Chapter 1

1. To express the answer in seconds, convert years to days (use 364 days in one year), days to hours and hours to seconds. Use the factor/label method.

2. Rules for significant digits are covered on page 7 of the text and pages 1-3 in the lab book.

3 . Read "Powers of 10" on page 4 of the lab book.

4. Read "Powers of 10" on page 4 of the lab book.

6. See page 5 "assumed uncertainty."

7. % Uncertainty = $\frac{uncertaity}{measurement} x100$

8. For addition and subtraction, round the answer to the least precise digit.
   Example: 1.003 + 2.1 + 12.43 = 15.5

9. For multiplication and division, round the answer to the least # of significant digits.
   Example: 4.63 x 12 = 56

12. The prefixes of Table 1-4 are on page 9 of the text.

14. Use a meter stick and a kg scale, or find these values using a yard stick and a bathroom scale, and convert.

16. a) Set up a conversion for feet to yards and then square both factors.
    b) Set up a conversion for meters to feet and then square both factors.

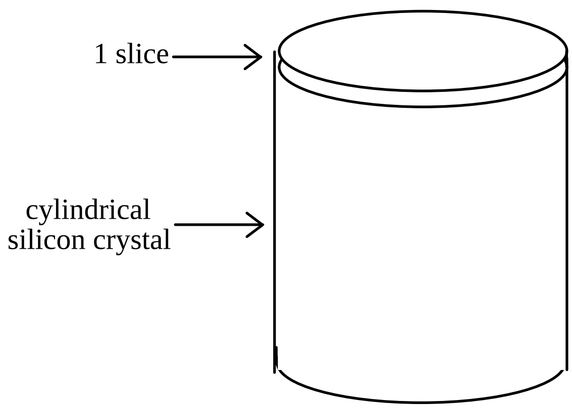
17. distance = rate x time. Find time.

18. a) convert meters to inches. b) Convert meters to centimeters.

20. a) Just convert miles to kilometers. The time in the denominator stays the same.
    b) Convert meters to feet. The time in the denominator stays the same.
    c) Set up "goal posts" with kilometers on top and hours on the bottom. Then convert kilometers to meters and hours to seconds.

22. a) Distance = speed x time. Multiply the speed of light in meters/second times the # of seconds in one year. To convert years to seconds, use 365 days per year, 24 hours in one day and 3600 seconds in one hour. Your answer will be in meters.
    b) Convert $1.5x10^8$ km to meters. Use that as your conversion factor for meters to AU. Then convert your answer from part (a) to AU.
    c) Speed = Distance / time. Divide your distance in AU from part (b) by the number of hours in one year.

35.



47. Use a meter stick to measure the length of your forearm in meters. Use that as your conversion factor and convert the dimensions from cubits (1 forearm) to meters.

49. Opposite angles are equal. Use sine or cosine and the known length of the base of the right triangle formed to find the length of the other side.

50. % uncertainty = uncertainty divided by the measured value. Change years to seconds and compare.

Chapter 2

A Good Thing To Know

There are 4 equations you will need to know to work all the problems in this chapter:

a) The distance equation: x = vt

b) The VAT equation: $v = v_0 + at$

c) The VAX equation: $v^2 = v_0^2 + 2a\Delta x$

d) The VATX equation: $\Delta x = v_0 t + \frac{1}{2}at^2$

3. Convert km/h to m/s. Then use the distance equation.

4. Just convert the distances. The times stay constant.

7. Use the distance equation: x = vt to find the time to travel the 130 km. Subtract that from the total time to find the time to travel the final distance.
   a) Use the distance equation to find the distance traveled after you slowed down, and add that to the initial 130 km.
   b) Divide the total distance by the total time.

9. and 10. Average speed = total distance per time. Average velocity is the displacement (shortest route from start to finish) per time.

11. Time = distance / speed. If the trains are going in opposite directions, either toward or away from each other, relative velocities add.

