Practice Problems
For Chapter 12

The problems and solutions that follow were designed by students. Although I have checked them, there are very possibly a few errors here and there. If you notice a mistake and turn in a typed correction, you will receive two extra homework points. You may also write new homework problems to add to any chapter and receive between 2 and 5 homework points per problem (see syllabus for details.) Please note: since these problems were written by students, the teacher takes no responsibility for errors – in other words, if there is a mistake and you make the same mistake on a test, you will not get credit for that mistake.

In the problems below, I have highlighted what I feel are the best problems to study prior to tests. The other problems are all ok, but they tend to be very easy problems or repeats of homework problems with slight variations. You may want to start with a few of the regular problems as warm up and then move on to the highlighted problems.

Chapter 12 Questions

1.) What is the velocity of a 3kg object that has been hit by a more massive 80kg object traveling at 2 m/s? that ball, with that velocity is launched off of a cliff at an angle of 24 degrees. How far will it land if it lands on an even plane? If it hits the ground and is traveling at a velocity of 30 m/s as it starts rolling on the ground, and the frictional constant of the ground is .4, how long will it take for it to stop?

Amish Bhatia '07

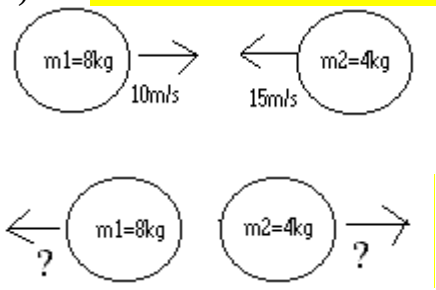
2.) If two clay balls (one is 14 kg traveling at 17 m/sec; the other is 20 kg traveling at 4 m/sec) what will be the final velocity of the new giant ball if they hit and stuck together (they are traveling towards each other)?

John Stevenson '07

3.) If one ball of clay (5 kg) is traveling at 15 m/sec and collides elastically with another clay ball (2 kg) that was traveling at 2 m/sec, what are their final velocities? (both going the same direction initially)

John Stevenson '07

4.) If two balls collide elastically as shown below, what will the final velocities be?



Emily Whitcher '07

5.) After the terribly hard Physics exam, the whole class is extremely angry and plots mutiny. Armed with sledgehammers and growling like orcs, they ominously march towards Mr. Laba. He gets really scared, jumps in his Porsche 911 (which he scandalously bought embezzling Physics department funds), and drives away, accelerating at 2.3 m/s^2. What is the impulse of the Porsche after 30 seconds? (mass of Porsche is 1500 kg)

Moritz Sudhof '07

6.) Marcy (60 kg) and Dana (50 kg) are ice skating and decide to skate at each other (Marcy at 6 m/s and Dana at 8 m/s) and grab onto each other when they meet. Predict what will happen.

Fontaine Foxworth ‘07

7.) The Interceptor, the fastest ship in the King’s Navy, gets caught by the infamous pirate ship, the Black Pearl. The two ships a now positioned as so:

William Turner and Elizabeth Swann are on the interceptor. Earlier Elizabeth ordered the crew to dump everything they could afford to lose of the ship so the Interceptor could go faster than the Black Pearl. Once the Pirate ship catches them, the Interceptor has no cannon balls so they have to improvise. They use anything they have left: forks, plates, and bottles. The cannon is on a frictionless, ice floor (from the cold), weighs 1200 kilograms, and points straight ahead. If the cannon fires the miscellaneous objects at 70 meters per second and the velocity of the cannon is -4 meters per second after it fires. What is the mass of the varied objects fired instead of a cannon ball?

Iana Gaidarski ‘07

8.) If a bouncy ball weighing 5kg moving at a velocity of 8 m/s collides elastically with another ball moving the opposite direction at 10 meters per sec and weighing 8 kg. What are the final velocities for each ball?

Iana Gaidarski ‘07

9.) Charlie is a very goofy person, and one day, he tries skateboarding. While skateboarding, Charlie—who weighs 80 kg—carries a 10 kilogram ball while rolling on his skateboard at 5 meters per second. As Charlie moves one way, he throws the 10 kilogram ball the other way with a velocity of 5 m/s.

a.) What would his speed be after he throws the ball?
b.) For our purpose, let’s say that the ball lands and travels smoothly across the ground with a velocity of -3m/s. Taking into account, the friction of the ground on the ball, how long would it take for the ball to stop rolling if the constant of kinetic friction is .23(highly improbable, but just go with it) ?
c.) How long would it take for Charlie to stop according to friction if he was on the same ground as the ball?

