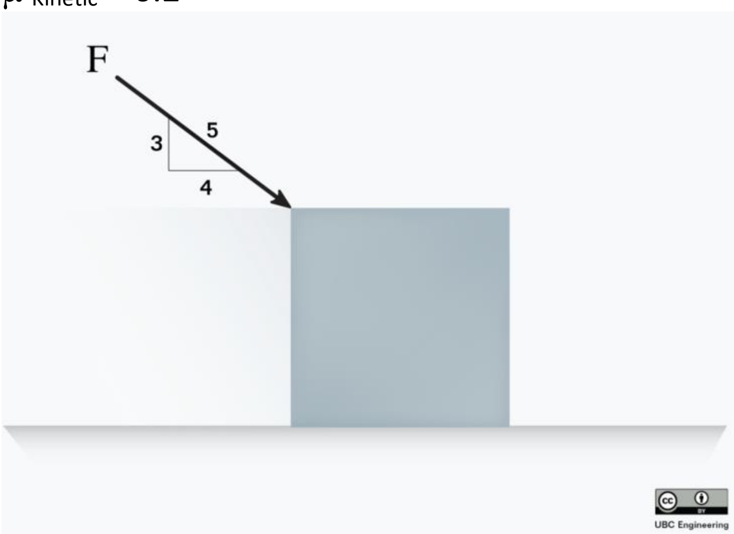
Chapter 8 - Friction
Preliminary Problem P8-1

Determine the friction force at the surface of contact.
Will the object slip? In other words, will it move?
Remember that the coefficient of static friction gives the MAXIMUM value of friction, but not the minimum.
Draw a clear force diagram for both (a) and (b)

F = 500 N
Weight = 200 N
$\mu_{Static} = 0.3$
$\mu_{Kinetic} = 0.2$



Answers: Sum of the forces in the y direction are zero.

Taking up to be positive
$0 = -(3/5)(500) - 200 + N$
so N = 500 N up

Assume the sum of the forces in the x direction are zero.
What is the F' force to the left needed to have the box in equilibrium?
$0 = (4/5)(500) - F'$ so $F' = 400$ N
This means the maximum static friction force has to be 400 N or bigger to prevent the box from slipping.

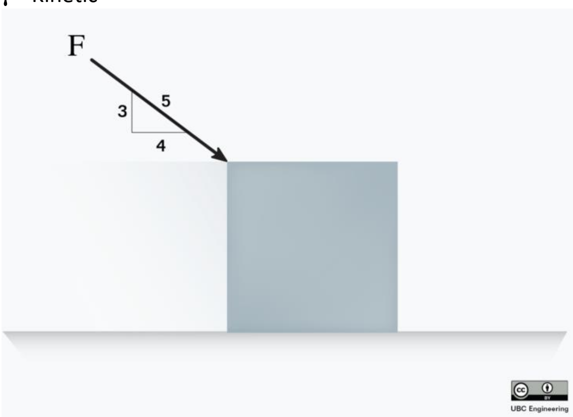
But friction force = coefficient x normal force

Maximum static friction force = 0.3 x 500 N = 150 N
150 N is less than 400 N so the box will slip.

Friction force = force of kinetic friction = 0.2 x 500 N = 100 N

Note. That means the net force acting on the box = 400 N – 100 N = 300 N
Mass = 20.4 kg a = Acceleration = (300 N) / (20.4 kg) = 14.7 m/s^2 to the right

b) Try it again with different forces and different coefficients
F = 100 N
Weight = 40 N
$\mu_{Static} = 0.9$
$\mu_{Kinetic} = 0.6$



Answers:
Sum of the forces in the y direction are zero.

Taking up to be positive

$0 = (3/5)(100) - 40 + N$

so N = 100 N up

Assume the sum of the forces in the x direction are zero.
What is the F' force to the left needed to have the box in equilibrium?

$0 = (4/5)(100) – F'$ so $F' = 80$ N
This means the maximum static friction force has to be 80 N or bigger to prevent the box from slipping.

But friction force = coefficient x normal force

Maximum static friction force = 0.9 x 100 N = 90 N

90 N is MORE than 80 N so the box will NOT slip.

The friction force = 80 N

Note: $a = 0\ m/s^2$ as v = 0 and constant

Answers for the other versions

Version 666 N and 88.8 N

Question One
666 N becomes 400 N vertically down and 533 N horizontally right
normal force = 600 N up
friction force maximum = 0.3 x 600 N = 180 N

but 180 N << 533 N so the box will slip

the box slips so the friction force = force of kinetic friction
so the friction force = kinetic friction = 0.2 x 600 N = 120 N

note: net force = 533 N – 120 N = 410 N
a = net force / mass = (410 N) / (200 / 9.80) = 20.1 m/s^2