12. Change km/h to m/s in both cases. Use relative velocities (see class notes).

14. For average speed, use the distance equation in both cases to find the time to travel to and from the destination. Add those times to the time for the lunch break. Then divide the total distance by the total time. For velocity, just take the average of the two velocities.

15. The 2.5 s = the time for the ball to travel the length of the lane + the time for the sound to travel back. Time = distance / velocity. Find the time for the sound to travel back to the bowler using 340 m/s for the speed of sound, and the length of the lane as the distance. Then subtract that from the 2.5 seconds to find the time for the ball to travel down the lane. Speed = distance per time. Find the speed of the ball using the length of the lane and the time left after the time for sound to travel the length of the lane is subtracted.

16. You're given initial velocity, final velocity and time. Choose from VAT, VAX or VATX and solve for acceleration. Be sure to convert km/hr to m/s first.

17. You're given initial velocity, final velocity and time. Choose from VAT, VAX or VATX and solve for acceleration. When you convert m/s^2 to km/hr^2 for part b, don't forget to square the times.

18. Convert km/hr to m/s, and list your variables: v_o, v, Δx and a. Choose VAT, VAX or VATX and solve for a.

19. Convert km/hr to m/s, and list your variables: v_o, v, Δx and a. Choose VAT, VAX or VATX and solve for a. To get your answer in g's, divide a by 9.8.

20. Graph the distance vs. time data. The slope of the line is the velocity. If the slope is changing (a curve) then the velocity is changing, and the object is accelerating. Find the velocity at each time using the equation: $v = \frac{x - x_0}{t - t_0}$. Then graph each velocity vs. time. The slope of that graph is the acceleration.

21. List your variables; v, t and v_o, and solve for a. Choose VAT, VAX or VATX for your equation

23. List your variables; v, Δx and v_o, and solve for a. Choose VAT, VAX or VATX for your equation. The plane started at 'takeoff" so you can assume $v_o = 0$.

26. List variables: a, v, Δx and solve for v_o. Choose VAT, VAX or VATX for your equation. The car skidded to a stop, so you can assume the final velocity is 0.

28. First, convert km/hr to m/s. Choose VAT, VAX or VATX for your equation.
    a) list your variables: v_o, v, and a and solve for Δx. Add to that the distance the car will travel at the initial speed for that one second it takes to react.
    b) same as part (a) using the different value for acceleration.

33. Since the stone is dropped, the initial vertical velocity is 0. You can use the "distance to fall" equation (see lecture notes).

34. Since the car rolls gently, the initial vertical velocity is 0. Acceleration is due to gravity, they want time and you're given final velocity. Convert the given velocity to m/s and list your variables. Choose VAT, VAX or VATX for your equation and solve for time.

35. If King Kong falls, the initial vertical velocity is 0.

a) You're given distance, acceleration is due to gravity and they want time. Use the "time to fall equation."

b) Now you know acceleration, v_o, time and distance. Choose VAT, VAX or VATX for your equation and solve for the final velocity.

36. We can assume the ball stops at the top of its trajectory. List your variables, v_o, v, and g. Choose VAT, VAX or VATX for your equation.

a) Solve for Δx

b) Solve for the time it took to reach that altitude, then double it to include the time to fall back down.

37. If it took 3.0s to go up and come down, it must have takes ½ that time to just go up. The ball stops at the top of its trajectory, making the final velocity = 0. You have the time it took to reach the top, the final velocity and acceleration. Choose VAT, VAX or VATX for your equation and solve for initial velocity and then distance.

38. Use the distance to fall equation, and calculate the position of the object at each ½-second time interval from 0 – 5 seconds. Now you have v, v_o, a, t and Δy for each time interval. Calculate final velocity for each and make a velocity vs. time graph.

