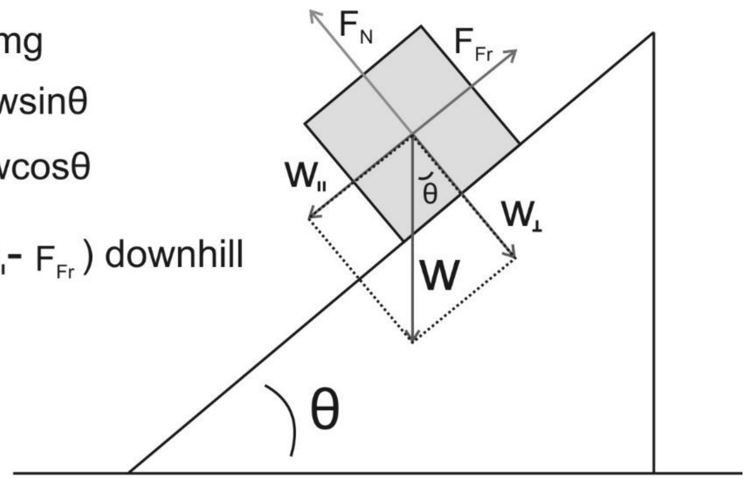
Physics 200 Name: ___________________________________
Newton's Laws in 2 Dimensions
Bodies on Inclines

$w = mg$

$w_{\parallel} = w\sin\theta$

$w_{\perp} = w\cos\theta$

$\Sigma F = (w_{\parallel} - F_{Fr})$ downhill



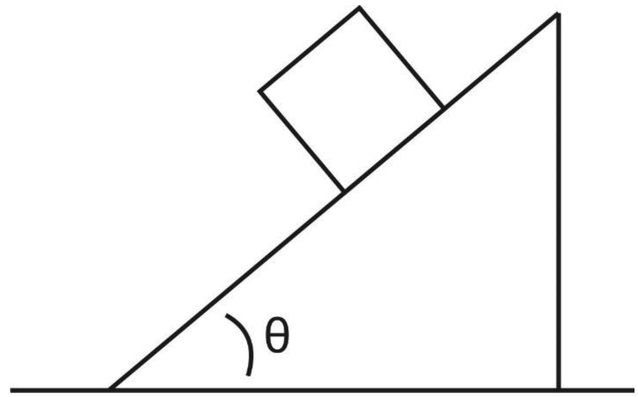
- The perpendicular component of weight determines the normal force and, therefore, friction.
- The parallel component of weight contributes to acceleration.
- Unless friction is as strong as the parallel weight component, friction and weight are the only two non-canceling forces contributing to the net force.

Practice Problem: Fill in the remaining cells in the table below.

Item	**Direction (When applicable)**	**Magnitude**
coefficient of friction	NA	0.4
θ (degrees)	NA	30
Mass of object (kg)	NA	2
Weight of object (N)		
Perpendicular Weight Component (N)		
Parallel Weight Component (N)		
Normal force (N)		
Force of Friction (N)		
Net force on object (N)		
Acceleration (m/s^2)		

1a. The figure to the right shows a block on an incline. Draw and label the forces acting on the block. Resolve weight into perpendicular and parallel components, relative to the surface.

1b. Fill in the table below for the block on the ramp The block is the "item."



Item	Direction (When applicable)	Magnitude
coefficient of friction	NA	.6
θ (degrees)	NA	60
Mass of object (kg)	NA	2
Weight of object (N)		
Perpendicular Weight Component (N)		
Parallel Weight Component (N)		
Normal force (N)		
Force of Friction (N)		
Net force on object (N)		
Acceleration (m/s^2)		

