Practice Problems
For Chapter 06

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 6 Problems

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1. Mr. Laba builds some wings onto his Porsche 911 Turbo because he wants to make it fly like an airplane. He figures out that he needs the Porsche to have a groundspeed of 500 km/hr before he can start soaring into the air. If the street he's using as a runway is only 1.5 km long, what does his acceleration (assumed constant) need to be so that he can lift off?

Moritz Sudhof '07

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2. One day, Matthew is tired of doing physics homework, and he involuntarily gets angry at Mr. Laba. It just so happens that Mr. Laba is out on a jog, and he passes by Matthew's window. At this point, Matthew jumps up, and runs after Mr. Laba. Unluckily for Matthew, Mr. Laba is already 80meters away, by the time he starts running. Matthew figures that Mr. Laba has been running at about a constant 4 meters per second. Matthew wants to catch up to Mr. Laba to hit him on the head with his calculator, but he realizes that Mr. Laba only has 5 minutes left in his run.

a.) How long did it take Matthew to start running after Mr. Laba?
b.) Matthew spends the first minute walking realizing that he has to warm up before he can start running at a constant speed. He starts walking at 2 meters per second with an unrealistic constant acceleration of .08 meters per second squared. How fast will Matthew be traveling after the first minute of warm-up?
c.) What will the distance be between Mr. Laba and Matthew by the end of the warm-up?
d.) Matthew realizes that he has little time to catch up to Mr. Laba(you should be able to figure this out given the previous information and the initial information), but he is getting readily tired after sprinting at his fast pace. How slow is his acceleration if he lets Mr. Laba escape by only 30 seconds?

Amish Bhatia '07

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3. Amish stands still as a look of desperation comes over his face when he looks at his watch and realizes that he has 10 seconds to make it to Physics class on time. If he is 20m away from class what is Amish's acceleration if he arrives to class 2.8 seconds early?

Karl Thumm '07

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4. If Hugo is running down the field at a speed of 15 m/s for five seconds and then accelerates 3 m/s for 6 seconds, how fast will he be going after the 11 seconds?

Annie Matusewicz ‘07

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5. One calm night while the Labamobile was sitting peacefully on the street outside of Mr. Laba’s house a man driving the PhysicsisDeathmobile hit the Labamobile. If the Deathmobile was going 20m/sec and the driver hit the brakes 3 seconds before hitting the Labamobile causing a deceleration of 5 m/sec^2, how fast was the Deathmobile going when it hit the Labamobile, and how far did the Deathmobile travel in those 3 seconds?

John Stevenson ‘07

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6. King Laba is in a rush to get to his five o’clock meeting with the other rulers of Labaland at LabaHall. If he leaves his palace at half past four in the afternoon and gets to the meeting a 6:00 pm, going 90m/s, how far is the LabaHall from the King’s palace?

Annie Matusewicz ‘07

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7. One day in Physics class Moritz challenged Annie to a race.
Before the race began they both agreed that the race was to be 55m.
Annie had an acceleration of 5 m/s2 for the first 50 meters of the race when she slowed down in the last 5 meters to 3.9 m/s2 (apparently she had a
Charlie Horse due to a lack of potassium)
A.) What was her time?
B.) If Moritz finished the race in 12 seconds did Annie beat him?

Karl Thumm ‘07

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8. Lucy was running track on day after school when she discovered that her digital watch had the luxury of a stopwatch. She was in such awe over this discovery that she decided to try it out while she was running. When she was jogging (2.1 m/s) she started the time and right when she peaked in her sprint (5.21 m/s) she stopped the time. If the total time was 8.9 seconds what was the total displacement from the time she started the watch to the time she stopped?

Karl Thumm ‘07

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9. One day instead of physics class Mr. Laba decided to take 3rd period to Laba Land Amusement Park (a fun/hip place to be). Karl was the first in line to ride the terrifying Laba Coaster. The first part of the coaster involves a straight level track that accelerates at high speeds before the coaster reaches incline of the High Slope of Death. There are two accelerations before you reach the incline, the first being 10.2m/s2 for 5 seconds, and the second being 15.9 m/s for 7.6 seconds. What is the final velocity? How far did the coaster travel down the track?