Amish Bhatia ‘07

10.) An angry student throws a massive hippopotamus at Mr. Laba at 25 m/s. The big scary hippo has a mass of 1,242 kg. It hits Mr. Laba, and he goes flying. The hippo keeps flying at 23 m/s after the collision. Momentum is conserved.
a. How fast is Mr. Laba moving? (His mass is 70 kg)
b. What percent kinetic energy is conserved?

Moritz Sudhof ‘07

11.) A Tyrannosaurus Rex kicks a soccer ball (mass 2 kg, was at rest). The ball goes flying off at 90 m/s.
a. What was the impulse?
b. If the soccer ball goes flying at 30˚, ignoring air resistance, will it reach the brachiosaurus who the T-rex is playing pass with? (Brachiosaurus is 250 m away, same level as the T-rex)
Moritz Sudhof ‘07

12.) God Emperor Mr. Laba picks up the moon and throws it at Mars. The moon hits Mars at 4,580 m/s. The collision is linear. After the collision, the moon is traveling at 156 m/s.
(Disregard motion of revolution of planets, etc.)
a. How fast is Mars moving after the collision?
b. Describe exactly what will happen after the collision and why.

Moritz Sudhof ‘07

13.) Mr. Laba rolls a soccer ball (2 kg), and the soccer ball travels 10 m/s on a frictionless surface. He realizes that this is too too slow for his taste, so he sends a bowling ball (6 kg) after the soccer ball. He wants the bowling ball to collide with the soccer ball, and he wants the soccer ball to be traveling at 20 m/s after the collision. Mr. Laba has strange instincts; for some reason he knows that the bowling ball will be moving at 3 m/s after the collision. How fast should he roll the bowling ball after the soccer ball?

Moritz Sudhof '07

14.) Mr. Laba and Arnold Schwarzenegger decide to have a showdown. Mr. Laba holds a 5 kg ball, and the Terminator holds a 20 kg ball. They will throw the balls at each other, and the balls will collide. After the collision- If both balls go towards Arnold, Mr. Laba wins. If both balls go towards Mr. Laba, Arnold wins. If Mr. Laba's ball goes back to Mr. Laba and Arnold's ball goes back to Arnold, it's a tie. Arnold hurls his ball at 8 m/s, and Mr. Laba hurls his at 40 m/s. The collision is elastic. Who will win?

Moritz Sudhof '07

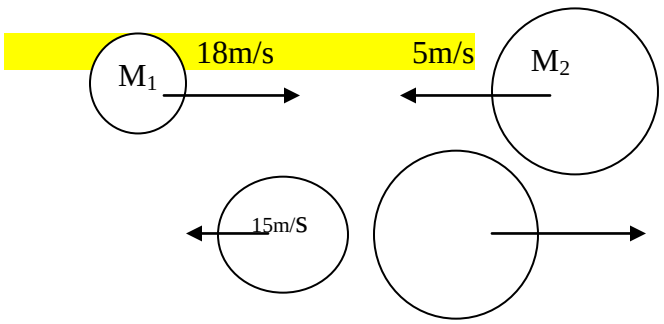
15.) In a non-elastic collision of two clay balls weighing 5kg and 8kg going -30m/s and 25m/s, what is the speed after the collision.

16.) A watermelon, weighing 750 g, is dropped from the balcony of Mr. Laba's room (5 meters hight). If it takes .35 sec to come to a stop, what was its:

a.) Change in momentum?
b.) Impulse?
c.) Force experienced?

17.) If a force of 55N was applied to a 25Kg object for 35sec, what is the maximum impulse imparted? What is the highest velocity it could reach if it began at rest?

18.) Determine the velocity of M_2 after the collision, given that M_1=4Kg and M_2=15kg.



19.) If a force of 1500N was applied to a 50kg object for 5sec, what is the maximum impulse imparted? What is the highest velocity it could reach if it began at rest?

20.) A 35 kg ball is moving to the right at 13 m/s when it elastically collides with a 45 gram ball that was moving at 46 m/s to the left. What are the velocities of each ball after the collision?

