

ENG1004: Engineering Physics 1

# **Momentum and Impulse**

## **Additional exercises**

### Question 1

A 0.0450 kg golf ball initially at rest is given a speed of 25.0 m/s when a club strikes it. If the club and ball are in contact for 2.00 ms, what average force acts on the ball? Is the effect of the ball's weight during the time of contact significant? Why or why not?

*Adapted from Young and Freedman, "University Physics with Modern Physics", 14<sup>th</sup> Edition, Pearson, 2015.*

#### Answer

562 N

### Question 2

A 10.0 g marble slides to the left at a speed of 0.400 m/s on the frictionless, horizontal surface of an icy New York sidewalk and has a head-on, elastic collision with a larger 30.0 g marble sliding to the right at a speed of 0.200 m/s. Find the velocity of each marble (magnitude and direction) after the collision. (Since the collision is head-on, all motion is along a line.).

*Adapted from Young and Freedman, "University Physics with Modern Physics", 14<sup>th</sup> Edition, Pearson, 2015.*

#### Answers

30.0 g marble moves left at 0.100 m/s. 10.0 g marble moves right at 0.500 m/s;

### Question 3

Jack (mass 55.0 kg) is sliding due east with speed 8.00 m/s on the surface of a frozen pond. He collides with Jill (mass 48.0 kg), who is initially at rest. After the collision, Jack is traveling at 5.00 m/s in a direction 34.0° north of east. What is Jill's velocity (magnitude and direction) after the collision? Ignore friction.

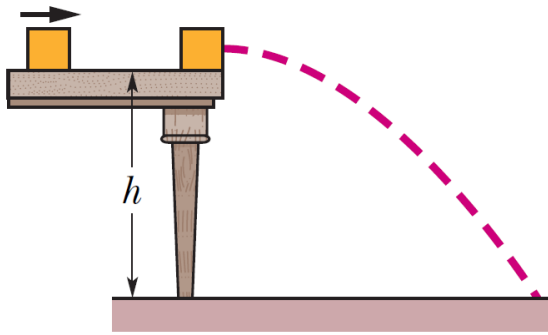
*Adapted from Young and Freedman, "University Physics with Modern Physics", 14<sup>th</sup> Edition, Pearson, 2015.*

#### Answers

Magnitude: 5.46 m/s;                      Direction: 36.0° south of east

#### Question 4

A 3.2 kg box of running shoes slides on a horizontal frictionless table and collides with a 2.0 kg box of ballet slippers initially at rest on the edge of the table, at height  $h = 0.40$  m. The speed of the 3.2 kg box is 3.0 m/s just before the collision. If the two boxes stick together because of packing tape on their sides, (a) what is their kinetic energy just before they strike the floor? (b) How far will it travel?



*Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.*

#### Answers

(a) 29 J;      (b) 0.528 m

#### Question 5

A cart with mass 340 g moving on a frictionless linear air track at an initial speed of 1.2 m/s undergoes an elastic collision with an initially stationary cart of unknown mass. After the collision, the first cart continues in its original direction at 0.66 m/s. (a) What is the mass of the second cart? (b) What is its speed after impact?

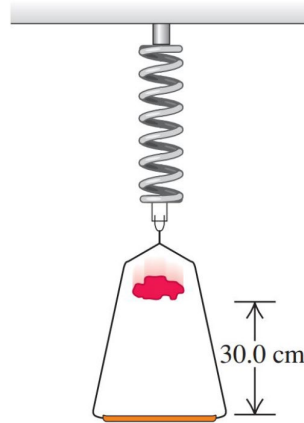
*Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.*

#### Answers

(a) 99 g;      (b) 1.9 m/s;

**Question 6 \***

A 0.150 kg frame, when suspended from a coil spring, stretches the spring 0.070 m. A 0.200 kg lump of putty is dropped from rest onto the frame from a height of 30.0 cm. Find the absolute value of the maximum distance the frame moves downward from its initial position.



*Adapted from Young and Freedman, "University Physics with Modern Physics", 14<sup>th</sup> Edition, Pearson, 2015.*

**Answer**

0.295 m