Karl Thumm '07

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10. Louie the janitor has an effective technique of sweeping the floor with his trusty broom. He first keeps the broom at still and then pushes it against the dirt across the floor into a pile. Given that the broom's acceleration is .75 m/s2 and he finishes off each stroke at 1.168 m/s. How far did his trusty broom go? How long did it take? If Louie paused 1.5 seconds between each stroke how many strokes can he do in a minute? How far would his broom of traveled in one minute?

Karl Thumm '07

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11. Sandra is stopped at a light on Preston and Royal and she is in dire need of an iced mocha latte. The light turns green and she makes it there in 20 seconds with a final velocity of 14.2 m/s. How far was Starbucks from the street light? What was her acceleration?

Karl Thumm '07

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12. A hockey puck was shot at the goalie at 15.8 m/s and by the time the puck had reached the point where it was considered a goal- the puck was traveling at 10.32 m/s. If the mass of the puck was .5 kg and it reached the goal in 5.3 seconds. What was the total distance traveled? What was the acceleration

Karl Thumm '07

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13. Mr. Laba is driving his car at a raging 30 m/s. His mind wanders to physics things, equations and the like. Suddenly, he realizes there's a brick wall 138.5 meters ahead of him. He slams on the brakes, which emit a force of 3,250 N. His reaction time is so astonishingly, infinitesimally small that we can ignore it, and the car weighs 1,000 kg. Will he stop in time?

Moritz Sudhof '07

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14. Mr. Laba and Arnold Schwarzenegger are locked in a furious race. Both are driving side by side in their sports cars at 90 m/s. Mr. Laba decides its time to show the Terminator once and for all that physicists are cooler than big-muscled movie stars (even if they do have awesome accents). Therefore, he kicks in his nas. Three seconds later, he's driving at 122 m/s.
(Mr. Laba + car = 600 kg)

How far ahead of Schwarzenegger will Mr. Laba be when he reaches the finish line, 600 m away? (Schwarzenegger goes at a constant speed)

Moritz Sudhof '07

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15. Fred Flinstone was traveling in his dino-mobile at 40 paces per second. A T-rex walks in front of his dino-mobile 5 paces away. What must be Fred's minimum acceleration in order to completely stop before hitting the T-rex. Also how much time does it take to stop?

Conner Nickell (Class of 2008)

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16. Mr. Laba attempts to fight the science god Bill Nye the science guy. After three years of intense battle Mr. Laba attempts to make his finishing blow by throwing the planet mars at Bill Nye. If Mr. Laba throws mars at 50 galaxies per second and Bill Nye is 450 galaxies away and the acceleration is 0, how long does Bill Nye have to dodge Mars. Also if Captain Planet attempts to save Bill Nye by flying into the path of mars at a point 150 galaxies away from the release point and he starts 250 galaxies away from this point with a velocity of 0 galaxies per second, what must Captain Planet's acceleration be in order to fly into the path in the nick of time?

Conner Nickell (Class of 2008)

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17. Mr. Laba is in the *USS Enterprise* and is about to take it out for a nice Sunday ride. The spaceship is at rest until Mr. Laba tells Mr. Spock to punch it to full throttle, and it then takes 45 seconds to reach 1000 m/s. What is the average acceleration of the *Enterprise*?

Colt Power (class of 2008)

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18. A Grizzly bear has a top speed of 35 miles per hour (15.6 m/s). A Polar bear has a top speed of 25 miles per hour (11.2 m/s). Assuming that their acceleration is the same (10 m/s^2) in how much shorter of a distance does the Polar bear reach its top speed? In how much less time does the Polar bear reach its top speed?

** these top speeds are true values, but the acceleration is fabricated

Colt Power (class of 2008)

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19. A supersonic, super-stealth plane, similar to the one rumored that Father Swan stores underneath the Quarry, is traveling at 175 m/s. When it taps into its super-secret ultra wrap drive, it can accelerate at 50 m/s^2. After it starts its super-secret ultra wrap drive, how long would it take for this special plane to achieve Mach speed (≈768 mi/h)? And after 45 seconds from the initial taping of the super-secret wrap ultra drive, approximately how far has this super plane traveled?

Zach Dearing (Class of 2008)

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20. Bringing back bear cubs for Jefferson's stone pit, Lewis and Clark are rowing 3 m/s down a river. If the river's current is flowing in the direction they are traveling when the current suddenly starts accelerating at 2 m/s^2. Also, the bear (since it is from the wild) freaks out (and mauls Lewis and Clark) if it travels faster than 15 m/s down a river. How long (in seconds) will it take to reach the point in which the bear "freaks out" causing the death of two American heroes?