Question Two
88.8 N becomes 53.3 N vertically down and 71 N horizontally right
normal force = 93.3 N up
friction force maximum = 0.9 x 93.3 N = 84.0 N

but 84.0 N friction force > pushing force of 71 N
so the box will not slip

friction force = 71 N (net force is zero)

Answers for the other versions
Version 666 and 88.8

Question One
666 N becomes 400 N vertically down and 533 N horizontally right
normal force = 600 N up
friction force maximum = 0.3 x 600 N = 180 N

but 180 N << 533 N so the box will slip

the box slips so the friction force = force of kinetic friction

so the friction force = kinetic friction = 0.2 x 600 N = 120 N

note: net force = 533 N – 120 N = 410 N
a = net force / mass = (410 N) / (200 / 9.81) = 20.1 m/s^2

Question Two
88.8 N becomes 53.3 N vertically down and 71 N horizontally right
normal force = 93.3 N up
friction force maximum = 0.9 x 93.3 N = 84.0 N

but 84.0 N friction force > pushing force of 71 N
so the box will not slip

friction force = 71 N (net force is zero)

Answers for the other versions
Version 888 N and 66.6 N

Question One
888 N becomes 533 N vertically down and 710 N horizontally right
normal force = 733 N up
friction force maximum = 0.3 x 733 N = 220 N

but 220 N << 710 N ***so the box will slip***

the box slips so the friction force = force of kinetic friction

so the friction force = kinetic friction = 0.2 x 733 N = 147 N

note: net force = 710 N – 147 N = N
a = net force / mass = (563 N) / (200 / 9.81) = 27.6 m/s^2

Question Two
66.6 N becomes 40.0 N vertically down and 53.3 N horizontally right
normal force = 80.0 N up
friction force maximum = 0.9 x 80.0 N = 72.0 N

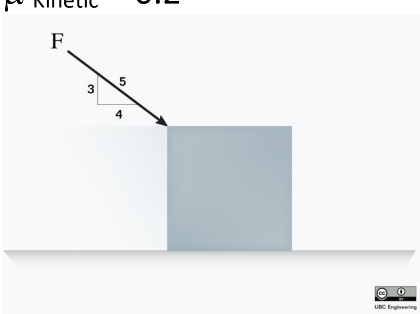
but 72.0 N friction force > pushing force of 53.3 N
so the box will not slip
friction force = 53.3 N (net force is zero)

PHYS 1170 Your Name:
Due at the end of class.
Your final answer must have 3 sig. figs. Your mark: /10

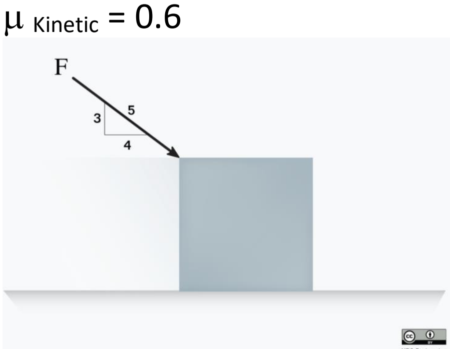
Question One Similar to Preliminary Problem 8-1

Determine the friction force at the surface of contact.
Will the object slip? In other words, will it move?
Remember that the coefficient of static friction gives the MAXIMUM value of friction, but not the minimum.
Draw a clear force diagram for both (a) and (b)

F = 888 N
Weight = 200 N
$\mu_{Static} = 0.3$
$\mu_{Kinetic} = 0.2$



F = 66.6 N
Weight = 40 N
$\mu_{Static} = 0.9$
$\mu_{Kinetic} = 0.6$



PHYS 1170 Your Name:
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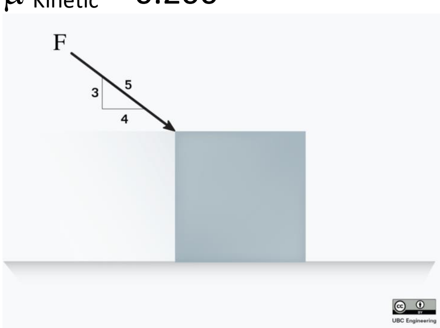
Question One Similar to Preliminary Problem 8-1
Determine the friction force at the surface of contact.
Will the object slip? In other words, will it move?
Remember that the coefficient of static friction gives the MAXIMUM value of friction, but not the minimum.
Draw a clear force diagram for both (a) and (b)

F = 666 N
Weight = 200 N
μ_{Static} = 0.300
$\mu_{Kinetic}$ = 0.200



F = 88.8 N
Weight = 40 N
μ_{Static} = 0.900
$\mu_{Kinetic}$ = 0.600