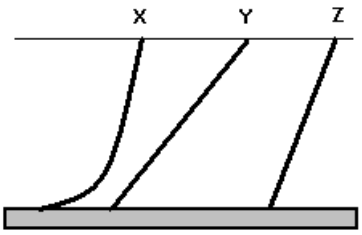
Conceptual Questions

1. A child has a choice of three frictionless slides along which to slide to the ground. His speed at the bottom of the slide is the:
   a) fastest for slide X.
   b) fastest for slide Z.
   c) the same for all three slides.
   d) the slowest for slide X.
   e) fastest for slide Y.

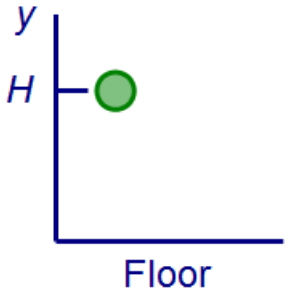


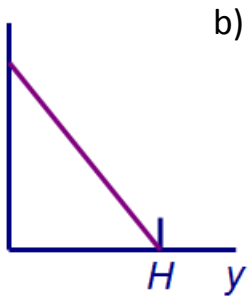
2. Equal forces were applied to three objects, P, Q, and R, initially at rest on a frictionless surface. If $m_P < m_Q < m_R$, which of the objects would have the greatest kinetic energy after traveling the same distance d?
   a) P b) Q c) R d) All will have the same kinetic energy.

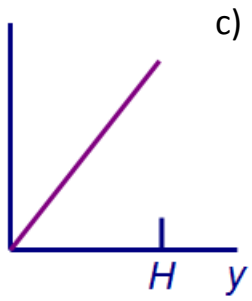
3. A puck starts at rest at the top of a straight, frictionless inclined plane, and slides to the bottom. When it is halfway down the ramp, the puck has
   a) half of the kinetic energy it had at the top.
   b) half of the potential energy it had at the top.
   c) half of the speed it had at the bottom.
   d) taken half of the total time it would spend sliding down the ramp.
   e) half the total energy it had at the top.

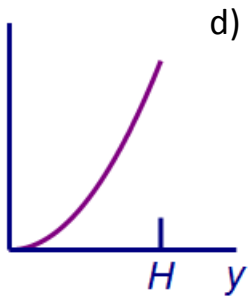
4. A skydiver opens her parachute, and falls towards the Earth at a constant speed of 3.6 m/s. As she falls at constant speed, what happens to her gravitational potential energy?
   a) The potential energy becomes kinetic energy of the skydiver.
   b) The potential energy becomes heat energy due to air resistance.
   c) Some of the potential energy becomes kinetic energy, and some becomes heat energy.
   d) All of the potential energy becomes heat energy at the moment she hits the ground.
   e) Since her speed is constant, her potential energy remains constant as she falls.

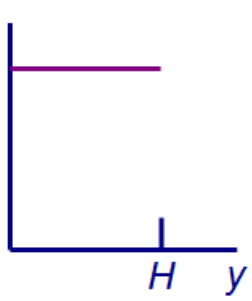
5. A ball is held at a height of *H* metres above a floor. It is then released and falls to the floor. If air resistance is negligible, which of the graphs shown relates the mechanical energy *E* as a function of the vertical height *y* of the ball?



a) 

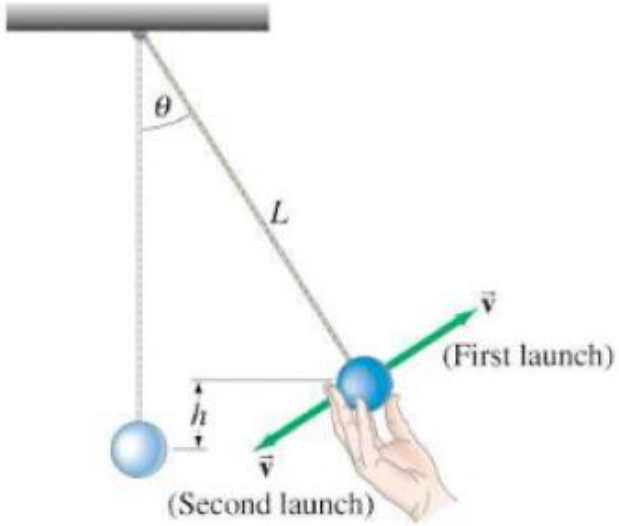
b) 

c) 

d) 

6. A child on a sled (total mass m) starts from rest at the top of a hill of height ***h*** and slides down. Does the velocity at the bottom depend on the angle of the hill if a) it is icy and there is no friction, and b) there is friction (deep snow)?

7. A pendulum is launched with an initial speed of 3.0 m/s in two ways: first directly upward along its trajectory, second downwards along its trajectory. Which launch will cause it to swing the largest angle from the equilibrium position? Explain.



Problems

8. A baseball (m=150 g) travelling at 40 m/s [→] enters a baseball glove horizontally. If the catcher moves his glove backwards a distance of 12 cm while bringing the ball to rest, calculate the work required to stop the ball.