Zach Dearing (class of 2008)

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21. The Labamobile starts off going at 400 m/s and accelerates at 3 m/s*s for 30 seconds. How far did the labamobile go?

Reed Duncan (class of 2008)

22. If an airplane has a 2mile runway to take off and a speed of 400km/hr to get into the air, what is the acceleration that the plane would need to take off. Give you answer in m/s.

Reed Duncan (class of 2008)

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23. Luke decides to challenge Mr. Laba to a footrace. If Luke runs at 5 m/s for 12.5 seconds, then accelerates 2m/s for 4 seconds, how much distance will he have covered? If Mr. Laba runs at a constant 6.3m/s the entire race how much distance will he cover in the same 16.5 seconds?

Mitch Williams (Class of 2008)

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24. Tonti and Russell decide to build a rocket to launch for fun. They somehow find a way to launch it in space so that gravity and air friction are not important. If the rocket launches and accelerates at a constant 8.5m/s how far will it have gone after 1 minute?

Mitch Williams (Class of 2008)

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25. Optimus Prime is in hot pursuit of some criminal. If he is traveling at 10 m/s, then accelerates at 7.8 m/s. how fast will he be traveling after 4 seconds?

Mitch Williams (Class of 2008)

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26. Inspector Clouseau's van is traveling at a speed of 11 m/s across the countryside. Unfortunately, he accidentally breaks the gas pedal so that it is accelerating at a rate of 4 m/s^2. The final velocity the van can reach is 34 m/s. When will he reach this speed?

Franci Rooney 08

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27. If a car is driving at 20 m/s, and 44 m away the driver sees a small child sitting in the middle of the road, what does the car's acceleration have to be to not hit the baby? Assume that we're *not* in a horror film so the child is a real child and not a creepy ghost-creature thing and we don't want to hit it.

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28. A trolley is trundling down the road at 4 m/s. Suddenly a super spy lands on the trolley and, which often happens in the world of the super spy, the trolley suddenly becomes equipped with a super engine. If the spy needs the trolley to zoom down the

street in order to reach the pier, 2500 meters away, and diffuse the bomb on the pier by cutting the blue (Red! Green!) wire, and he needs this to happened within the next 25 seconds, how much would the trolley need to accelerate?

Franci Rooney 08

Here continues the story of the space ship Nickellogan

29. Because of your mastery of navigation, you have now been promoted to the engineering deck of the Nickellogan. You now control the engines of the ship. For your first task, you must back the Nickellogan out of her docking bay at Port Sisson. Unfortunately, the senior engineer, who is supposed show you the ropes of your new job, is in the restroom. This would normally not be a problem (since Captain Steve has a fairly high level of patience—for a pirate), but the Tralfamadorians have just alerted the chief of police in Port Sisson, Troy Haller, of who you really are, and he is on his way with a detachment of colony militiamen. It looks like you're going to have baptism by fire for this job! Now, if the ship's thrusters have a maximum capacity of accelerating the ship at 10 m/sec^2 (the port automatically puts a limit on ship's thrusters while docked) and you must cover a distance of 100 meters (to get you out range of the port's thruster limiter, thereby allowing you to activate the Nickellogan's warp drive), and the militiamen will arrive in 10 seconds, will the Nickellogan get away?
30. Praise Yeubegish! The Nickellogan escaped thanks to your wondrous engineering skills. It looks like you have a strong future ahead of you on this ship! Unfortunately, one of the militiamen (who was a really good runner back in galaxy high school) made it to your dock in time to launch a tracer round from his Mark VII Phaser. And now his tracer is giving Port Sisson's tractor beam a point to lock onto. So, to get away Captain Steve has only one option left: he must detonate a pinch (it is like an atom bomb, but without the explosion—in other words, it fries all electronics without causing any physical destruction) in Port Sisson. But to do so the ship must be 500 meters away from Port Sisson—otherwise the Nickellogan's electronics will also be fried. Because your solar sails have not been deployed yet, you are only traveling at 150 m/sec. And now that the tractor beam for Port Sisson has gotten a fix on the Nickellogan it is slowing the Nickellogan down at a rate of 10 m/sec^2. If you have 7 seconds before the pinch detonates, will the Nickellogan escape the blast?
31. Glory, Glory, Glory! Victory tastes better than a week on a beach on the seventh moon of Yavin 5 with a Sleuchy Dancer. But unfortunately for the citizens of Port Sisson, Captain Steve is angry. So, in his anger he orders the residing gunnery chief, Lieutenant Arterburn, to fire upon Port Sisson's now disabled Capital Ship.

