Practice Problems
For Chapter 08

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 8 Questions

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1. One Day, Mr. Laba punched Micheal. Micheal cried out for help before he was hit with a massive amount of force. Luckily for him, physics man came to Micheal's aid. Physics man had the bragging rights of being the strongest physics-ite in the world. But Mr. Laba had a secret weapon—Apollo 13. Mr. Laba then deployed Tom Hanks from Apollo 13 while Physics man was 250 meters away. If Mr. Laba and Physics man were at the same level, and Mr. Laba launched Tom Hanks at a velocity of 50 m/s, what angle would Mr. Laba have to launch tom hanks at in order to hit Physics man dead on?

Amish Bhatia '07

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2. One day, Mr. Laba launched Tom Hanks at Physics man. Unluckily for Mr. Laba, Physics man evaded the missile. Mr. Laba launched another Tom Hanks missile and was unsure of whether it hit Physics man or not. He launched the second missile at a velocity of 50 m/s at an angle of 23 degrees while Physics man was 195 meters away. If the Tom Hanks missile has an effective radius of 20 meters, does Mr. Laba hit Physics Man?

Amish Bhatia '07

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3. A man stands on a cliff 150m cliff. Mr. Laba stands on the ground, 200 m from the base of the cliff. The man waves his arm, trying to get Mr. Laba's attention. The man is stuck up on the cliff, and he needs help getting down. Mr. Laba sees the man waving his arms, and decides he wants to do a kind deed for the man. Mr. Laba wants to give the man a companion because he looks lonely, so he gets out his cannon and fires a teddy bear up to the man. The teddy bear is a big teddy bear; he has a mass of 15 kg. He is fired up at an angle of 70°. How fast must Mr. Laba fire the teddy bear if he wants it to reach the poor, lonely man?

Moritz Sudhof '07

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4. One day in Laba Land a man named Mario thought it'd be "cool" to drop slot machines directly from the bottom of his Jet plane. The plane is traveling at a speed of 220 m/s and is 120 meters from the ground when it released the first slot machine. A.) What is the total horizontal distance traveled (by the slot machine) from the time of the release to the time it hits the ground? B.) How many slot machines would he have to drop in order to have a full mile of slot machines in a straight line? (Given his velocity and height stay the same)

Karl Thumm '07

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5. Alex enjoys playing golf in his free time and decided to construct a driving range that overlooked the Atlantic Ocean (how romantic…) The platform for the driving range is 50m high and he strikes the ball and sends it 25 m/s with a 5 Iron to (ensure an angle of 0 degrees off of the platform). How long will it take the ball to land in the ocean?
Karl Thumm '07

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6. **Daniel was playing a rousing game of tennis with Mr. Laba one day after school when Mr. Laba presented a projectile motion problem to him. Since the Great Laba has exceptional physics skills as well as tennis skills- Daniel agrees to work the problem. Mr. Laba asked the student if he strikes a tennis ball at an initial speed of 27 m/s at an angle of 38 degrees and the ball takes 2.2 seconds to land. How far would the tennis ball go?**
Karl Thumm '07

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7. Bozo the clown is shot out of a cannon at a circus performance. If he is launched at 60 m/sec at 45 deg from the horizontal, how far in the x-direction will he travel if he lands on the same level as the cannon?

John Stevenson '07

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8. Chief Tecumseh stands 43 meters away from an unsuspecting peacock. In order to be saved by the Great Laba he must shoot the peacock with a time under 1 second. If Tecumseh shoots the peacock with a velocity of 50 m/s at an angle of 29.7 degrees, will the Great Laba save Chief Tecumseh? How long will it take for the arrow to strike the peacock?

Karl Thumm '07

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9. A man named Sally decided to jump from sky scraper to sky scraper one day… (note: he had just seen the movie Spider Man). Building A is 210m high and Building B is 154m high. The buildings are 6 meters apart and he has a speed of 3.1 m/s (horizontally), will he make the jump?

Karl Thumm '07

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10. Mr. Laba decides to hold a competition. A target is placed on a cliff, 30 m up and 140 m away, and contestants have to fire a cannon and hit the target. The cannon fires at a 70 degree angle. The contestants can only affect the firing speed. The prize is a duck that has been specially trained to recite physics equations, so you obviously really want to win. At what speed should you fire the

cannon ball (ignoring air resistance)?