2. Fill out the table for the 2kg block. Then find the masses' accelerations and the tension in the string.

a = ______________

Tension = ______________

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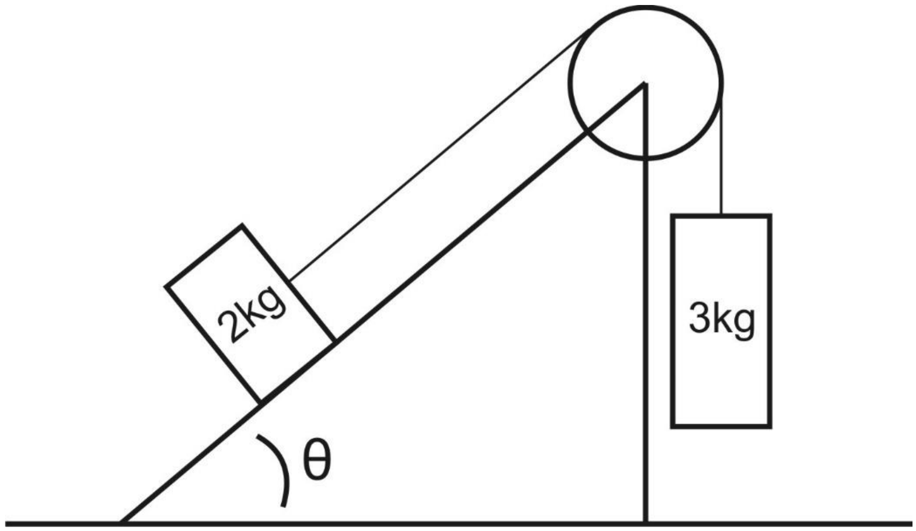
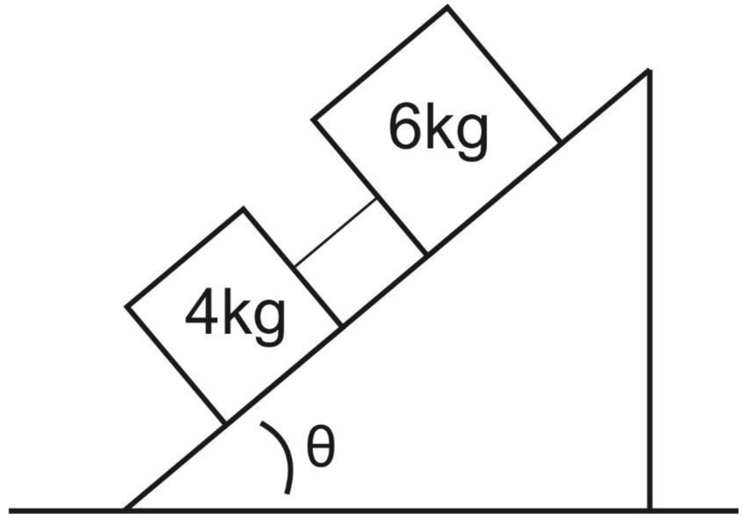


Item (2kg block)	Direction (When applicable)	Magnitude
coefficient of friction	NA	**0.5**
θ (degrees)	NA	**70**
Mass of object (kg)	NA	**2**
Weight of object (N)		
Perpendicular Weight Component (N)		
Parallel Weight Component (N)		
Normal force (N)		
Force of Friction (N)		

3. In the diagram, the 6kg block has a μ_k of 0.5, but the 4kg block is frictionless. Fill in the tables. Then find the accelerations of the blocks and the tension in the string.

a = _______________

Tension = _______________



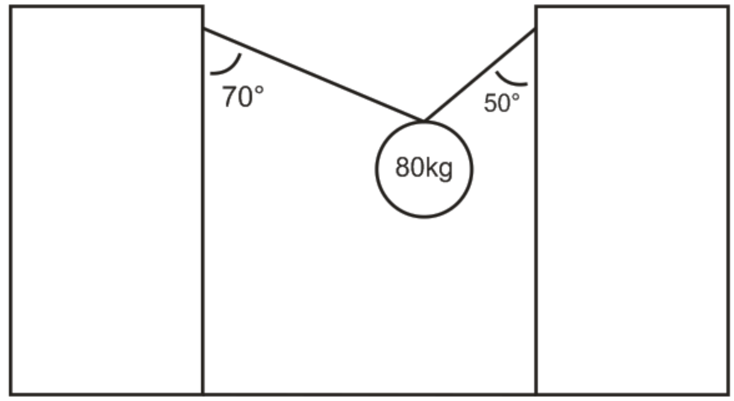
Item (4kg block)	Direction (When applicable)	Magnitude
coefficient of friction	NA	**0**
θ (degrees)	NA	**50**
Mass of object (kg)	NA	**4**
Weight of object (N)		
Perpendicular Weight Component (N)		
Parallel Weight Component (N)		
Normal force (N)		
Force of Friction (N)		