If the Lieutenant Arterburn fires a round from the laser artillery cannon that is traveling at 100 m/sec and the capital ship is 400 meters away and the capital ship has just gotten its black hole drive online (which slows down light—effectively allowing the ship to slow down lasers to the point where they are ineffective) which slows the laser down at a rate of 64 m/sec^2, will the laser hit Port Sisson's Capital Ship?

32. Blast, No Blast! Lieutenant Arterburn in her great ignorance fired a laser when she should have fired an armor piercing atomic round from the rail gun! Of course you know this, but she did not so in a fit of rage Captain Steve puts her into the cargo hold and 'accidentally' opens the airlock sending *all* of the Nickellogan's refuse into the nothingness of space. This is GOOD NEWS!!! When you scoffed at the former Lieutenant for her blunder the Captain heard you (he didn't really know she made a mistake—your scoff was what gave him the idea to kick her off the Nickellogan) and so now, in his great wisdom, he has promoted you to gunner chief. Your first task is to successfully blow up Port Sisson's Capital Ship. You launch eh armor piercing atomic round and it is a direct hit, but before receiving your fatal blow, the Capital Ship launches ten ravager missiles (after penetrating the target's hull these missiles release swarms of flesh eating nano-particles that seek out sentient beings—a strike from one will bring an end to the Nickellogan and her crew). Though you could simply warp to safety, Captain Steve, in his great wisdom, decides to instead capture the ravagers for future use. The solar sails are now online as well as the Nickellogan's solar panels so full power has been restored to the Nickellogan. The Captain's plan is to outrun the missiles until they run out of fuel and then retrieve them. If the missiles are traveling at 150 m/sec and are 300 meters away and accelerating at a rate of 50 m/sec^2 for five seconds, and the Nickellogan can now accelerate at 200 m/sec^2 (it will accelerate at this rate until it matches the final speed of the missiles) will the Captain's plan work?
33. Success!!! You have now matched the speed of the missiles and they have not struck the Nickellogan, so since you are in space you can shut off the thrusters and continue moving at this rate. But wait! Because this is space, the missiles also will continue moving at their final velocity. It appears the Nickellogan will need to slow them down! So, at this point the Captain turns to the chief of ship defense, Captain Riley, and orders her to activate the impedentary drives and slow the missiles to a halt. Unfortunately, Captain Riley, in her vast impudence, reverses the polarity of the impedentary drives and speeds the missiles up to at a rate of 20 m/sec^2. If nothing changes, how long does the Nickellogan have until the missiles hit (assuming she is now 600 meters away and the missiles are

currently traveling at a rate of 400 m/sec—which is the same speed as the Nickellogan)? Hint: since the two objects are initially traveling at the same rate, you can consider them both to be standing still and the missiles accelerating from zero.

34. But do not fear! Since you noticed Captain Riley's vast impudence immediately, she was also placed in the cargo bay with an 'accidentally' opened airlock. This is also good news! Since you are clearly SO much smarter than Captain Riley, and she is clearly VERY dead, you have now been promoted to the chief of ship defense. As your first task, you must slow the missiles down before they penetrate the Nickellogan. Assuming it took two seconds to rid the ship of Captain Riley and reverse the polarity of the impedentary drive (as well as strengthen it significantly) will you be able to stop the missiles in time if they are now traveling at 440 m/sec and you are slowing them down at a rate of 300 m/sec (assume the ship is now 800 meters away—it increased its speed when you were reading this)?
35. Huzzah! The ravager missiles are yours! They have been slowed down before penetrating the Nickellogan, and as such she has retained the purity of her hull! As it turns out, the vastly wealthy Sir Thomas Sisson—founder and owner of Port Sisson—was on his space yacht enjoying the warm beaches of Ilsar IV underneath the Ulracht suns while you fled Port Sisson. At present he is preoccupied by his famed Precheyton girls, so his yacht is vulnerable to attack. To your positions men (and women—Captain Steve is no sexist), there's plundering to be done! If you launch a ravager missile at Sir Thomas' yacht that is traveling at 200 m/sec and is 600 meters away and the ravager missile is traveling at 400 m/sec after being launched and is accelerating at 50 m/sec^2, and Sir Thomas' defense shields slow missiles down at a rate of 60 m/sec^2, will the ravager missile strike his yacht? And how long will it take to strike the yacht?
36. It's a direct hit! The flesh eating nano-particles devoured the crew members of Sir Thomas Sisson's Yacht. But Sir Thomas in his infinite brilliance boarded an escape pod seconds before the missile struck his yacht. His Precheyton girls, however, did not survive (he can always buy more though!). He will likely alert the Tralfamadorians within minutes so if we are 600 meters from his yacht and it is traveling at 200 m/sec and we are traveling at 150 m/sec and can accelerate at 50 m/sec^2, how long will it take to close the distance and dock with his ship?
37. Husharyish Spice is a beautiful thing! After successfully docking with Sir Thomas Sisson's yacht, the Nickellogan has plundered its supplies, which, in our great fortune, includes the extremely valuable Husharyish Spice (a rare hallucinogen). If The Ganges (the largest crime syndicate in the Milky Way) have an offloading