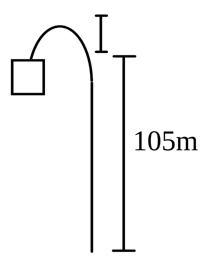
39. The package has an initial vertical velocity up (+) and it decelerates due to gravity (-9.8). It was released at an initial distance (-) but continues up some distance because of its initial velocity, before it stops and falls. This problem can be solved in one step using VATX and the quadratic equation, but you must be careful with your (+) and (-) signs. OR, it can be solved in three steps as follows:

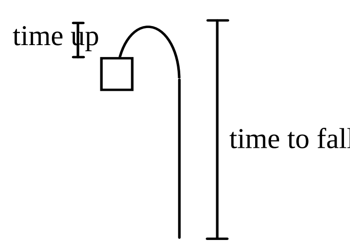
a) You're given initial velocity, acceleration is due to gravity and you know it will stop at the top of its trajectory. Choose VAT, VAX or VATX for your equation and solve for the distance that the package went up before it stopped. Add that to the initial vertical height.

b) Use the time to fall equation and calculate the time it took the package to fall the total distance calculated in step a).

c) Choose VAT, VAX or VATX for your equation and solve for the time it took for the package to travel to its final height before it stopped. Add the two times together for the total time the package was in the air.

Find the distance up and add that to the 105m.



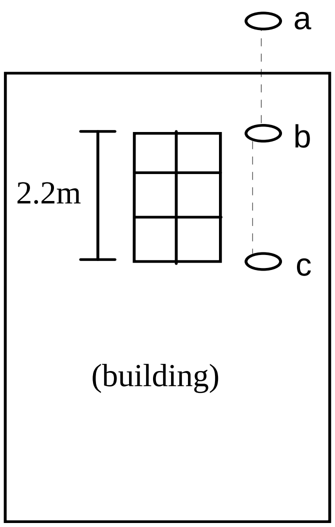


Calculate the time to fall the total distance and add that to the time it took to go up.

42. a) You know initial velocity, distance and acceleration. Choose VAT, VAX or VATX for your equation and solve for final velocity at the given altitude.

b) Now you have initial velocity, distance, acceleration and final velocity. Use VATX and the quadratic equation to solve for time.

44. You're given time, distance and you know acceleration is due to gravity. Choose VAT, VAX or VATX for your equation:



a). Solve for the initial velocity of the rock at the top of the window.

b). Let the initial velocity you found in part (a) be the final velocity of the rock after it fell from the inital drop point on top of the roof to the top of the window. Since it was dropped, the inital velocity at position (a) was $v_o = 0$. Now you know intitial velocity, final velocity and acceleration. Choose from VAT, VAX or VATX and solve for the distance the rock fell form position (a) to (b).

45. This is a lot like the bowling ball problem (#15). You can use the "distance to fall equation," but the time will be equal to the 3.2 s – the time for the sound to return ($\frac{\Delta y}{340}$).

This will put you in the quadratic equation, solving for Δy. Have fun!

47. Part (a) is just like the helicopter problem in #39. For part (b), list your variables. You have initial velocity, distance acceleration and time. . Choose VAT, VAX or VATX for your equation and solve for v_o. One way to do part (c) is to use the initial velocity given, assume it stops at the peak of the trajectory an solve for the initial Δy. Then add that to the height of the cliff.

48. a) You know the final speed at 28 m and the acceleration. Choose VAT, VAX or VATX for your equation and solve for v_o.

b) Now you know v_o, acceleration and v (it stops at the top). Choose VAT, VAX or VATX for your equation and solve for Δy.

c) Find the time to fall that distance Δy and double it to account for the time up.

50. The instantaneous velocity is equal to the slope of the line tangent to the curve at that point. Estimate the slope of the line tangent to each of the times given in this problem. DO NOT MAKE MARKS IN THE TEXT BOOK.

52. Use the graph shown in Fig. 2-28 on page 39. The slope of a distance vs time graph is equal to the velocity. Where the slope is steep, the velocity is high. Where the slope is not very steep, the velocity is lower. Where the curve is horizontal, the slope is 0 and the velocity is 0. Distance is on the y-axis. A (+) slope indicates one direction and a (-) slope indicates motion in the opposite direction.

55. Use the slope of the graph at each 10 second interval to determine the velocity at that point. Graph the velocity values vs. time.