Item (6kg block)	Direction (When applicable)	Magnitude
coefficient of friction	NA	**0.4**
θ (degrees)	NA	**50**
Mass of object (kg)	NA	**6**
Weight of object (N)		
Perpendicular Weight Component (N)		
Parallel Weight Component (N)		
Normal force (N)		
Force of Friction (N)		

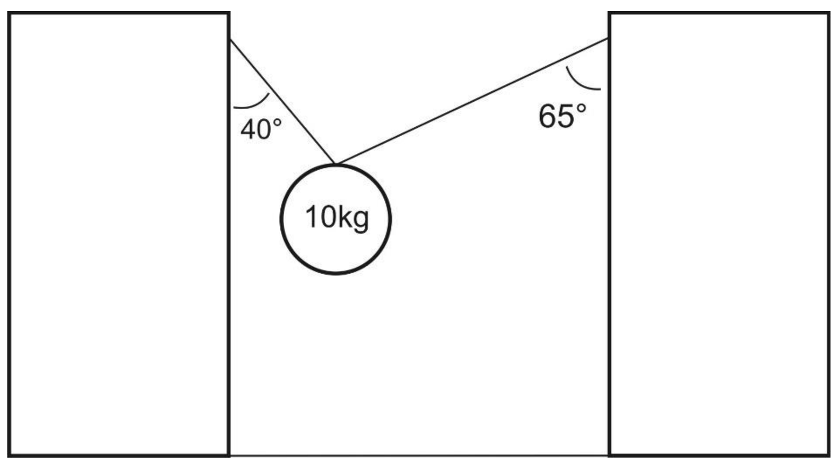
Physics 200 Name: ___________________________

Masses Hanging and Dragged at Angles – Newton's Laws in 2 Dimensions

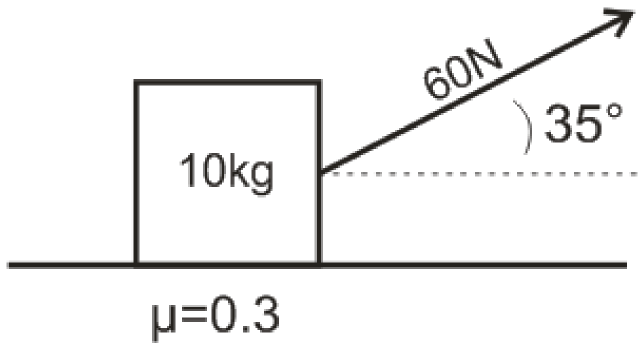
1. The 80kg mass is in static equilibrium. Find the tensions in the two segments of rope.



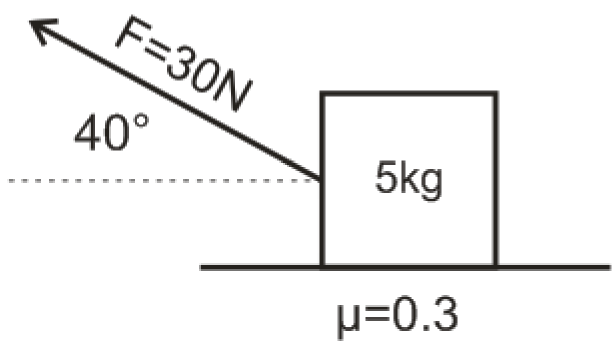
2. The 10kg mass is in static equilibrium. Find the tensions in the two segments of rope.



3. A 10kg mass is being accelerated horizontally by the tension in a rope that is attached to the mass as shown. Find the acceleration of the 10 kg mass.

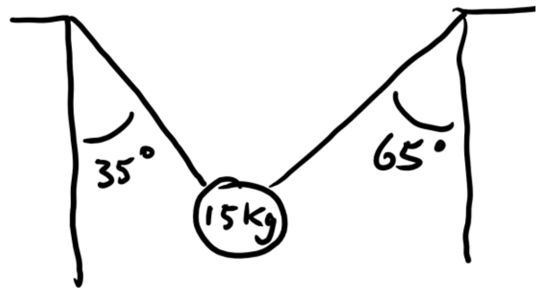


4. A 5kg mass is being accelerated horizontally by the tension in a rope that is attached to the mass as shown. Find the acceleration of the 8kg mass.