warp point where we can trade the spice that is 500,000,000,000 km away (distances are more normal now) and our fully deployed solar sails as well as our ion drive allow us to travel accelerate at a rate of 150,000,000 m/sec^2 (assume we are sitting still now), how long will it take us to reach the warp point?

Continues in chapter 7

Logan Nickell (class of 2010)

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38. Winston realizes he is 8 miles away from his house and has no clue where he is, using his mental power he is able to move his car to being directly west of his house, but then stops. He was traveling at 7000m/s (he has a BMW of course) and stops in .2 seconds (gotta love those ceramic breaks right). What was his acceleration? How far did he travel while stopping? Is he probably injured?

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39. Well you're wrong. Winston is actually covered in adamantium (lucky him) and so he did not die. He realizes Maddy is probably going to be angry with him for being late, so he finds the secret button on his dash and presses it. His car sprouts wings and hovers up to 43.5 meters above the ground. His jet engine also pops out of the trunk and he blasts off. Since it is a rocket motor he accelerates all the way to his house before realizing he needs to slow down. It takes him 20 seconds to reach his house and he accelerates at a constant rate. So what is his acceleration? What is his velocity when he reaches his house? Additionally, if he has the same braking power in the air as on the ground how long does it take him to stop? And how far from his house is he?

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40. Unfortunately, although Winston manages to survive this again, because of that adamantium covering him, the car doesn't. Winston forgot that he was in the air (thought he was slowly driving, lovely BMW) and he stops it in the air and it plummets to the ground. Unfortunately, the build quality doesn't live up to Toyota pickup trucks and the car won't start and Winston's adamantium broke the roof and all the windows. Fortunately it is stuck in neutral and will roll. So Winston resolves to push it to his house (since it is so close). Unfortunately he is very weak, so he uses a portable motor to accelerate at 1 m/s for 3 seconds. But then it breaks, but he manages to maintain that speed but can't speed up. What is his speed after that acceleration? And how long does it take him to reach his house if he slows it down for the last meter to end at a complete stop?

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41. Winston runs inside and steals his mother's mini cooper. He uses his supreme mathematical capabilities and determines it is exactly 3167.43 meters to Maddy's house on regular roads. Fortunately, all the lights are broken, and its 2 a.m. so no one else is on the road (and the UP police are asleep). The Mini Cooper has improved suspension and chassis and therefore incredibly good handling. So it doesn't have to slow down when going around corners. So he accelerates until he is going 70 mph. So if he accelerates to

that speed in 167.43 meters, how long does it take him? and what is his acceleration? Given the answer to the problem with a rocket motor, does he have one in the Mini Cooper? And how long does it take him to travel all the way to Maddy's house. Answers in meters/second.

Chapter 6 Solutions

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1. 500 km/hr = 139 m/s
1.5 km = 1500 m

$V_f^2 = V_i^2 + 2a\Delta X$
$139^2 = 0 + 2(1500)a$
$a = 6.43\ m/s^2$

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2. a.) X=vt+at^2
80=4t
t = 20s
notice that of the 5 minutes, 20 seconds have already gone by.
Remaining time= 4:40

b.) vf=vi+at
vf = 2 + .08(60)
vf = 6.8
time remaining in run = 3:40

c.) mr. laba
X = 4(60)
X = 240m

Matthew
X = V(avg)t
V(avg) = (6.8+2)/2
X = 4.4(60)
X = 264
240-264 = -24, but remember the first 80 meters
80-24 = 56m

d.) time remaining in run= 3:40, but since Mr. Laba needs to escape by 30 seconds we shall say it he has to run for 4:10
4:10 = 250s 3:40 = 220s
mr. laba
X = 4(220)
X = 880m