57. a) You know the initial vertical velocity is 0, and that acceleration is due to gravity. Choose VAT, VAX or VATX for your equation and solve for the final velocity of the jumper after falling 15 meters.
b) Let this be the initial velocity for his deceleration over the 1.0 meter that the net stretches. Now you now have initial velocity as he hits the net, final velocity after it stops him, and distance over which he stopped. Choose from VAT, VAX or VATX and solve for acceleration.
b) Think about it!

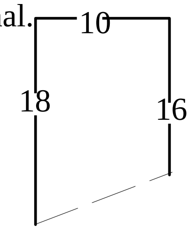
59. Convert 30 g's to acceleration in m/s^2 to determine acceleration. Then convert 100 km/hr to m/s. List your variables v_o, v and a. The distance the car collapses is the distance over which the car decelerated. Choose VAT, VAX or VATX for your equations and solve for Δx.

77. a) Convert km/hr to m/s. Us a coordinate system such that the point where the speeder passes the policeman is at the origin.
b) You are given velocity, distance and acceleration (a = 0, he is traveling at constant velocity) of the speeder. Choose from VAT, VAX or VATX and solve for time.
c) You are given initial velocity (he was sitting still), acceleration and time (from part b) for the police officer. Choose from VAT, VAX or VATX and solve for acceleration.
d) You have initial velocity, acceleration and time for the police officer. Choose from VAT, VAX or VATX and solve for final velocity.

78. a) The first stone is dropped, so it has no initial vertical velocity. Use VATX and solve for vertical distance in terms of Δy and t_1. The second stone has an initial vertical velocity, but travels the same vertical distance as the first. Use VATX for the second stone, and solve for vertical distance in terms of Δy and using $(t_1 - 2.00)$ for t_2. Now set the two equations equal to each other and solve for t_1.
b) You now have initial vertical velocity and time for the first stone. Solve for vertical distance.
c) You have initial vertical velocity, distance and time for both stones. Choose from VAT, VAX or VATX for your equations and solve for final velocity.

Chapter 3

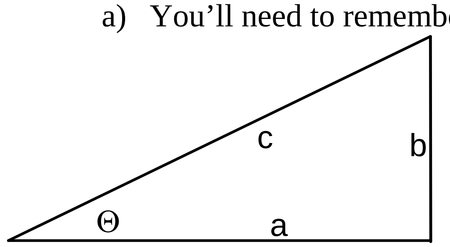
2. Draw the problem out and find length of the diagonal.



4. The vectors are at right angles to one another. Use Pythagorean theorem to solve.

5. Get a metric ruler and a protractor and draw the 3 vectors as described. Now measure the distance between the beginning of the first vector and the end of the third. That is the <u>magnitude</u> of the length or size of the resultant vector. Now measure the angle of that vector relative to the horizontal for the orientation of the vector.

8. A negative x axis means it points left. A +45° angle means it points up and to the right. The tips of the arrows will be pointing away from each other.
   a) You'll need to remember your trigonometry to do this. An example follows:

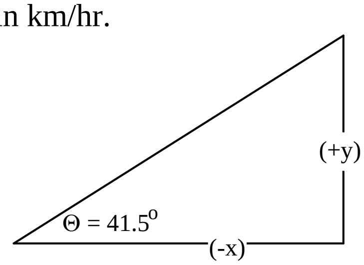


The length of b = c sin Θ.
This is vertical, so it is the y component of c.
Line b has no x component because it is perfectly vertical.

The length of a = c cos Θ This is horizontal so it is the x component of c.
Line a has no y component because it is perfectly horizontal.

   b) Add the x components of each vector to get the x-component of the resultant.
   Add the y components of each vector to get the y-component of the resultant.
   Use the Pythagorean theorem to find the resultant.

9. a) Use trig functions to find the vertical and horizontal components of the vectors
   Let the northerly direction be the +y component, and the westerly direction be the –x component. Since you are finding the x and y components of a velocity vector, the x and y components will be in km/hr.



   b) Find the distance the plane has traveled at 735 km/hr in 3 hrs. Now find the x and y components of that vector using trig functions and a 41.5° angle.

