Physics 200
Newton's Laws + Trig.
Bodies on Inclines

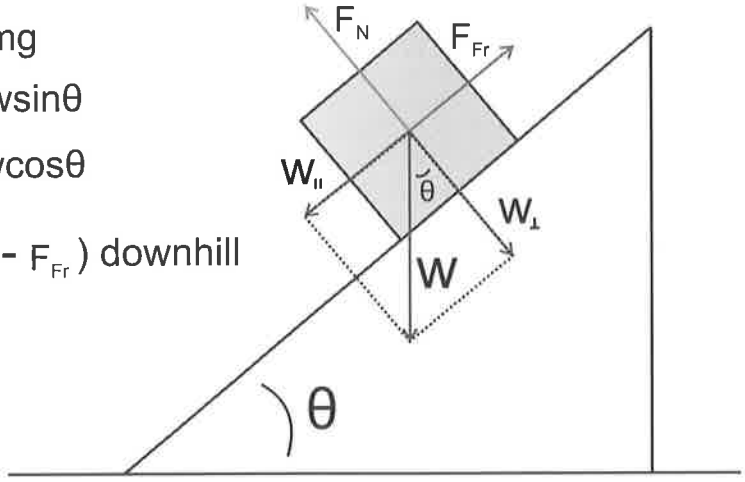
Name: _____

$w = mg$

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

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

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

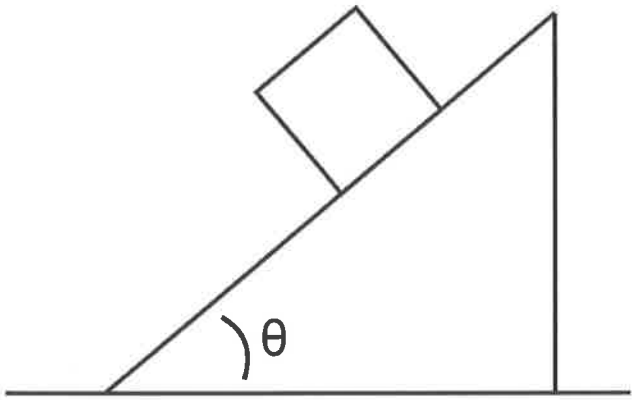


- The perpendicular component of weight determines the normal force and, therefore, friction.
- The parallel component of weight contributes to acceleration.
- Unless friction is as strong as the parallel weight component, friction and weight are the only two non-canceling forces contributing to the 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)	Downward	19.6
Perpendicular Weight Component (N)	Perpendicularly toward incline	16.97409791
Parallel Weight Component (N)	Parallel to incline, downhill	9.8
Normal force (N)	Perpendicularly away from incline	16.97409791
Force of Friction (N)	Parallel to incline, uphill	6.789639166
Net force on object (N)	Parallel to incline, downhill	3.010360834
Acceleration (m/s^2)	Parallel to incline, downhill	1.505180417

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.



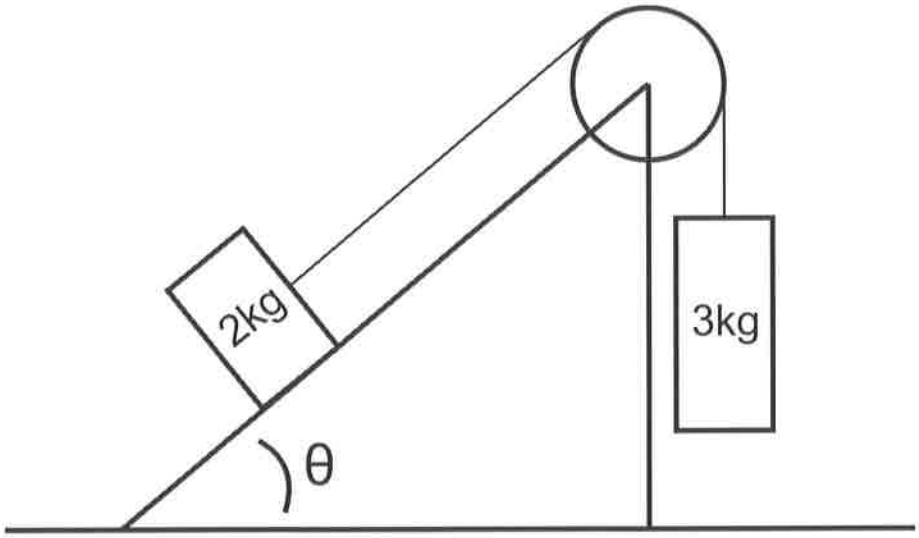
1b. Fill in the table below for the block on the ramp.