Matthew needs to go the same distance except 30 seconds late
880m = 6.8(250)+1/2 a (250^2)
a = -.2624m/s/s

3. 10s – 2.8s = 7.2s

$x = Vi\ t + ½\ a\ t^2$
$20 = 0 + ½\ a\ 7.2^2$
$20 = 25.92a$
$a = .77\ m/sec^2$

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4. $V_f = V_i + at$
   $V = 15 + 3*6$
   $V = 33$

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5. $Vf=vi+at$
   $Vf=20+(-5*3)$
   Answer: $Vf=5$ m/sec
   $Vf^2=vi^2+2a\Delta x$
   $5^2=20^2+(2*.5)\ \Delta x$
   Answer: $\Delta x=37.5$ meters

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6. $Vf=vi+at$
   $Vf=20+(-5*3)$
   Answer: $Vf=5$ m/sec
   $Vf^2=vi^2+2a\Delta x$
   $5^2=20^2+(2*.5)\ \Delta x$
   Answer: $\Delta x=37.5$ meters

7.
   $50 = .5\ (5)\ t2$
   $20 = t2$
   $t=4.4721$

$vfs = vi2 + 2a)x$
$3.9^{\ 2} = 5^{\ 2} + 2\ (a)\ 5$
$15.21 = 25 + 10a$
$-9.79 = 10a$
$a = -.979$

$5 = vi\ t\ \_\ .5\ (-.979)\ t^2$
$0 = -.4895\ t^2 + 5t – 5$

use the quadratic formula to find the second time
t=9.09 seconds

9.09 + 4.4721 =

13.563 seconds

B.) no

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8. x= .5(vi+vf) t
.5 (2.1 + 5.21) t
.5 (7.31) (8.9)
x = 32.5295

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9. 10.2 = a 5 sec 5+7.6 = (12.6) seconds
15.9 = a 7.6 sec

Vf= Vi + at
Vf= 0 + (10.2) (5)
Vf= 51 m/s

Vf= 51 + 15.9 (7.6)
Vf= 51 + 120.84
Vf= 171.84

171.84 = 12.6a
13.63 = a

Vf= 0 + 2a(12.6)
171.84^2 = 2ax
171.84^2 = 2(13.63) x
29528.9856 = 27.276 x
x = 1082.59956m

10.
Vi= 0
Vf= 1.169
A= .75

1.169 = 0 + .75t
t = 1.55733 sec

1.168^2 = 2 (.75) x

1.364224= 1.5 x
x = .9095

1.56 s + 1.5 s =
3.06 seconds(x) = 60 seconds
20 times in 1 minute

20 times)x
18.19 m in 60 seconds

11.

x= .5 (14.2) (20)
x= 142m

14.2^2 = 2 a (142)
201.64 = 284a
a = .7 m/s

12.

Vf = Vi + at
10.32 = 15.8 + a (5.3)
-5.48 = a (5.3)
a= -1.033

$10.32^2 = 15.8^2 + 2(-1.033)$ x
106.32 = 249.64 + -2.066 x
-143.1376 = -2.066 x
x= 69.2824

13.

F = ma
3,250 = 1,000a
a = 3.25 m/s^2

$V_f^2 = V_i^2 + 2a\Delta x$
$0 = 30^2 + 2(-3.25)\ \Delta x$
900 = 6.5x
Δx = 138.46 m

yes, he makes it

14. A.
$V_f = V_i + at$
$122 = 90 + 3a$
$32 = 3a$
$a = 7.67\ m/s^2$

B.
$V_f^2 = V_i^2 + 2a\Delta x$
$V_f^2 = 90^2 + 2(7.67)(600)$
$V_f^2 = 17304$
$V_f = 131.5$

$V_f = V_i + at$
$131.5 = 90 + (7.67)t$
$41.5 = 7.67t$
$t = 5.42$ sec
(time till Mr. Laba gets to the finish)

(how much Schwarzenegger covers in that time)
Distance = rate(time)
$X = (90)(5.42)$
$X = 487.7$
$600 - 487.7$ = how far ahead Mr. Laba is