Physics 200 Name: ___________________________________

Last Year's Test Retake – Newton's Laws in 2-D

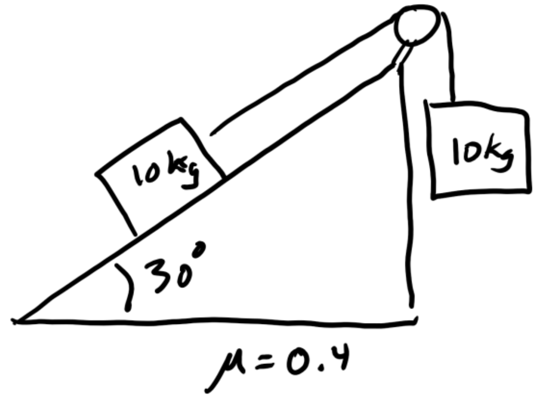


For each problem, enter the correct answers into the table. Note that only the yellow (shaded, if black and white) cells will be graded (except on #1, where you may receive partial credit for the blank cells.)

1. Two segments of rope are supporting an object. Segments are angled at the same angle, relative to horizontal. Find the object's weight and the tensions in the two ropes (yellow cells). You may receive partial credit for correctly entering the blue terms -- but you will not lose points if they are wrong.

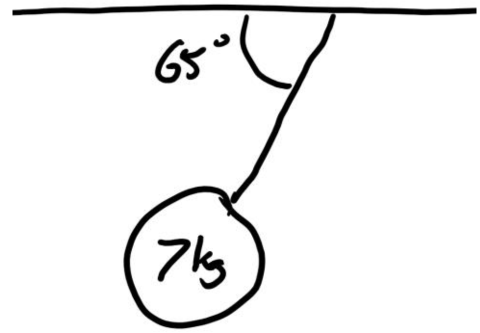
Description	**Magnitude**	**Units**	**Direction**
Rope 1 Angle (relative to vertical)	35	degrees	Right of downward
Rope 2 Angle (relative to vertical)	65	degrees	Left of downward
Hanging Mass	15	kg	NA
T_{1x} (in terms of T_1 -- tension in Rope 1)		T_1	Leftward
T_{1y} (in terms of T_1)		T_1	Upward
T_{2x} (in terms of T_2)		T_2	Rightward
T_{2y} (in terms of T_2)		T_2	Upward
T_1 (in terms of T_2)		T_2	Along String
Weight of the hanging mass		N	Downward
T_2 (tension in Rope 2)		N	Along String
T_1 (tension in Rope 1)		N	Along string

2. A sliding mass on an incline is connected via a string and pulley to a hanging mass. μ_k is given.



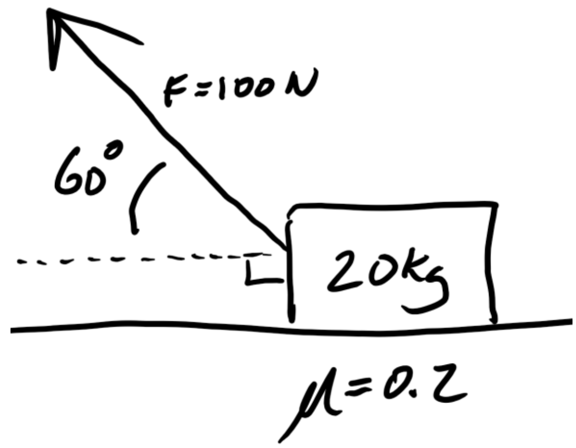
Description	Magnitude	Units	Direction
Angle of incline to horizontal	30.00	degrees	Above rightward
Sliding mass	10.00	kg	NA
Hanging mass	10.00	kg	NA
Coefficient of friction	0.40	NA	NA
Weight of sliding mass			
Perpendicular Component of sliding object weight			
Parallel Component of sliding object weight			
Weight of hanging object			
Normal Force acting on sliding object			
Friction			
Net Force			
Acceleration			
String Tension			

3. An object is hanging by a rope from the ceiling of a train car. The rope makes a constant angle with the horizontal ceiling.