Moritz Sudhof '07

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11. One cannon A is fired at 100 m/s at 30 degrees. Another cannon B is fired at 75 m/s at 45 degrees. Which will spend more time in the air?

Moritz Sudhof '07

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12 In Labaland, the annual Laba Celebration, which honors the Creator-God of this world, includes a shooting competition. A duck runs straight ahead of you, waddling with an acceleration of 3.2 m/s^2. To win the competition, you need to hit the duck, using a cannon. The cannon is set at 60 degrees and fires at 70 m/s. The flags go down, the duck starts waddling. How long should you wait before you fire?

Moritz Sudhof '07

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13. In Labaland, the God Emperor, Mr. Laba, wakes up every morning and goes for his morning workout. He starts running, accelerating at 9 m/s^2 consistently for 3 minutes. He then does his two cross-ocean jumps, in which he launches himself into the air at an angle of 30 degrees and a velocity of 70 m/s.
A. How much distance (Δx) does Mr. Laba cover in his everyday workout?
B. What is the average ground velocity of his workout period?

Moritz Sudhof '07

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14. Mr. Laba, the human cannonball, is shot out of a cannon on flat ground at an angle of 35 degrees and a speed of 50 m/s. If a lake begins 100 meters away from the cannon and ends 200 meters away from the cannon, will Mr. Laba land safely in the lake or land painfully on the shore?

Colt Power (class of 2008)

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15. A lemming runs horizontally off a cliff with a velocity of 4 m/s. Another lemming, running behind the first, jumps off the cliff at an angle of 25 degrees but a velocity of 2 m/s. If the cliff is 100 meters high, which lemming splats the farthest away from the cliff?

Colt Power (class of 2008)

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16. Carlos Hathcock, a marine sniper, set the record for longest sniper shot at 2,250 meters with a .50 Caliber. (This record has since been broken by a Canadian sniper team which confirmed a snipe at 2,310 meters) If a .50 caliber rifle shoots with a muzzle velocity of around 3,000 fps (914 m/s) and his target is at the same level as the muzzle, at what angle must Carlos aim his gun?

Colt Power (class of 2008)

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17. Robin Hood must shoot an evil soldier up on a ledge far away. He shoots his arrow at an angle of 30° with the ground. He shoots the arrow at a velocity of 60m/s and it takes 4sec to hit the target. How far is the target away from Robin Hood both in horizontal and vertical distance? However, the soldier decides to move 12m away from his original horizontal distance from Robin Hood and jumps down into a ditch to hide before Robin Hood can shoot. If Robin Hood shoots at the same velocity and the arrow takes the same time to hit the soldier, what angle must he shoot at, and how high is the soldier now?

Connor Nickell '08

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18. Leonidas must teach a Persian messenger a lesson for insulting his Queen and threatening Sparta with death and slavery. He has cornered this insolent fool at a ledge. The ledge quickly drops down 30m to the ground and this goes a certain distance horizontally until it reaches a pit… of DOOM! Leonidas decides to kick the messenger from the ledge using his wonderfully sculpted thighs into the pit… of DOOM! He kicks the Persian at an angle of 20 degrees above the horizontal and with a velocity of 40m/s. How far away is the pit? Also, if the pit is 90m away, what must Leonidas' initial velocity be now?

Connor Nickell '08

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19. Arthur shoots an arrow at 30 m/s straight into the air. A raven is flying 50 m above him at a 50º angle. How fast must the raven be flying for the arrow to hit him in the jugular while the arrow is still flying upwards?

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20. Bob Jones is involved in a car chase with the Mafia. Up ahead, 200 meters ahead to be exact, he spies a bridge that is sliding open. He is in a souped-up Mini Cooper a la Italian Job and the Mafia are chasing him in an armored truck with a much larger mass. He is hoping that if he gets up enough speed, he will clear the bridge and the truck will fall into the water below. If the space between the sides of the bridge is 15 meters, and

the other half of the bridge is 5 meters below the half he will be flying off of, how fast should Bob Jones be going to clear the gap? If he is currently driving 2 m/s, at what rate should he be constantly accelerating? **Franci Rooney 08**

Chapter 8 Solutions

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1. X = - (V^2sin2(theta))/g
250 = - (50^2 sin 2(theta))/9.8
250*9.8/(50^2) = sin 2theta
Theta = 39.26 degrees

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2. X = V^2 sin 2theta / 9.8
X = 50^2 sin 2(23) / 9.8
X = 183.5

183.5 + or – 20m

163.5 or 203.5
Mr. Laba was successful in destroying Physics Man.

