*
      i. Develop an expression to determine which direction the system would be likely to accelerate *[steps: assume that $\mu = 0$; set up fbds for both masses; develop the expression for the acceleration of the system; under what conditions would the acceleration be greater than zero?; under what conditions would the acceleration be greater than zero?]*
      ii. Draw the free body diagram for m_1. *[to determine the likely direction of friction, use the information you gained from step (i)]*
      iii. Draw the free body diagram for m_2.
      iv. Show the Newton's second law relationship for m_1.
      v. Show the Newton's second law relationship for m_2.
      vi. Develop the equation to determine the acceleration of the system (show steps)
      vii. Use the relationship you developed for m_1 to develop an expression for the force of tension (F_T) in the cord.
      viii. Develop the equation to determine the minimum value of the coefficient of static friction (μ_s) for which the system will remain at rest.

   b. For the next 4 steps, solve the problems using numerical values. You may use equations that you developed in part "a" of this question.
      i. Calculate the acceleration of the system (magnitude and direction) if the surface of the incline is greased, making $\mu \approx 0$.
      ii. Calculate the minimum value of μ_s for which the system will remain at rest.
      iii. Calculate the acceleration of the system if $\mu_k = 0.256$



$m_1 = 2.56$ kg
$m_2 = 1.34$ kg
$\theta = 35.0°$

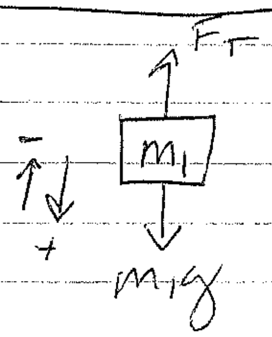
4. The diagram below shows a box of mass 4.6 kg being pulled along a horizontal sidewalk by a force of 51 N as shown. The coefficient of friction between the box and the sidewalk is 0.70



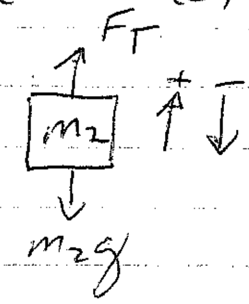
   a. Draw the free body diagram for the box
   b. Develop the expression for the normal force (F_N).
   c. Develop the expression for the acceleration of the box.
   d. Calculate the acceleration of the box.

ANSWER KEY Physics 12 PRACTICE QUIZ (DYNAMICS) Ch4

1.(a)(i)



(ii)



(iii) $\Sigma F_1 = m_1a = m_1g - F_T$ (iv) $\Sigma F_2 = m_2a = F_T - m_2g$

(v) $m_1a = m_1g - F_T$

$m_2a = F_T - m_2g$

$\therefore (m_1+m_2)a = g(m_1 - m_2)$

$\therefore a = \frac{g(m_1 - m_2)}{m_1 + m_2}$

(vi) $F_T = m_1(g - a)$

(b) (i) $a = \frac{g(m_1-m_2)}{m_1+m_2}$

$= \frac{(9.8\,N/kg)(0.50\,kg - 0.35\,kg)}{(0.50\,kg + 0.35\,kg)}$

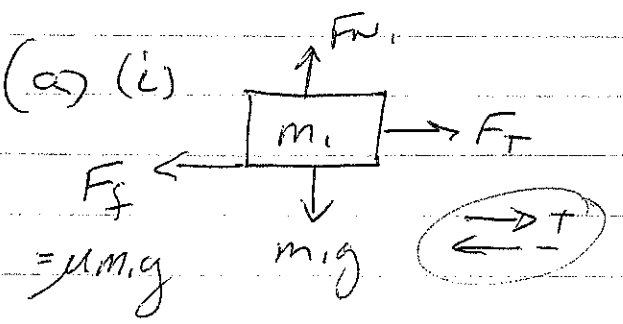
$\therefore \vec{a} = 1.7\,m/s^2$ m_1 is accelerating down

(ii) $F_T = m_1(g - a)$

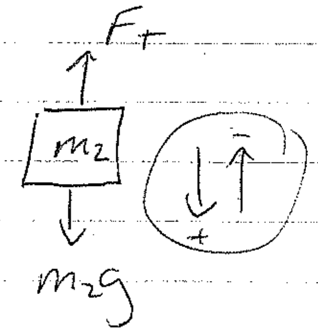
$F_T = (0.50\,kg)(9.8\,N/kg - 1.729\,m/s^2)$

$F_T = 4.0\,N$

2. (a) (i)



(ii)



(iii) $\Sigma F_1 = \boxed{m_1 a = F_T - \mu m_1 g}$

(iv) $\Sigma F_2 = \boxed{m_2 a = m_2 g - F_T}$

(v) add (iii) and (iv) $(m_1 + m_2) a = g(m_2 - \mu m_1)$

$$\therefore \boxed{a = \frac{g(m_2 - \mu m_1)}{m_1 + m_2}}$$

(vi) $\boxed{F_T = m_1 (a + \mu g)}$

(vii) $m_2 - \mu m_1 = 0$

$$\therefore \boxed{\mu = \frac{m_2}{m_1}}$$

(b) (i) $a = \frac{m_2 g}{m_1 + m_2} = \frac{(1.34\,kg)(9.8\,N/kg)}{(1.34\,kg + 2.56\,kg)}$

$\therefore \boxed{\vec{a} = 3.37\,m/s^2}$ (m_2 accelerates down, m_1 accelerates to the right)