112.3 m

15.
Let p=paces
$Vf^2 = Vi^2 + 2a\Delta x$
$0^2 = (40p/s)^2 + 2(a)(5p)$
$-1600p^2/s^2 = 10p(a)$
$-160p/s^2 = a$

$0p/s = 40p/s - 160p/s^2(t)$
$(-40p/s)/(-160s^2/p) = t$
$.25s = t$

16.
A.) V = 50 gal/s
450/50 = 8.5s = time Bill Nye has to dodge Mars

B.) 150/50 = 2.5 sec

$\Delta x = .5(a)(t^2)$

$250 = .5a(2.5^2)$

$250 = .5a(6.25)$

$40 = .5a$

$80 gal/sec^2 = a$

17.

$V_i=0$

$V_f= 1000$ m/s

t= 45 seconds

$V_f= V_i+at$

$1000=0+45t$

$1000/45=t$

$\underline{t=22.22 \text{ m/s}^2}$

18.

Grizzly

$V_i=0$

$V_f= 15.6$ m/s

a= 10 m/s^2

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

$15.6^2= 2(10)\ \Delta x$

$243.36=20\Delta x$

12.17 meters $=\Delta x$

$V_f=V_i+at$

$15.6=10(t)$

t=1.56 seconds

Polar

$V_i=0$

$V_f= 11.2$ m/s

a= 10 m/s^2

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

$11.2^2= 2(10)\ \Delta x$

125.44=20Δx
6.3 meters =Δx

$V_f=V_i+at$

11.2=10(t)
1.12 seconds

Final Calculations

<u>12.17-6.3=5.87 meters shorter distance to reach top speed</u>

<u>1.56-1.12=.44 seconds shorter time to reach top speed</u>

19.

1 mi/h = (1600 m/3600 sec)
768mi/h * (1600 m/3600 sec) = 341.33 m/s
$V_f = V_i + at$
341.33 m/s = 175 m/s + 50 m/s^2 (t)
341.33 m/s – 175 m/s = 50 m/s^2 (t)
(166.33 m/s) / (50 m/s^2) = t
t = 3.3266 sec

$\Delta x = V_i t + (1/2)at^2$
Δx = 175 m/s(45 sec) + (1/2)(50 m/s^2)$(45 sec)^2$
Δx = 7875m + 50625 m
Δx = 58500 m

---

20. $V_f = V_i + at$
15 m/s = 3 m/s + (2 m/s^2)t
15 m/s – 3 m/s = (2 m/s^2)t
(12 m/s)/(2 m/s^2) = t
t = 6 sec

21.

$\triangle x = V_i t + (1/2)at^2$

$\triangle x$= (400m/s)(30s)+(1/2)(3m/s*s)$(30s^2)$

$\triangle x$= 12,000 m + 1350 m
$\triangle x$= 13,350 m

---

22. a.

2 miles(1.6km/1mile)(1000m/1km)= 3200m
400km/hr(1000m/1km)(1hr/3600s)= 111m/s

$Vf^2=Vi^2+2a\triangle x$
$(111m/s)^2=a(6400m)$
$12321m^2/s^2=a(6400m)$
$1.9m/s^2=a$

23.
Answer part a: 102.5m
Answer part b: 122.85m

24.
Answer: 15555m (15.55km)

25.
Answer: 118 m/s

26.

34 = 11 + 4t, t = 5.75

27.

$Vf^2 = Vi^2 + 2a\Delta x$
$0 = 20 + 2(44)a)$
$-.227\ m/s^2$

28.

$2500 = 4(25) + (1/2a25^2)$
a = 7.68

---

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

100=(1/2)(10)t^2

t=4.472 seconds

4.472<10 so they get away

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

500=(150)t+(1/2)(-10)t^2

10t^2-150t+500=0

t^2-15t+50=0

t=5 and 10 (the 10 is when it comes to a stop and then comes back past the 500 meters)

Since the time exists, the Nickellogan does pass the 500 meters and does it under 7 seconds so it escapes the blast from the pinch.

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

0=100^2+2(-64) Δx

Δx=78.125 meters

Therefore the missiles does not hit.

32. $Vi + at = Vi + at$

150+50t=200t

t=1

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

Δx=150+25

Δx=175 meters

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

Δx=.5*200

Δx= 100 meters

Since the Nickellogan is accelerating faster than the missiles, the point when it surpasses the speed of the missiles is the point when the missiles will be closest to the Nickellogan. And since the missiles do not close the 300 meter gap, the ship is never hit.