Bethany Berg (class of 2011)

21.) A little boy shoots a marshmallow gun at a wax figure (35 kg) at Ripley's Believe it or Not Museum. The marshmallow's velocity is a constant 8.5 m/s and the marshmallow weighs 2.3 grams. The marshmallow then sticks to the wax figure and it makes it move (the wax figure is on a frictionless floor). What is the final velocity of the wax figure with the marshmallow inside?

Bethany Berg (class of 2011)

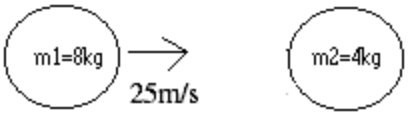
Chapter 12 Solutions

1.) mv = mv
80 (2) = 3(v)
v = 53.3
X = v^2 sin 2theta / 9.8
215.43 meters
mu(normal) = Ff
.4 (3(9.8)) = Ff
11.76 = Ff
Ff = Ma
A = -3.92
Vf = vi + at
0 = 30 + -3.92t
7.65 seconds = time

2.) *Work:*
DeltaP=o
Mv-mv=mv
*(14*17)-(20*4)=34v*
Answer: v= 4.65 m/sec

3.) *Work:*
13 m/sec and 0 m/sec
v1=(5-2)/(5+2)v
*v2=(5*2)/(5+2)v*
v1=5.44+2
v2=18.52+2
Answers: v1=7.44 m/sec and v2=20.52 m/sec

4.) Switch reference frames (add 15m/s right) to get:



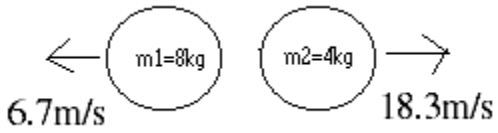
Use the equations:
$v_{1f}/v_{1i} = (m_1-m_2)/(m_1+m_2)$
$v_{2f}/v_{1i} = 2m_1/(m_1+m_2)$

v1=(8-4)/(8+4)(25)
v2=(16)/ (8+4) (25)

v1= 8.333

v2= 33.333

Switch back reference frames (add 15m/s left)
V1=-6.7m/s
V2=18.3m/s



5.) $V_f = V_i + at$
$V_f = 30(2.3)$
$V_f = 69$ m/s

$\Delta P = \Delta mv = 1500(69)$
$\Delta P = 103500$ kgm/s

6.) $m_1v_1+m_2v_2=(m_1+m_2)v_3$
$(60kg)(6m/s) + (50kg)(-8m/s)=(60+50)\ v_3$
$360 + -400 = 110\ v_3$
$-40=110v$
$-.36=v$
So, they will go **-.36m/s in the direction Dana was headed**

7.) Since the system is closed and isolated

$\Delta P= 0$

$Pi=Pf$

$0=(1200)(-4) + (m)(70)$

$4800=70m$

$68.6kg=m$

8.) Switch Frame of Reference:

(5kg)------8+10 m/s--→ (8kg)

V1=(m1-m2) (v) = -3/13 (18)= -4.15 m/s

m1+m2

V2= (2m1)/ (m1+m2)(v)= 10/13 (18)= 13.85m/s

Now switch back

←4.15 m/s-----(5kg) (8kg)---(13.85m/s)→

Add 10 m/s going left so answer:

←14.15m/s-----(5kg) (8kg)------3.85m/s→

V1=-14.15 m/s V2=3.85m/s

9.) a. (P=0
Pb=Pa
Mv(before) = mv(of Charlie) – mv(ball)
(80+10)(5)= (80)(v) – (10)(5)
450+50 = 80(v)
500/80= v = 50/8 = 6.25m/s
b. (F=ma
(mu)(N) = ma
.23 * (10*9.8) = 10a
2.254=a
now use this in motion equations
Vf = Vi + at
0= -3 + (2.254)(t)
3/2.254=t
t = 1.33 sec
c. (F = ma
(mu)(N) = ma
.23 * (80*9.8) = 80 a
180.32/80 = a
a = 2.254
Vf=Vi+at
0 = 6.25 – 2.254 t
-6.25/-2.254= t
t = 2.77 seconds

10.) a.
$\Delta p = 0$
$p_B = p_A$
$(25)(1242) = (23)(1242) + (70)(v)$
$2484 = 70v$
$v = 35.5$ m/s

b.
$T_B = (1/2)(1242)(25^2)$
$T_B = 388125$ J
$T_A = (1/2)(1242)(23^2) + (1/2)(70)(35.5^2)$
$T_A = 372582.26$ J
$(T_B)/ (T_A) = (100)/(x)$
$388125/372582.26 = 100/x$
$x = 96\%$

11.) a.
impulse $= F\Delta t = \Delta mv$
$(2)(90) = 180$ kg(m)/sec

b. $\Delta x = -(V^2 \sin 2\theta)/g$
$\Delta x = -(90^2 \sin(60))/9.8$
$\Delta x = 251.9$ m
Yes, the soccer ball will reach the brachiosaurus.