(ii) $\boxed{\mu = \frac{1.34}{2.56} = 0.523}$

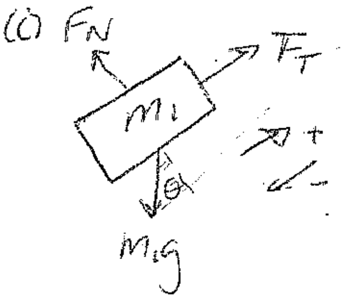
(iii) $\vec{a} = \frac{(9.8)(1.34 - 0.256 \times 2.56)}{1.34 + 2.56} = 1.72\,m/s^2$

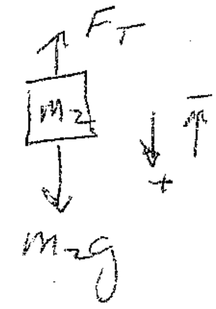
$\boxed{\vec{a} = 1.72\,m/s^2 \text{ (to right)}}$

(iv) $m_2 = \mu m_1$
$= (0.655)(2.56\,kg)$

$\boxed{m_2 = 1.68\,kg}$

3, (a) (i)





$$\Sigma F_1 = m_1 a = F_T - m_1 g \sin\theta$$
$$\Sigma F_2 = m_2 a = m_2 g - F_T$$

sum

$$(m_1 + m_2) a = m_2 g - m_1 g \sin\theta$$

$$\therefore a = \frac{g(m_2 - m_1 \sin\theta)}{m_1 + m_2}$$

if $m_2 - m_1 \sin\theta > 0$, then the system accelerates to the right.

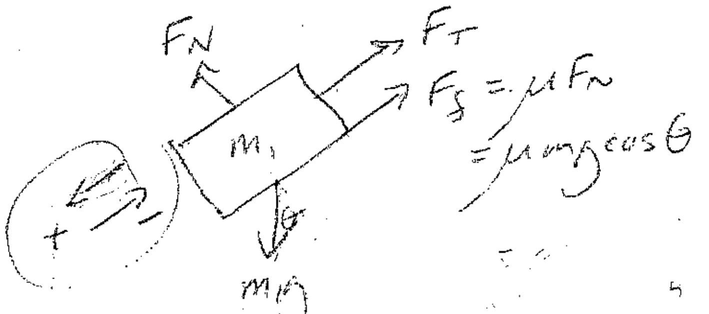
$\therefore m_2 > m_1 \sin\theta$

if $m_2 - m_1 \sin\theta < 0$, then the system accelerates to the left

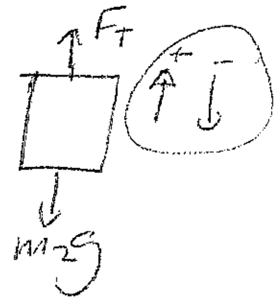
$\therefore m_2 < m_1 \sin\theta$

(ii) in this case ($m_1 = 2.56$ kg; $m_2 = 1.34$ kg, $\theta = 35.0°$) the system will tend to $\vec{a}$ to left,

$\therefore F_f$ on m_1 is to the right.



(iii)



(iv) $\Sigma F_1 = m_1 a = m_1 g \sin\theta - \mu m_1 g \cos\theta - F_T$

(v) $\Sigma F_2 = m_2 a = F_T - m_2 g$

(vi) $$\boxed{\vec{a} = \frac{g(m_1 \sin\theta - \mu m_1 \cos\theta - m_2)}{m_1 + m_2}}$$

(vii) $F_T = m_1(g\sin\theta - \mu g\cos\theta - a)$

(viii) from (vi), if $\vec{a} = 0$

then $m_1\sin\theta - \mu m_1\cos\theta - m_2 = 0$

$$\therefore \mu = \frac{m_1\sin\theta - m_2}{m_1\cos\theta}$$

$$\mu = \tan\theta - \frac{m_2}{m_1\cos\theta}$$

(b) (i) $$a = \frac{g(m_1\sin\theta - m_2)}{m_1 + m_2} = \frac{9.8(2.56\sin 35^\circ - 1.34)}{2.56 + 1.34}$$

$\vec{a} = +0.323\,m/s^2$ (to left)

(ii) $$\mu = \tan 35^\circ - \frac{1.34}{2.56\cos 35^\circ}$$

$\mu = 0.0612$

(iii) $$a = g\frac{(m_1\sin\theta - \mu m_1\cos\theta - m_2)}{m_1 + m_2}$$

$$= \frac{(9.8)(2.56\sin 35^\circ - 0.256 \times 2.56\cos 35^\circ - 1.34)}{(2.56 + 1.34)}$$

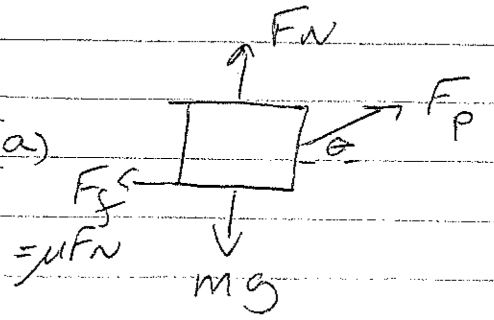
$\vec{a} = -1.03\,m/s^2$ (to the left)

* the system is slowing

(μ is greater than minimum needed for static)

4.

(a)



(b) $\Sigma F_y = 0 = F_N + F_p \sin\theta - mg$

$\therefore F_N = mg - F_p \sin\theta$

(c) $\Sigma F_x = ma = F_p \cos\theta - \mu F_N$

$\therefore a = \dfrac{F_p \cos\theta - \mu(mg - F_p \sin\theta)}{m}$

(d) $a = \dfrac{[51 \cos 35° - 0.7(4.6 \times 9.8 - 51 \sin 35°)]}{4.6}$

$a = 6.7\ m/s^2$ [to the right]