Item	Direction (When applicable)	Magnitude
coefficient of friction	NA	.6
θ (degrees)	NA	60
Mass of object (kg)	NA	2
Weight of object (N)	Downward	19.6
Perpendicular Weight Component (N)	Perpendicularly toward incline	9.8
Parallel Weight Component (N)	Parallel to incline, downhill	16.97409791
Normal force (N)	Perpendicularly away from incline	9.8
Force of Friction (N)	Parallel to incline, uphill	5.88
Net force on object (N)	Parallel to incline, downhill	11.09409791
Acceleration (m/s^2)	Parallel to incline, downhill	5.547048957

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

a = **1.53m/s^2 up the ramp**

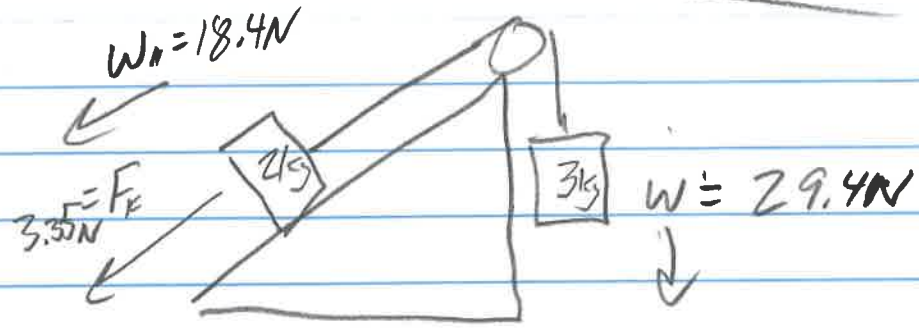
Tension = **24.8N**



Item	Direction (When applicable)	Magnitude
coefficient of friction	NA	**0.5**
θ (degrees)	NA	**70**
Mass of object (kg)	NA	**2**
Weight of object (N)	Downward	19.6
Perpendicular Weight Component (N)	Perpendicularly toward incline	6.703594809
Parallel Weight Component (N)	Parallel to incline, downhill	18.41797537
Normal force (N)	Perpendicularly away from incline	6.703594809
Force of Friction (N)	Parallel to incline, **downhill**	3.351797405

Bodies on Inclines #2 & 3 accel. & tension

2.



$$\Sigma F = 29.4N - 18.4N - 3.35N$$
$$= 7.65N \curvearrowright$$

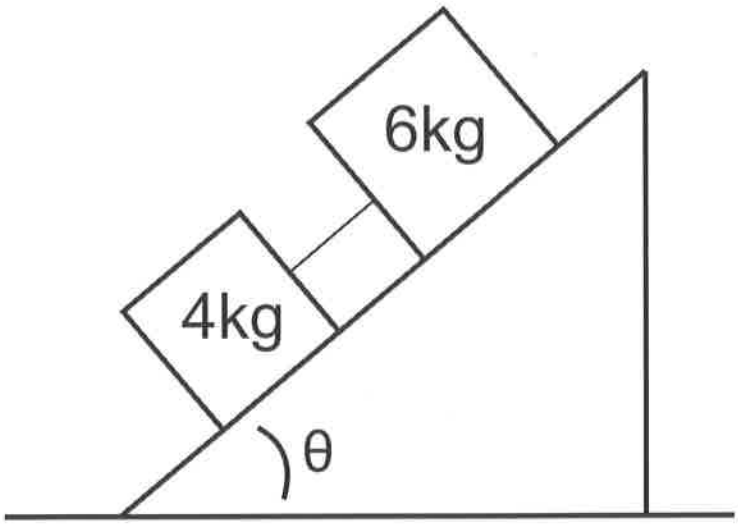
$$7.65N = (5kg)\,a \Rightarrow a = 1.53 m/s^2 \curvearrowright$$