12.) a.
Mass of the moon $= 7.36 \times 10^{22}$ kg
Mass of Mars $= 6.4191 \times 10^{23}$ kg

$\Delta p = 0$
$p_B = p_A$
$(4{,}580)(7.36 \times 10^{22}) = (156)(7.36 \times 10^{22}) + (v)(6.4191 \times 10^{23})$
$3.371 \times 10^{26} = 1.15 \times 10^{25} + (v)(6.4191 \times 10^{23})$
$3.256 \times 10^{26} = (v)(6.4191 \times 10^{23})$
$v = 507.2$ m/s
b.
Mars and the moon will keep traveling in the same direction at a constant speed of 507.2 m/s and 156 m/s respectively. This happens because of Newton's First Law—Inertia. Unless acted upon by an outside force (i.e. colliding with another object, etc.), they will keep moving like this forever.

13.) $\Delta p = 0$

$p_B = p_A$

$(2)(10) + (6)(v) = (2)(20) + (6)(3)$

$6v = 38$

$v = 6.33$ m/s

14.)

$\Delta p = 0$

$p_B = p_A$

$(5)(40) + (20)(-8) = (5)(v_1) + (20)(v_2)$

$40 = 5v_1 + 20v_2$

$v_1 = -4v_2 + 8$

$\Delta T = 0$

$T_B = T_A$

$(1/2)(5)(40^2) + (1/2)(20)(8^2) = (1/2)(5)v_1^2 + (1/2)(20)v_2^2$

$4640 = 2.5v_1^2 + 10v_2^2$

substitute

$4640 = 2.5(-4v_2 + 8)^2 + 10v_2^2$

$4640 = 2.5(16v_2^2 - 64v_2 + 64) + 10v_2^2$

$0 = 50v_2^2 - 160v_2 - 4480$

$v_2 = (160 (+/-) 960)/100$

$v_2 = 11.2$ or ~~$v_2 = -8$~~

$v_1 = -4(11.2) + 8$

$v_1 = -36.8$ m/s

They tie. Both balls return to their thrower. The Laba-Schwarzenegger rivalry is still in the air.

15.) Delta P=0

5kg*-30m/s + 8kg*25m/s = 50m/s

50/13= 3.846 m/s

16.) a.) $V_f^2 = V_i^2 + 2a\Delta$

$V_f^2 = 2(9.8m/s^2)(5m)$

$V_f = 9.899m/s$

$\Delta P = \Delta mv$

$\Delta p = m(v_f - v_i)$
$\Delta p=(.75kg)(9.899m/s)$
$\Delta p=7.42kg*m/s$

b.) Impulse $=\Delta mv$
impulse$=7.42kg*m/s$

c.) $F=\Delta p/\Delta t=21.2N$

17.) $F\Delta t=\Delta p$
$(55N)(35sec)= \Delta mv$
$Impulse=1925N*s$
$\Delta mv=1925N*s$
$V=77m/s$

18.) $\Delta p=0$
$M_1(18m/s)-m_2(5m/s)=m_1(-15m/s)+m_2v_2$
$-3=-60+(15kg)v_2$
$V_2=3.8m/s$

19.) $F\Delta t=\Delta p$
$(1500N)(5sec)= \Delta mv$
$Impulse=7500N*s$
$\Delta mv=7500N*s$
$V=150m/s$

20.)

Change reference frame so add 46 m/s so v=59 m/s to right

$V_1=[(m_1 - m_2)/(m_1 + m_2)]v$
$V_1= [(35-.45)/(35+.45)]59$
$V_1= 57.5$ m/s – 46 = 11.5 m/s to the right

$V_2=[(2m_1)/(m_1+m_2)]v$
$V_2=[(70)/(35.45)]59$

$V_2 = 116.502 \text{ m/s} - 46 \text{ m/s} = 70.5 \text{ m/s}$

21.

$\Delta P = 0$
$.0023(8.5) = (35 + .0023)(v)$
$v = 5.59 \times 10^{-4} \text{ m/s}$