**ECE 105 Tutorial Problems for Week 3**

**Thursday’s Problem**

An L-shaped block of m = 5.0 kg rests on a frictionless surface and has a M = 10.0 kg block sitting on top of it. The pulley is massless and frictionless. The static coefficient of friction between the blocks is µs = 0.40. For the 10.0 kg block NOT to move with respect to the 5.0 kg block it sits on when it is pulled with a force, F:

1. What is the maximum force, F, with which block M can be pulled without sliding?
2. What is the resulting acceleration, a, of both blocks?

F

M

m

**Thursday’s Group Work**

**1**  What is the direction of the frictional force on m?

1. To the right
2. There is none
3. unknown
4. To the left

**2** What is the total force on the pulley due to the tension in the rope?

**a)** F

**b)** 2F

**c)** F + Ma

**d)** F - Ma

**3** Which forces acting on M have a component in the direction of its acceleration?

**a)** friction, *f*

**b)** F

**c)** 2F

**d)** F and *f*

**4** Which forces acting on m have a component in the direction of its acceleration?

**a)**  F

**b)** 2F

**c)**  F and *f*

**d)** *f*

**5** Which forces acting on (M+m) have a component in the direction of its acceleration?

**a)** F

**b)** F and *f*

**c)** *f*

**d)** 2F

**Friday’s Problem**



A block with mass m=2.5 kg is placed on a movable θ = 400 ramp with mass M weighing 120 N. The friction coefficients between the ramp and the block are μk = 0.15 and μs = 0.35. The ramp itself sits on a frictionless surface. With what force does the ramp need to be pushed to keep the block sliding at a constant speed **up** the ramp?

**Friday’s Group Work**

**1)** What is the direction of acceleration of m?

1. Up the incline
2. There is no acceleration
3. Down the incline
4. Horizontal to the right

**2** What is the direction of the normal force on m?

**a)** Perpendicular to the ramp and (right and up)

**b)** Horizontally to the left

**c)** Perpendicular to the ramp and (left and down)

**d)** Horizontal to the right

**3** What is the direction of friction, *f,* on m?

**a)** Parallel to m’s acceleration

**b)** Anti-parallel to m’s acceleration

**c)** Parallel to the ramp (up and left)

**d)** Parallel to the ramp (down and right)

**4** Which forces acting on m have a component in the direction of its acceleration?

**a)**  F

**b)** N

**c)**  N and *f*

**d)** none

**5** How many “Normal” force(s) act on M?

**a)** 3

**b)** 0

**c)** 1

**d)** 2

**Solutions:**

**Thursday’s Problem**

An L-shaped block of m = 5.0 kg is on a frictionless surface and has a M = 10.0 kg block placed on it with a static coefficient of friction of µs = 0.40 between the blocks. For the 10.0 kg block NOT to move with respect to the 5.0 kg block it sits on when pulled

1. What is the resulting acceleration, a, of both blocks?
2. What is the maximum force, F, with which block M can be pulled?

F

M

m

For M: *f* – F = Ma for m: 2F – *f* = ma (F = T) and *f* = usMg

uMg – F = Ma and F = uMg – Ma substitute in second equ : 2(uMg – Ma) – uMg = ma

or uMg -2Ma = ma and a(m + 2M) = uMg giving **a =** 0.4(10)9.8 / 25 = **1.57 m/s2**

**F** = (M + m)a = 15(1.57) = **23.4 N**

**Friday’s Problem**



A 2.5 kg block is placed on a movable θ = 400 ramp weighing 120 N. The friction

coefficients between the ramp and the block are μk = 0.15 and μs = 0.35. With what

force does the ramp need to be pushed to keep the block sliding at a constant speed **up** the

ramp?

note: chose the coordinate system’s x-axis in the direction of the ramps’s acceleration, NOT parallel and perpendicular to its incline.

*m; x: Nsin40 + fcos40 = ma -> Nsin40 + ukNcos40 = ma -> N = ma/(sin40 + ukcos40)*

*y: Ncos40 – mg - fsin40 = 0 -> Ncos40 – mg – ukNsin40 = 0*

*N = mg/(cos40 - usin40); equating ma/(sin40 + ucos40) = (mg)/(cos40 - usin40) or*

*a/g = (sin40 + ucos40)/(cos40 - usin40) = (tan40 + u)/(1 - utan40)*

*a/g = 1.13 or* ***a = 11.1 m/s2 M: F = (M + m)a = (120/g + 2.5)11.1 = 163.7 N***