Practice Problems
For Chapter 14

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.

Practice Problems for Chapter 14

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1. Joe is trying to push a box across a flat surface. The box has a mass of 50 kg and its coefficient of friction is .45. Once he begins pushing, Lacy (70 kg) decides to run over and sit on top of the box to make it harder to push. How much harder (in N) does Joe have to push?

Fontaine Foxworth ‘07

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2. A giant leaves his Rubik’s cube (15 kg) on a pool slide at the local YMCA. The cube slides down the slide that has a 50 angle to the ground. How long does the giant have to save his Rubik’s cube from getting wet if the slide has a Uk of .3 and a distance of 5 m? Can the giant make it will a slow reaction time of 3 sec?

Iana Gaidarski ‘07

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3. Natalie and Sarah, the famous Barbie actresses from Iana’s Aurora project are cruising down Plastic Avenue when smoke covers the windshield. First they believe that they are experiencing another natural phenomenon, but it just turns out that the car is breaking down. Luckily Natalie the brunette finished college while perusing her acting career so determined that their 6 kg pink corvette only needed a force of 100 N to get the car going. What is the coefficient of static friction? If the coefficient of friction is only 50% of the above answer and the barbies continue to push the car with the original force, how fast will the car be going after 15 seconds?

Iana Gaidarski ‘07

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4. a)What is the force of friction on a sitting Toyota Camry (3450 lbs) if one was trying to push it? (on level ground, friction coefficient is .05 because of the road surface)

   b) Now take the same situation in question #17 but put the Camry on an incline with a degree measure of 25 deg, and compare the friction coefficient of the Toyota Camry on the slope versus the friction coefficient of a Hummer H1 (weight 7847 lbs). Which coefficient is larger if they are on the same incline? Explain your findings.

   c) If one was to push the same car (the Camry) on the same ground and values that were in #17, would the car move if one applied 50N of force upon it?

   d) If the car was on an incline of 32 deg with a friction coefficient of .62, how hard would one have to push to get it to move up hill?

   John Stevenson ‘07

5.) Mario is racing in the Bowser Cup with his mario cart in first place and is going down the track with an initial velocity of 80m/s. He is speeding toward a speed booster portion of the track that eliminates the Force of Friction and also adds 20m/s to his velocity when he passes over it. Mario is 191.32m from the speed booster and his engine fails so that he

can no longer make it accelerate or even stay the same speed. Mario is only able to coast and hope he can make it to the finish line using the velocity he was at. If the force of friction in the ground is .40, he and his cart have a mass of 110kg, and the the finish line is 1000m from the speed booster, will he make it to the finish line? Also if he is 15 seconds ahead of the second place racer (Donkey Kong) would he Mario make it to the finish line still in first place?
Connor Nickell ‘08

6.) Mr. Laba is trying to push a 500 N block across the floor during class with a force of 100 N. The starting friction is 0.50. Will Mr. Laba be able to push the block across the floor? What if he pushes with a force of 300 N?

Carolyn Bird (Class of 2007)

7.) A 900 N block is resting on an incline plane. The plane is at an angle of 68 degrees. What is the coefficient of static friction?
Carolyn Bird (Class of 2007)

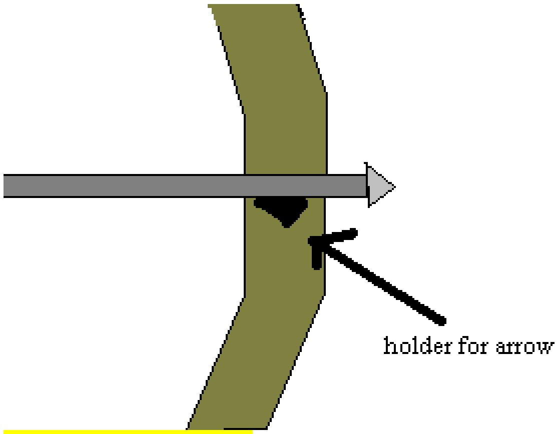
8.) One day on the way to school, Mr. Laba runs out of gas, but he decides that because he is not far from school that he will push his car the rest of the way because he wants the exercise. The car weighs 2200 N. If Mr. Laba pushes the car with a force of 500 N, will he be able to move the car? The starting friction is 0.60.

Carolyn Bird (Class of 2007)

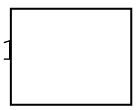
9.) A massive 10,000 N block is sitting on a table in the commons. One of the students tries to push it off the table with a force of 600 N. Will that student be able to move the block? The coefficient of static friction is 0.60.

