

SOLUTIONS

Name: _____
 Honors Physics – More Inclined Plane Practice

1) A 12-kg block is placed on a ramp, which is inclined at an angle of 32° . The coefficients of static and kinetic friction are 0.71 and 0.50, respectively.

$$W = mg = 118 \text{ N}$$

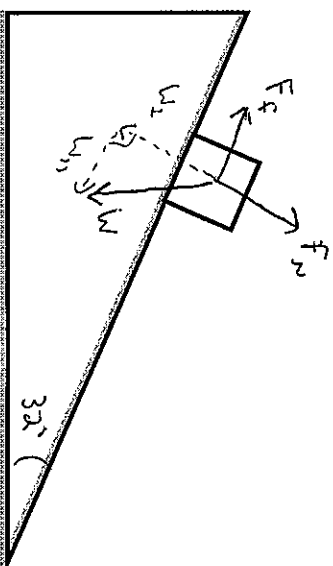
Static:

$$F_N = W_{\perp} = W \cos \theta = 99.7 \text{ N}$$

$$F_f \leq \mu_s F_N$$

$$F_f \leq 70.8 \text{ N}$$

$$W_{\parallel} = W \sin \theta = 62.3 \text{ N}$$



(a) Will the block begin to slide down the ramp? Explain.

No, static friction is able to push with a force equal to W_{\parallel} (62.3 N). Block will remain at rest unless other forces are exerted on it.

(b) Assume that the block is in motion sliding down the ramp. Determine the block's acceleration.

$$F_f \text{ (kinetic)} = \mu_k F_N = 49.9 \text{ N}$$

$$\Sigma F = 12.4 \text{ N down the ramp}$$

$$a = \frac{\Sigma F}{m} = 1.03 \text{ m/s}^2 \text{ down the ramp}$$



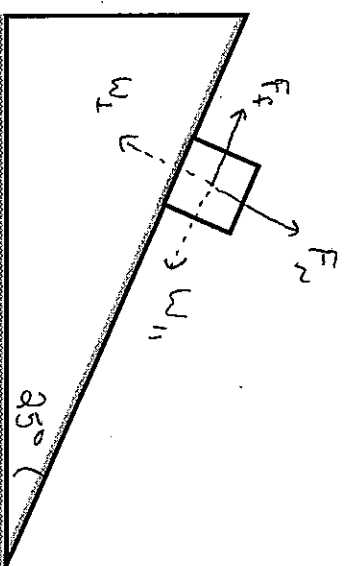
2) A 70-N block is placed on a ramp that is initially horizontal. One end of the ramp is raised until, at an incline of 25° , the block begins to slide. Determine the coefficient of static friction between the block and the ramp.

At this angle, W_{\parallel} must equal (or be slightly greater than) the maximum static friction force.

$$W = 70 \text{ N}$$

$$W_{\perp} = F_N = W \cos \theta = 63.4 \text{ N}$$

$$W_{\parallel} = F_{f \text{ max}} = W \sin \theta = 29.6 \text{ N}$$



$$\mu_s = \frac{F_{f \text{ max}}}{F_N} = 0.467$$

3) A frictionless inclined plane has a length of 1.25 m and is inclined at an angle of 40° . A 4-kg block is placed at the very top of the ramp and, released from rest, allowed to slide down the entire length of the ramp. Determine the velocity of the block when it reaches the bottom of the ramp.

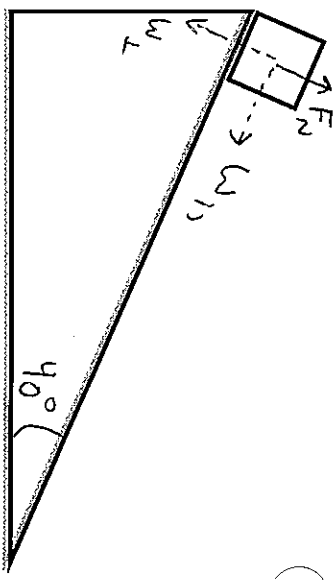
$$W = mg = 39.2 \text{ N}$$

$$F_N = W_\perp = 30.0 \text{ N}$$

$$W_{\parallel} = 25.2 \text{ N}$$

$$\Sigma F = W_{\parallel} = 25.2 \text{ N}$$

$$a = \frac{\Sigma F}{m} = 6.30 \text{ m/s}^2$$



KINEMATICS!

$$a = 6.30 \text{ m/s}^2$$

$$v_0 = 0$$

$$x = 1.25 \text{ m}$$

$$v = ?$$

$$v^2 = v_0^2 + 2ax$$

$$v = \sqrt{2ax}$$

$$= 3.97 \text{ m/s}$$

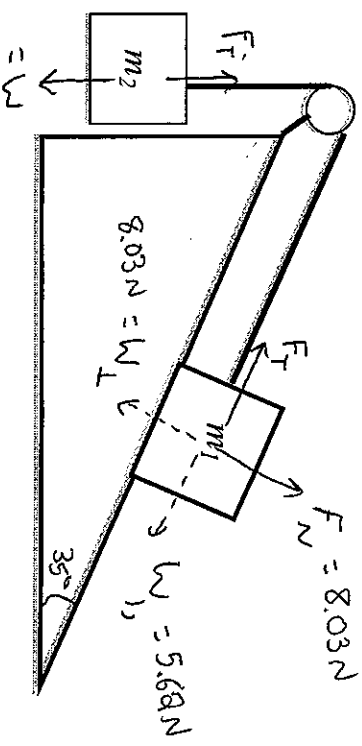
4) The ramp in the diagram is frictionless and inclined at an angle of 35° . Mass m_1 and mass m_2 are each 1 kg. Determine the acceleration of the system of the two masses. (Hint: The only outside forces in the direction of motion are the weight of mass m_2 and the parallel component of the weight of m_1 .)

$$\Sigma F = W_{m_2} - W_{\parallel m_1}$$

$$= 4.18 \text{ N}$$

$$a = \frac{\Sigma F}{m} = \frac{4.18 \text{ N}}{2 \text{ kg}} = 2.09 \text{ m/s}^2$$

TOTAL MASS EXPERIENCING THIS NET FORCE

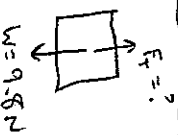


BONUS QUESTION: WHAT IS THE TENSION IN THE ROPE?

MASS M_a

$$a = 2.09 \text{ m/s}^2 \text{ DOWN}$$

$$\Sigma F = m_a = 2.09 \text{ N DOWN}$$



$$F_T = 9.8 \text{ N} - 2.09 \text{ N}$$

$$= 7.71 \text{ N}$$

-OR- MASS M_b

$$a = 2.09 \text{ m/s}^2 \text{ UP RAMP}$$

$$\Sigma F = m_a = 2.09 \text{ N UP RAMP}$$



$$F_T = 5.62 \text{ N} + 2.09 \text{ N}$$

$$= 7.71 \text{ N}$$