Description	Magnitude	Units	Direction
Mass	7	kg	NA
Angle between rope and horizontal ceiling	65	degrees	below leftward
Weight of hanging object			
Vertical component of tension			
Tension			
Horizontal Component of tension			
Acceleration of Hanging Object			

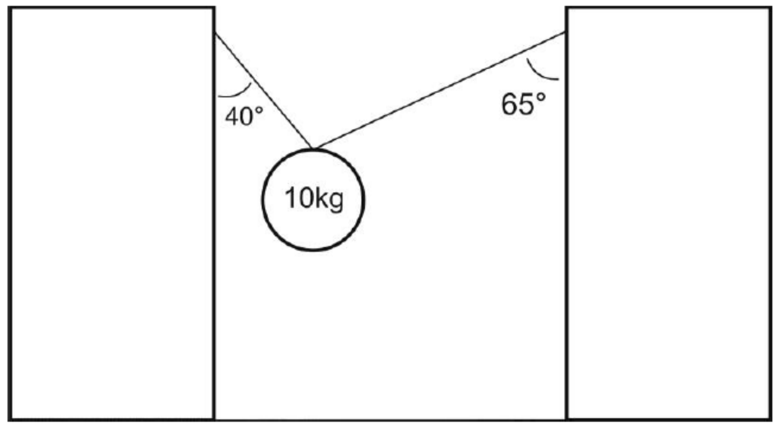
4. A sliding box is being pulled by a rope. The rope extends to the right of the mass at an upward angle, relative to horizontal. The box slides to the right.



Description	Magnitude	Units	Direction
Box Mass	20	kg	NA
Angle of rope	60	degrees	Above leftward
Coefficient of Kinetic Friction	0.2	NA	NA
Force applied by rope	100	N	60 degrees above leftward
Box Weight			
Y component of Rope Pulling Force			
X component of Rope Pulling Force			
Normal Force of surface against box			
Friction			
Net Force acting on Box			
Box Acceleration			

Practice Test #2 – Newton's Laws in 2-D

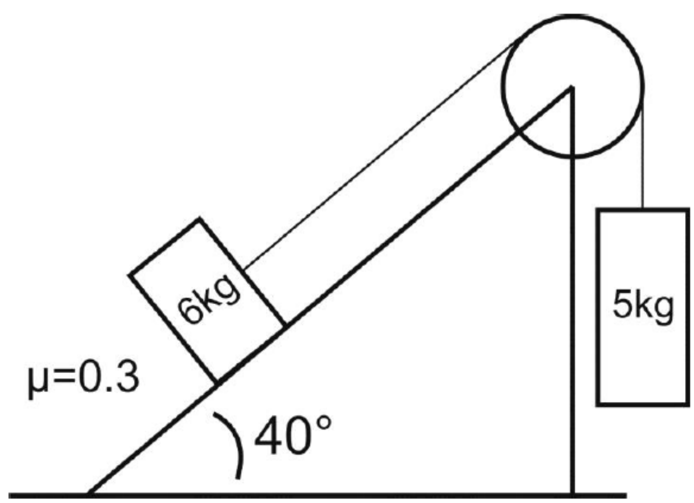
1. The 10kg mass is in static equilibrium. Find the tensions in the two segments of rope.



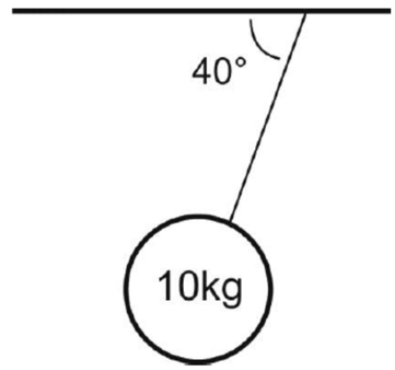
2. Find the acceleration of the masses and the tension in the string.

   a = ___________

   T = ___________



3. The mass is suspended from the ceiling of a moving vehicle. The angle shown is constant. Find the acceleration of the mass and the tension in the string.



a = __________

T = __________

4. Find the acceleration of the 8kg mass.