10. Using trig functions as before, find the x and y components of each of the three vectors. Add the three x-components to find the resultant x-component. Add the three y-components to find the resultant y-component. Use the Pythagorean theorem and the resultant x and y components to find the resultant vector. Find the angle relative to the horizontal.

17. Use the time to fall equation to find out how long the tiger is in the air before he hits ground.
Use that time + his horizontal speed to find out how far from the rock he will land (Δx).
***Remember** in the horizontal direction, he does not accelerate!

18. The vertical distance the diver falls is independent of his horizontal speed. Use the distance to fall equation to find his vertical distance. Use the given time to fall and his horizontal speed to find how far from the base the diver hit the water.

20. To get the pebbles to hit with only a horizontal component to the velocity, Romeo has to make sure the window is at the very peak of the pebble's trajectory. Find the time it takes to fall the 8m from Juliet's window to Romeo's hand. That will be the same time it took for Romeo to throw the pebbles up to her window in the first place. Now you have the horizontal distance and time necessary to calculate the horizontal speed.

21. Use the height of the building to calculate the time to fall. Now you have the horizontal distance and the horizontal time. You can calculate horizontal speed.

22. Find the vertical component of a 18.0 m/s kick at a 35º angle. Use that for your v_{oy}.
List your variables v_{oy}, v_y and g. Choose from VAT, VAX or VATX and solve for t.
That will give you the time up; double that for the time to go up and come back down.

23. Use the horizontal distance and speed to calculate the time the ball takes to fall the height of the building. Use that time to calculate the height of the building.

26. Use the given horizontal distance and velocity to find the time the bullet is in the air.
a) Then find the distance to fall equation to find how far it falls in that time.
b) You now know vo, and Dx. Since the target is on the same level as the gun, you can use the Range Equation to solve for Θ.

27. Convert km/hr to m/s. Use the time to fall equation to calculate the time the supplies will spend falling.

29. Example 3-5 is found on page 58. The example gives you Θ and v_o; the problem gives you Δx and Δy. Use trig. functions to fine v_x and the distance equation to find the time the ball is in the air. Then choose from VAT, VAX or VATX to solve for Δy, or just use the distance to fall equation. Compare the calculated height to the height of the crossbar.

30. a) Use trigonometry to find the vertical component of the speed of the projectile. Use with the vertical deceleration caused by gravity. List our variables and choose from VAT, VAX, VATX or the Range equation to solve for Δy.

b) Now you know v_{oy}, v_y, acceleration and height. List your variables and choose from VAT, VAX, VATX or the Range equation to solve for t. Remember that the total time in the air will be twice the time to go up or come down.

c) List your variables and choose from VAT, VAX, VATX or the Range equation to solve for Δx

d) The horizontal velocity is constant and can be found using trigonometry to find the horizontal component of the speed of the projectile. Use VAT with the vertical component of the velocity as v_{oy}, to find the vertical velocity after 1.5 seconds.

31. a) You are given an initial height (Δy). Use the angle and initial velocity to find the initial vertical velocity. Now you have distance, acceleration (gravity) and initial velocity. Use VAT, VAX or VATX and solve for time. You can do this in three steps as in problem #39 of chapter 2, or one, using the quadratic equation.

b) Use the angle and initial velocity to find the initial horizontal velocity. The projectile does not accelerate horizontally, so use the distance equation and the time from part a) to find the horizontal distance traveled.

c) You now have initial horizontal and vertical velocities, horizontal and vertical acceleration and distances. Choose from VAT, VAX, VATX and the distance equation to solve for the final velocity of each.

d) Use the Pythagorean theorem and the answers from part c.

e) Use the tangent function and the horizontal and vertical velocities to find the angle.

32. Since the ball does not take off and land at the same level, you can't use the Range Equation. Using v_o and Θ, find v_x and v_y. Using v_y, g and Δy, use VATX and solve for the time the ball is in the air. Then use v_x, the time and the distance equation to calculate the horizontal distance traveled.