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3. $\Delta y = (\tan 2\theta)\Delta x + (g)\Delta x^2)/(2V^2\cos^2\theta)$
$150 = (\tan 140)(150) + (9.8)(15^2)/(2V^2\cos^2 70)$
$V^2 = 390.5$
$V = 19.8$ m/s

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4. $x = Vi\ t + ½\ a\ t^2$ □ $120 = ½\ a\ t^2$
$120 = ½\ 9.8\ t^2$
$t = 2.23$s

x = (vx)t

x = 220 (2.23)
x = 490.6 m

1 mile = 1 609.344 meter□ □11609.344m / 490.6m

4 slot machines (3.28)

5.

$x = Vi\ t + ½\ a\ t^2$
$50 = ½\ a\ t^2$
$50 = 4.9\ t^2$
$t = 1.443s$

6.
$x = vi(\cos(theta))\ )t$
$x = 27(\cos(38))\ 2.2$
$x = 46.80\ m$

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7. *Work:*
$\Delta x=(v^2 \sin 2\Theta)/g$
$\Delta x=(60^2 \sin 2(45))/9.8$
Answer: $\Delta x=367.3469388$ meters

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8. □A 2.) >t = >x / Vi Cos0□□43/(50cos29.7)□.9900630886 seconds□□Yes-Chief Tecumseh will be saved (just barely)□

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9. □A 13.)
)x= 6
vi= 3.1
0= 10

t= 6 / (3.1 cos(10))
t= 1.965

6 = 3.1 (cos(10)) 1.965
6 does not equal 5.998

No he does not make it.

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10. $\Delta y = (\tan\vartheta)\Delta x + (g(\Delta x^2))/(2V^2\cos^2\vartheta)$
$30 = \tan 70(140) + ((-9.8)(19600))/(2V^2 \cos^2 70)$
$30 = 384.65 – 821010.6/V^2$
$-354.65\ V^2 = -821010.6$
$V^2 = 2315$
$V = 48.1\ m/s$

11.

Time in air depends on V_y

A
$V_y = V\sin\theta$
$V_y = 100\sin30$
$V_y = 50$ m/s

B
$V_y = V\sin\theta$
$V_y = 75\sin45$
$V_y = 53$ m/s

Cannon B will spend more time in the air

12.
$V_y = V\sin\theta$
$V_y = 70\sin60$
$V_y = 60.62$ m/s

$\Delta y = V_y t + (1/2)gt^2$
$0 = 60.62t + (1/2)(-9.8)t^2$
$0 = t(-4.9t + 60.62)$
$t = 12.37$ sec
Time cannonball spends flying

$V_x = V\cos\theta$
$V_x = 70\cos60$
$V_x = 35$
$\Delta x = V_x t$
$\Delta x = (35)(12.37)$
$\Delta x = 432.95$
How far away cannonball will land

$\Delta x = V_i t + (1/2)at^2$
$432.95 = (1/2)(3.2)t^2$
$t^2 = 270.6$
$t = 16.45$ sec
Time it takes rabbit to get where cannonball lands

16.45 – 12.37 = 4.08

You need to wait 4.08 seconds

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13. A.
3 minutes = 180 seconds

$\Delta x = V_i t + (1/2)at^2$
$\Delta x = (1/2)(9)(180^2)$
$\Delta x = 145800$ m

$\Delta x = (V^2 \sin 2\vartheta)/g$
$\Delta x = (70^2 \sin 60)/9.8$
$\Delta x = 433$ m

(433 x 2) + 145800 = total Δx

$\Delta x = 146666$ m

B.
146666 m
180 sec + time in air during the two jumps

$V_y = V \sin \vartheta$
$V_y = 70 \sin 30$
$V_y = 35$ m/s

$\Delta y = V_y t + (1/2)gt^2$
$0 = 35t + (1/2)(-9.8)t^2$
$0 = t(-4.9t + 35)$
$t = 7.14$ sec

total time = (7.14 x 2) + 180
t = 194.28 sec

total average velocity = meters/second
V = 146666/194.28
V = 754.9 m/s

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14. *Solution:*

$V = 50$ m/s
$\Theta = 35$ degrees

$\Delta x = -(V^2 \sin 2\Theta)/g$

$\Delta x = -(50^2 \sin(2(35)))/-9.8$

$\Delta x=239.7$ meters

Because he lands at 239.7 meters he will miss the lake and land painfully, but walk away unharmed.

