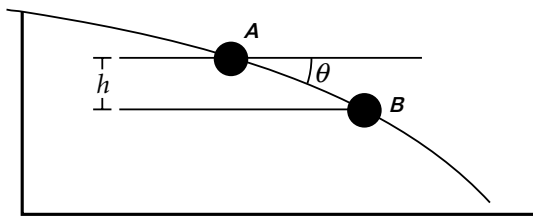


*Work and Energy*

1. A ball has a mass of 3 kg. What is the work done on this ball by the gravitational force exerted by Earth if the ball moves 2 m along each of the following directions?
  - a. downward (along the force) \_\_\_\_\_
  - b. upward (opposite the force) \_\_\_\_\_
  
2. A stone with a mass of  $m$  is thrown off a building. As the stone passes point  $A$ , it has a speed of  $v_A$  at an angle of  $\theta$  to the horizontal. The stone then travels a vertical distance  $h$  to point  $B$ , where it has a speed  $v_B$ .



- a. What is the work done on the stone by the gravitational force due to Earth while the stone moves from  $A$  to  $B$ ?
 

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- b. What is the change in the kinetic energy of the stone as it moves from  $A$  to  $B$ ?
 

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- c. What is the speed  $v_B$  of the stone in terms of  $v_A$ ,  $g$ , and  $h$ ?
 

\_\_\_\_\_
  
- d. Does the change in the stone's speed between  $A$  and  $B$  depend on the mass of the stone?
 

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\_\_\_\_\_
  
- e. Does the change in the stone's speed between  $A$  and  $B$  depend on the angle  $\theta$ ?
 

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**3.** An empty coffee mug with a mass of 0.40 kg gets knocked off a tabletop 0.75 m above the floor onto the seat of a chair 0.45 m above the floor. Assume that the gravitational potential energy,  $PE_g$ , is measured using the floor as the zero energy level.

**a.** What is the initial gravitational potential energy associated with the mug's position on the table?

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**b.** What is the final gravitational potential energy associated with the mug's position on the chair seat?

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**c.** What was the work done by the gravitational force as it fell from the table to the chair?

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**d.** Suppose that zero level for the energy was taken to be the ceiling of the room rather than the floor. Would the answers to items a to c be the same or different?

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**4.** A carton of shoes with a mass of  $m$  slides with an initial speed of  $v_i$  m/s down a ramp inclined at an angle of  $23^\circ$  to the horizontal. The carton's initial height is  $h_i$ , and its final height is  $h_f$ , and it travels a distance of  $d$  down the ramp. There is a frictional force,  $F_k$ , between the ramp and the carton.

**a.** What is the initial mechanical energy,  $ME_i$ , of the carton? (Hint: Apply the law of conservation of energy.)

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**b.** If  $\mu$  is the coefficient of friction between the ramp and the carton, what is  $F_k$ ?

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**c.** Express the final speed,  $v_f$ , of the carton in terms of  $v_i$ ,  $g$ ,  $d$ , and  $\mu$ .

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