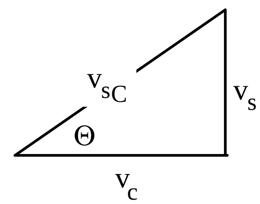
35. a) Find the time it will take the package to fall the vertical distance, and then use the distance equation and the horizontal velocity to find how far the package will travel in the time it takes to fall that far.

b) From part a), you find that the package will travel farther than 425 meters in the time it takes to fall, so it needs a push to get to the drop site in time. Use the horizontal distance (425 meters) given, the horizontal velocity and the distance equation to find the time the package has to fall. Now you have time, vertical distance, and acceleration. Choose from VAT, VAX or VATX and solve for initial vertical velocity.

c) Use the initial velocity found in part b), vertical acceleration and vertical distance and choose from VAT, VAX or VATX to find the final velocity.

For 36 and 37, the two velocities form the legs of a right triangle. Each problem is asking for the hypotenuse of the triangle.

38. This is just a vector problem. The velocity of the snow with respect to the car is the hypotenuse.

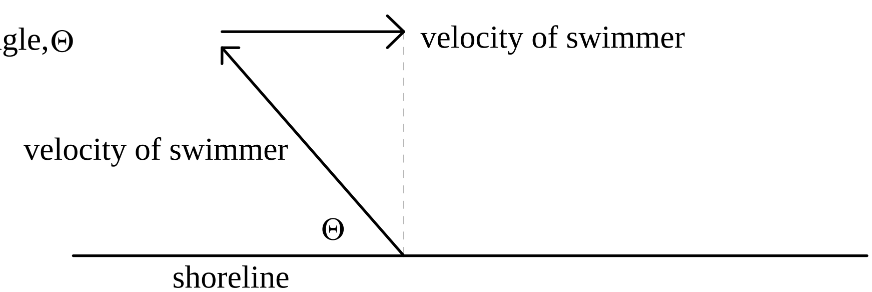


39. a) the two velocities form the legs of a right triangle. This problem is asking for the hypotenuse of the triangle.
    b). You know velocity and time, find distance (no accelerating force)

40. The planes are flying toward each other on the same axis. The relative velocity will be the sum of the two vectors. Neither is accelerating. You have distance and velocity, find the time.

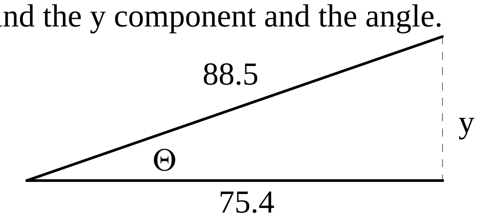
47. a) The swimmer's speed in still water is proportional to the width of the river in the same way the speed of the current is proportional to the distance downstream traveled.
    b) The time to reach the other side depends only on the speed the swimmer can swim and the width of the river.

48. Find the angle, Θ

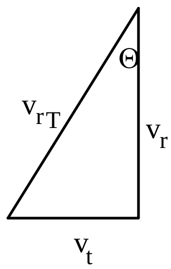


53. List the variables. William Tell is aiming directly at the apple, so the arrow will launch and land at the same level. Use the Range Equation and find Θ.

56. Use trigonometry to find the y component and the angle.



57. This is just a vector problem. The velocity of the rain with respect to the train is the hypotenuse.



66. Use the horizontal distance and the horizontal speed to find the time he is in the air. ½ that time was spent going up, and the other ½ coming back down. At the top of his trajectory, $v_y = 0$. Now you know final velocity, time and acceleration (gravity.) Choose from VAT, VAX or VATX and solve for distance.

68. a) Using trigonometry and the example triangle from problem 8, find the y component of the 1.8 m/s^2 vector.
    b) Your answer from part a is your vertical acceleration. If the skier started from rest ($v_o = 0$), list your variables v_o, a and Δy, where Δy = the elevation. Choose from VAT, VAX, or VATX and solve for time.