

SPH4U UNIVERSITY PHYSICS

DYNAMICS

☛ Motion Along An Incline (P.77-83)

Motion Along An Incline

When you watch speed skiers, it appears as though there is no limit to the rate at which they can accelerate. In reality, their acceleration is always less than that of a free-falling object, because the skier is being accelerated by only a component of the force of gravity and not by the total force.



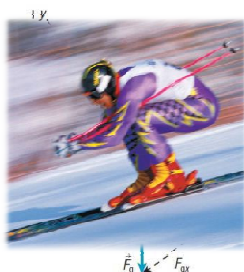
September 8, 2012

4U1 - Motion Along An Incline

1

Coordinate System for an Incline

The key to analyzing the dynamics and motion of objects on an inclined plane is choosing a coordinate system that simplifies the procedure. Since all of the motion is along the plane, it is convenient to place the x-axis of the coordinate system parallel to the plane, making the y-axis perpendicular to the plane, as shown.



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2

Coordinate System for an Incline

NOTE!
 It is much easier to resolve one force (F_g) into its component forces (F_{gx} and F_{gy}) rather than resolving several other forces.

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Coordinate System for an Incline

PRACTICE

1. Which component of the gravitational force affects each of the following?

- (a) acceleration down the incline
- (b) the force of friction
- (c) the tension in a rope pulling the object up the ramp

(a) F_{gx} ($F_g \sin\theta$)
 (b) F_{gy} ($F_g \cos\theta$)
 (c) F_{gx} ($F_g \sin\theta$)

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Coordinate System for an Incline

NOTE!
 Since several forces in addition to the gravitational force can affect the motion on an inclined plane, FBDs are essential in solving inclined-plane problems.

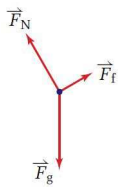
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Motion Along An Incline

PRACTICE

2. You are holding an 85 kg trunk at the top of a ramp that slopes from a van to the ground, making an angle of 35° with the ground. You lose your grip and the trunk begins to slide.

(a) Draw a FBD of the situation.



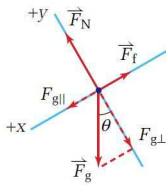
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Motion Along An Incline

PRACTICE

2. You are holding an 85 kg trunk at the top of a ramp that slopes from a van to the ground, making an angle of 35° with the ground. You lose your grip and the trunk begins to slide.

(b) Resolve F_g into its component vectors. Include values in the diagram.



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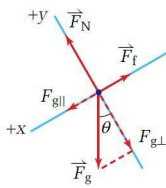
Motion Along An Incline

PRACTICE

2. You are holding an 85 kg trunk at the top of a ramp that slopes from a van to the ground, making an angle of 35° with the ground. You lose your grip and the trunk begins to slide.

(c) If the coefficient of friction between the trunk and the ramp is 0.42, what is the acceleration of the trunk?

(c) $a = 2.3 \text{ m/s}^2$



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Motion Along An Incline

PRACTICE

2. You are holding an 85 kg trunk at the top of a ramp that slopes from a van to the ground, making an angle of 35° with the ground. You lose your grip and the trunk begins to slide.

(d) If the trunk slides 1.3 m before reaching the bottom of the ramp, for what time interval did it slide?

(d) $t = 1.1 \text{ s}$

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PRACTICE

3. A boy is pulling a sled and rider with a combined mass of 82 kg up a 6.5° slope at a steady speed. The coefficient of kinetic friction between the sled and snow is 0.10.

(a) Draw a FBD of the situation.

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Motion Along An Incline

PRACTICE

3. A boy is pulling a sled and rider with a combined mass of 82 kg up a 6.5° slope at a steady speed. The coefficient of kinetic friction between the sled and snow is 0.10.

(b) Resolve F_g into its component vectors. Include values in the diagram.

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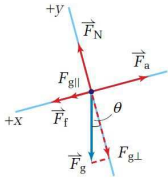
Motion Along An Incline

PRACTICE

3. A boy is pulling a sled and rider with a combined mass of 82 kg up a 6.5° slope at a steady speed. The coefficient of kinetic friction between the sled and snow is 0.10.

(c) What is the tension in the rope?

(c) $F_T = 170 \text{ N}$



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Check Your Learning

TEXTBOOK

P.82 Q.2,3 (Practice)
 P.89 Q.4 (Practice)
 P.90 Q.4 (Review)

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