$$\Sigma F = m\,a$$

$$T - 29.4N = 3kg\,(-1.53 m/s^2)$$

$$T = 24.8N$$

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.



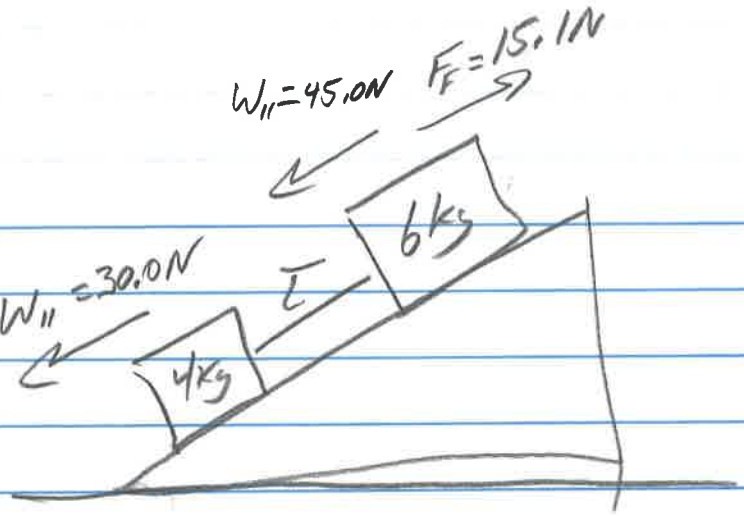
a = **6.0 m/s^2 downhill**

Tension = **6.0N**

Item	Direction (When applicable)	Magnitude
coefficient of friction	NA	**0**
θ (degrees)	NA	**50**
Mass of object (kg)	NA	**4**
Weight of object (N)	Downward	39.2
Perpendicular Weight Component (N)	Perpendicularly toward incline	25.1972743
Parallel Weight Component (N)	Parallel to incline, downhill	30.02894217
Normal force (N)	Perpendicularly away from incline	25.1972743
Force of Friction (N)	NA	0

Item	Direction (When applicable)	Magnitude
coefficient of friction	NA	**0.4**
θ (degrees)	NA	**50**
Mass of object (kg)	NA	**6**
Weight of object (N)	Downward	58.8
Perpendicular Weight Component (N)	Perpendicularly toward incline	37.79591145
Parallel Weight Component (N)	Parallel to incline, downhill	45.04341326
Normal force (N)	Perpendicularly away from incline	37.79591145
Force of Friction (N)	Parallel to incline, uphill	15.11836458

3.

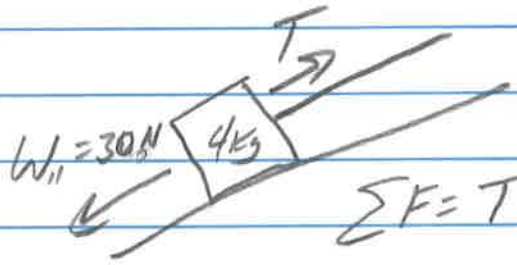


$$\Sigma F = 15.1N - 45.0N - 30.0N = -59.9N$$

$$-59.9N = ma = 10kg(a)$$

$$a = -5.99\ m/s^2$$

$a = 5.99\ m/s^2$ downhill



$$\Sigma F = T - 30N = 4kg(-5.99\ m/s^2)$$

$T = 6.04N$