15.
Solution:

First lemming
$\Delta y=V_y t+(1/2)gt^2$
$100=0+(1/2)(9.8)t^2$
$t^2=20.41$
$t=4.52$ seconds

$\Delta x=V_x t$
$\Delta x=4(4.52)$
$\Delta x=18.08$ meters

Second lemming
$\Delta y=V_y t+(1/2)gt^2$

$V_y=V\sin\Theta$
$V_y=2\sin(25)$
$V_y=.85$ m/s

$100=.85t+(1/2)(9.8)t^2$
$0=4.9t^2+.85t-100$
$t= 4.43$ or -4.61

$\Delta x=V_x t$

$V_x=V\cos\Theta$
$V_x=2\cos(25)$
$V_x=1.81$ m/s

$\Delta x=1.81(4.43)$
$\Delta x= 8.02$ meters

The first lemming travels farther

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16. *Solution:*

$\Delta x=-(V^2\sin2\Theta)/g$
$2,250=-(914\sin(2\Theta))/-9.8$
$-22050==-(835396\sin(2\Theta))$

.026=sin(2 Θ)
$\sin^{-1}$(.026)=1.49=2 Θ
Θ=.745 degrees

Carlos must aim his rifle .745 degrees high in order to hit his target.

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17. A.) Vi = 60 m/s
θ = 30°
Δx = ?
Δy = ?

Vx = 60cos(30°)
Vx = 52m/s

Vy = 50sin(30°)
Vy = 30m/s

Δx = Vx(t)
Δx = 52(4)
Δx = 208m

Δy = Vy(t) + .5(g)(t^2)
Δy = 30(40) + .5(9.8)(4^2)
Δy = 120 + 78.4
Δy = 198.4

Vi = 60 m/s
Δx = 220m
θ = ?
Δy = ?

Vx = 60cos(θ)
Δx = Vx(t)
220 = (60cos(θ))(4)
θ = 23.56°

Δy = Vy(t) + .5(g)(t^2)
Δy = 23.56(4) + .5(9.8)(4^2)
Δy = 94.24 + 78.4
Δy = 172.64m

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18. **Part I:**

Δy = 30m

$\theta = 20°$
$V_i = 40 m/s$
$\Delta x = ?$

$\Delta y = \tan\theta(\Delta x) + (g/(2V_i^2\cos^2\theta))\Delta x^2$
$(-30) = (\tan(20°))(\Delta x) + (-9.8/(2(40^2)\cos^2(20°)))\Delta x^2$
$-30 = (.364)(\Delta x) + (-9.8/(3200)(.883))\Delta x^2$
$-30 = .364\Delta x + (-9.8/(2825.671))\Delta x^2$
$0 = .364\Delta x - .00347\Delta x^2 + 30$ ←quadratic formula
$\Delta x = 159.2 m$

Part II:

$\Delta y = 30 m$
$\Delta x = 90 m$
$\theta = 20°$
$V_i = ?$

$\Delta y = \tan\theta(\Delta x) + (g/(2V_i^2\cos^2\theta))\Delta x^2$
$(-30) = \tan(20°)(90) + (-9.8/(2(V_i^2)\cos^2(20°)))(90^2)$
$-30 = 32.76 – (5.55/V_i^2)(8100)$
$-62.76 = -(5.55/V_i^2)(8100)$
$.00775 = (5.55/V_i^2)$
$.0014 = (1/V_i^2)$
$714.29 = V_i^2$
$26.73 m/s = V_i$

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19. **The raven is 38 m in the air, 32 m away. The arrow will take 1.2 seconds to be 38 meters in the air. So, the raven needs to fly 32 m in 1.2 seconds, or 26 m/s.**

Franci Rooney 08

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20. **$V_x = V\cos 0$, $V_x = V$**
$15 = V_xT$
$5 = 9.8t^2/2$
$t = 1.01$
$V = 14.85$
$V_i = 2$; $V_f = 14.85$
$\Delta x = 1200$
$14.85^2 = 2^2 + 2a200$
$a = .541$