9. A ball (m=150 g) that is thrown vertically upward has 6.0×10^2 J of initial kinetic energy.
   a) With what speed is it thrown up?
   b) How high will the ball rise? Ignore air friction.

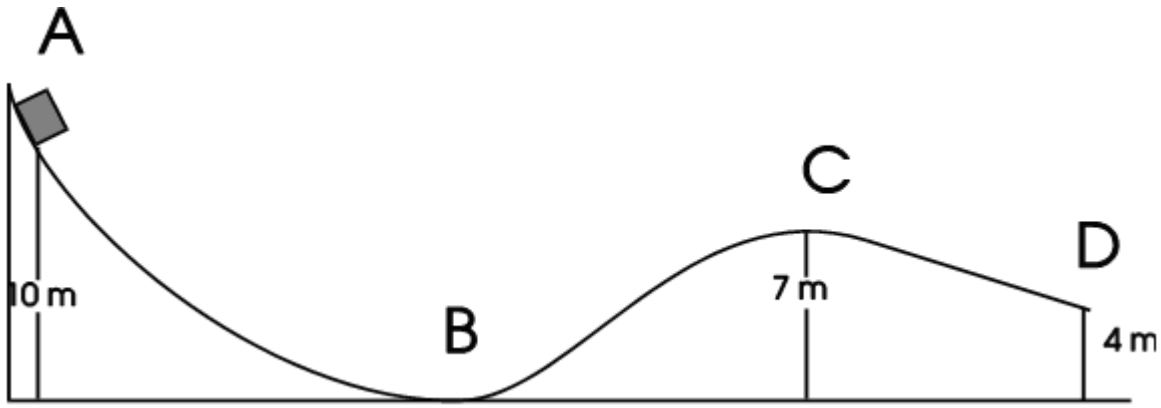
10. A car travelling at an initial speed of V_o, slams on the brakes and comes to a halt in distance D. How far would the same car take (in terms of D) coming to rest if it were travelling at $2V_o$ and the retarding forces were the same as in the first case?

11. An apple (m= 100. g) drops from a branch of a tree that is 5.0 m above the ground.
    a) If air friction can be ignored, with what velocity does the apple hit the ground?
    b) If the apple actually hits the ground with a velocity of 6.0 m/s, what is the average force of friction that acts on the ball as it falls?
    c) Determine the efficiency of the fall.

12. A child (m=50. kg) is at the top of a slide so that she is 3.0 m vertically above the bottom of the slide. If she gains a speed of 2.0 m/s by the time she reaches the bottom of the slide,
    a) calculate the amount of energy lost because of friction.
    b) determine the efficiency of the slide.

13. A block of ice (m=4.0 kg) starts from rest and slides down a frictionless hill from a height of 10.0 m. It strikes a snowman (m=7.0 kg), initially at rest, at the bottom of the hill and rebounds back up the hill to a height of H after the collision. If the snowman is moving at 10.50 m/s just after the collision, what is the value of H?

14.



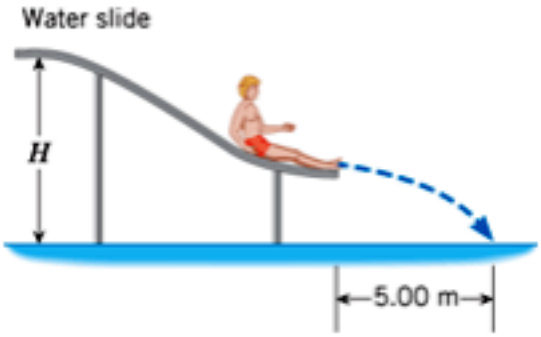
    a) In the above diagram, calculate the speed of the 10.0 kg mass at ***B***, ***C*** and ***D***, if it starts from rest at ***A***. Assume that no frictional forces exist and that all heights have two significant digits.

    b) If the speed at ***B*** is only 1/2 of the value obtained in question 14, how much energy is lost along the trip from ***A*** to ***B***? What would be the efficiency of the slide?

c) If the 10.0 kg object does not start from rest but is pushed along the ramp with an initial velocity of 5.0 m/s, what velocity would the object have at B (assume no friction)?

d) If the 10 kg starts from rest and strikes a stationary 12 kg mass at B such that after the collision the 10 kg mass is moving backward at 1.0 m/s, would the 12 kg mass arrive at ***C***? Prove it (i.e. show work).

15. A water slide is constructed so that swimmers, starting from rest at the top of the slide, leave the end of the slide traveling horizontally. As the drawing shows, one person hits the water 5.00 m from the end of the slide in a time of 0.500 s after leaving the slide. Ignoring friction and air resistance, find the height H in the drawing.



16. A 2.5 kg block is released from rest at the top of a frictionless 12.2 m high hill. At the bottom of the hill the block encounters a rough, horizontal path whose coefficient of friction is 0.34.
    a) How far along this rough path will the block be when moving at 3.8 m/s?
    b) If the block started at the top of the hill with a speed of 4.4 m/s, how far along the rough path would the block travel before coming to rest?