Carolyn Bird (Class of 2007)

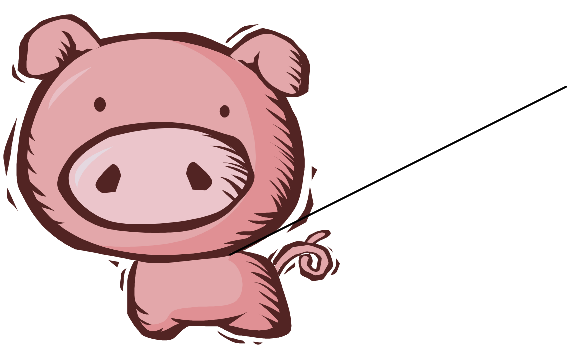
10.) Robin Hood is going to fire his magical wonder bow to see how far that an arrow travels when he pulls fires it at full speed. When the bow is pulled back the bow string places a force of 200N on the arrow (which has a mass of 3kg). The arrow tip rests on a holder on the bow shaft. The holder creates friction on the arrow as the bowstring is released. The μ is .4 for the arrow on the holder. After the arrow (which is 5m long) is released from the bow, the acceleration stops on the arrow, and the time it stays in the air is 15sec. Considering the friction that the holder places on the arrow, how far will the arrow go in horizontal distance? (Robin Hood doesn’t stand up and shoots from the ground at an angle of 45°)



Connor Nickell ‘08



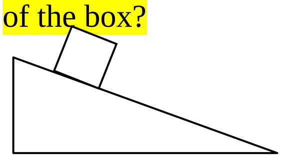
11.) This box weighs 7 kg. If you push it with a force of 66 Newtons, and it still refuses to move, what is the friction constant?



12.) You yank a 44 kg pig with a force of 270 N upward in the 23º direction. If the pig doesn’t move, what is the coefficient of standing friction?

Franci Rooney ‘08

13.) If a box slides down the 20º incline (3m) in 2.7 seconds, what is the kinetic friction of the box?



Franci Rooney '08

14.) If this box weighs 5 kg, and, when pushed with a force of 98 N, refuses to move, what is the friction constant?
Franci Rooney '08

15.) If you use 45 Newtons to push a frictionless cup of coffee to the end of the counter and it accelerates at a rate of 4 m/s^2, what is the mass of the cup? If you accidentally didn't push it completely to the left, but sort of pressed down on it at a 14° angle, what would its acceleration be then? What if there was friction, and the constant was .3, what would the accleration be?

Here continues the story of the space ship Nickellogan.

16. After plundering the Sisson blockade runner we discovered that Julia Mirliss herself was on board (as it turns out, she and Sir Thomas Sisson are lovers). This is good news! We can hold her for ransom! But first we must make a horrific video of her nearly being sucked out of the airlock into space. The most effective method is to strap her into a friction suit, give her a space suit and open the air lock. The friction suit will barely hold her in place, causing her to slide sickeningly slow towards the door. If the depressurization pulls her with a horizontal (at zero degrees) force of 1000 Newtons for three seconds and the friction suit causes a coefficient of friction of .75 (assume the gravity is the one you found earlier—15m/sec^2) and she weighs 50 kg, how far will the depressurization pull her?

Here ends the story for now.

Logan Nickell (class of 2010)

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17. A little girl's wagon (200 N) broke so now she pulls it across the ground without wheels so the coefficient of friction is .54. When she drags it, the handle makes a 42 degree angle with the horizontal. What force must the girl pull with so that the box moves at a constant speed.

Bethany Berg (class of 2011)

Chapter 14 Solutions

1.) Mg = N = (50)(9.8) = 490 N
Ff = μN = (.45)(490) = 220.5 N at first
Mg = N = (120)(9.8) = 1176 N
Ff = μN = (.45)(1176) = 529.2 N when Lacy jumps on
529.2-220.5 = **308.7 N**

2.) Find N:
ΣFy = 0
N=mgcos50
N=62.99 =63 newtons

Find acceleration:
ΣFx=ma
Mgsin50-Ff=10a
75-(.3)(63)=10a
56.2=10a
5.6=a

Find time:
Δx=vit+ (1/2) at ^2
5= (.5)(5.6)t^2
1.78=t^2
1.3 =t

No the giant will not make it in time… the colorful puzzle will get wet.

3.) Find N
N=mg
N=58.8

Find U
Σfx= 0
P-Ff=0
100-u(58.8)=0
100=u(58.8)
1.7u

50%
.5*1.7=.85
Efx=ma
100-(.87)(58.8)=6a
a= 8.2

vf=vi+at
vf=8.2(15)
123.85=vf

4.)

Work:
Ff=μN
Ff=.05(1564.89*9.8)*
Answer: Ff=766.7961N

Work:
tan Θ=μ
Answer: tan25=.466; the coefficients are the same because the coefficient is determined by the angle measure of the incline, not the weight of the object

Work:
ΣF=?
P-Ff=?
*50-(1564.86*9.8)= ?*
?=-15285.628
Answer: No

Work:
Mgcos21=N
Ff=μN
ΣFx>0
Ff+mgsin32>0
(.62(1564.86*9.8*cos32))+1564.86*9.8=?*
Answer: 23398.94508 N