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

600=(.5*20)t^2

t=7.746 seconds

The trick here is to realize the following: since the two objects are initially traveling at the same rate, you can consider them both to be standing still and the missiles accelerating from zero.

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

    0=(440*440) + (2*-300) Δx

    Δx=322.67 meters

    Though it would usually be necessary to consider the moving ship, in this problem you need only work the steps above, because the missiles are brought to zero m/sec well before hitting the ship.

35. Since the missiles are accelerating at 50 m/sec^2 and also slowed down at 60 m/sec^2 you can just combine them and have an acceleration of -10 m/sec^2. Similar to this, you can subtract the speed of Sir Thomas' yacht from the speed of the missiles (effectively bringing the yacht to zero so you don't have to consider it in your equations.

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

    400=(200)t+(.5)(-10)t^2

    10t^2-200t+400=0

    t^2-20t+40=0

    t=2.25 seconds

    Since the time exists, the missiles do hit.

36. Again, we can change reference frames to make this problem easier. Instead of having two moving objects we just make the Nickellogan's initial velocity -50 m/sec and Sir Thomas' ship zero.

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

    600=(-50)t+(.5)(50)t^2

    -25t^2+50t+600=0

    t^2-2t-24=0

    t= 6 seconds

37. Note: here we change all the kilometers to meters.

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

    500,000,000,000,000=(.5*150,000,000)t^2

    50,000,000=7.5t^2

t=2,582 seconds or 43.03 minutes.

38. Vf = Vi +at
0= 7000 +.2a
-7000/.2= a
A= -35000m/(s^2)
(Delta)X= Vi(t) + a(t^2)/2
X = 7000(.2) + (-35000)(.04)/2
X= 1400 – 700
X=700 meters
Most likely he is injured.

---

39. (Delta)X= Vi(t) + a(t^2)/2
1609x8 = 0 + a(400)/2
12872 = 200a
12872/200 = a
A= 64.36 m/(s^2)
He accelerates at 64.36 m/(s^2) on his journey to his house.

Vf = Vi + at
V= 0 +(64.36)(20)
V=1287.2 m/s
He is going 1287.2 m/s when he reaches his house.

Vf = Vi + at
0 = 1287.2 + (-35000)(t)
-1287.2/-35000 = t
t = .036777 seconds
He stops in .0368 seconds

(Delta)X= Vi(t) + a(t^2)/2
X= (1287.2)(.036777) + (-35000)(.036777^2)/2
X= 23.66976 meters
He is about 23.7 meters from his house.

---

40. Vf = Vi +at
Vf = 0 + 1(3)
Vf = 3 m/s
His speed after accleration is 3 meters per second.

(Delta)X= Vi(t) + a(t^2)/2
X= 0 + 1(9)/2
X=4.5 meters

23.7-4.5 =19.2 meters to go – 1 = 18.2

v= 3 m/s
(Delta)X= Vi(t) + a(t^2)/2
18.2 = 3t + 0
18.2/3 = t
6.067 seconds

the last meter=
vf(vf) = vi(vi) + 2a(delta x)
0 = 9 + 2a (a)
-9/2 = a
a = -4.9 m/(s^2)

vf = vi + at
0 = 3 + (-4.9)t
-3/-4.9 = t
t = .6122 seconds

.6122 + 6.067 + 3 = 6.7144
He takes about 6.7 seconds to travel back to his house.

---

41. (70/1609)(3600) = 156.6 m/s
Vf(vf) = Vi(Vi) + 2a(Delta X)
156.6(156.6) = 0(0) + 2a(167.43)
24523.56/334.86 = a
A = 73.24 m/(s^2)
He accelerates at 73 m/(s^2).
And clearly has a rocket motor, which is more powerful than the one in his BMW.

(Delta)X= Vi(t) + a(t^2)/2
167.43 = 0 + 73(t^2)/2
167.43/36.5 = t^2
sq root (4.587(= t
T = 2.1417 seconds
It takes Winston 2. 1 seconds to travel the first 167.43 meters.

(Delta)X= Vi(t) + a(t^2)/2
3000 = 156.6 m/s (t) + 0
3000/156.6 = T
19.157 seconds

19.157 seconds + 2.14 seconds = 21.297 seconds
It takes Winston 21.3 seconds to travel to Maddy's house, where he promptly scampers inside.