5.) μ= .40

V_i = 80m/s

Δx (initial position to speed boost) = 191.32m

Δx (end of speed boost to finish line) = 1000m

Mass of car and Mario = 110kg

T = 100sec

A.) 9.8(110) = N = 1078

∑F = ma

$-F_f = ma$

$-N(\mu) = ma$

$1078(.40) = (110)a$

$-3.92 m/s^2 = a$

$V_f^2 = V_i^2 + 2a\Delta x$

$V_f^2 = (80)^2 + 2(-3.92)(191.32)$

$V_f^2 = 4900$

$V_f = 70 m/s$ (at the speed booster)
70 + 20 = 90m/s = V after booster

$V_f^2 = V_i^2 + 2a\Delta x$

$(0)^2 = (90)^2 + 2(-3.92)\Delta x$

$-8100 = -7.84\Delta x$

$\Delta x = 1033m$

Therefore Mario will cross the finish line before stopping

B.) $\Delta x = Vi(t) + \frac{1}{2}at^2$

$\Delta x = (90)(15) + \frac{1}{2}(-3.92)(15)^2$

$\Delta x = 909m$
Therefore Mario would not make first place. However, in reality he would because Luigi would be riding on the back platform of his cart and would either fix the engine or push the cart fast enough so that he would win in time.

6.) F=?
Fsubx=?
Push – Friction =?
P – (uN)
100 - .5(500) =?
100 – 250 =?
Mr. Laba will not be able to push the box with a force of 100 N.

Fsuby=0
N – mg = 0
N = 500

300-250 =?
Mr. Laba will be able to push the box with a force of 300 N.

7.) F=0

Fsubx=0
Wsubx – Friction = 0
900sin(68) – (uN)=0
834.47 – (uN) = 0
834.47 = u(337.146)
u = 2.475

Fsuby=0
N – Wsuby=0
N = 900cos(68)
N = 337.146

8.) F=?

Fsubx=?
Push – Friction =?
P – (uN) =?
500 - .6(2200) =?
500 – 1320 = ?

Fsuby=0
N – mg = 0
N = 2200

Mr. Laba will not be able to push the car to school; he should have planned better and gotten gas earlier. :)

9.) F=?

Fsubx=?
Push – Friction=?
P - (uN)=?
600 – (.6)(10,000)=?
600 – 6000 =?

Fsuby=0
N – mg=0
N = 10,000

No, the student cannot move the block. That student needs to do some heavy lifting if he wishes to move the block off the table.

10.) μ = .4
mass of arrow = 3kg
bow F on arrow (Fb)= 200N
angle of bow witht ground = 45°
length of arrow = 5m
θ with ground = 45°
time in air = 15sec
Δx of the arrow = ?

Normal Force (N)= 3(9.8) = 29.4N
Ff = Nμ = 29.4(.4)
Ff = 11.76N

Σf = ma
Fb – Ff = ma

$200 - 11.76 = (3)a$
$188.24 = 3a$
$62.75 m/s^2 = a$

$Vf^2 = Vi^2 + 2a\Delta x$
$Vf^2 = 2(62.75)(5)$
$Vf = 25 m/s$

$Vx = V\cos\theta$
$Vx = (25)\cos(45)$
$Vx = 13.1 m/s$

$\Delta x = Vx(t)$
$\Delta x = (13.1)(15)$
$\Delta x = 196.5m$

11.) **$F = \mu N$**
$66 = 7*9.8\mu$
$\mu = .962$

12.) **Efy = N – G + 270sin23**
N – 44(9.8) + 105.497
N = 325.70
Efx = 270cos23 – F = 0
F = 248.536 = uN
248.36 = u (325.70)
u = .763

13.) **Ma = Efx**
$\Delta x = \frac{1}{2} at^2$
$3 = 1/2a2.7^2$
a = .823
Gravity angle = 20
Efx = uN – 9.8mcos(70) = ma
Efy = 0 = N – 9.8msin(70)
uN – 9.8mcos70 = ma
9.8msin70 = N
u(9.8~~m~~sin70) – 9.8~~m~~cos70 = ~~m~~a
9.21 u – 3.351 = .823
u = 4.174/9.21 = .45

14.) **98 = 49(u)**
u = 98/49
u =2

15.) **45 = 4(m)**
m = 11.25
second part:
Efx = ma = 45cos(-14)
A = 3.88
Third part:
Efy = N – (11.25)(9.8) – 45sin-14
N = 121.136
F = uN, F = 36.3
Ma = 45-36.3
A = .7697

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16. Ff=mau

Ff=50(15)(.75)

Ff=562.5 N

Force-Ff=ma

1000-562.5=(50)a

a=8.75m/sec^2

$\Delta x = Vit + \left(\frac{1}{2}\right) at^2$

$\Delta x = .5 * 8.75(3^2)$

Δx=39.375 meters

17.

$\sum Fy = 0$
N+Psin42 = 600
N = 600 – Psin45

$\sum Fx = 0$
Pcos 42 – F_f = 0
Pcos42 – (.54)(600-Psin42) = 0
Pcos42 – 324 + .54Psin42 = 0

$P\cos 42 + .54\,P\sin 42 = 342$
$P(.743 + .361) = 342$
$P = 309.7$ Newtons