2.1 Quizlette – Speed and DA **Name**_____

Speed (Use your formula packet)

1. A Cross Country runner runs 5000 m in 1292 s (21:32). What is their velocity in m/s?

2. A car going 60 mph is traveling at 88 f/s. How many feet will it travel in the 1.7 s it takes you to pick a song on your iPhone?

3. What time does it take a baseball going 132 f/s (90 mph) to go the 60.5 feet to home plate?

4. A car going 95 f/s can see 160 feet with its low beams at night. What time does it take to go this distance?

5. A car going 95 f/s goes how far in the 1.5 seconds it takes most drivers to react?

6. A runner goes 100 m in 12.0 s. What is their velocity?

7. A train going 18 m/s goes how far in 52 s?

8. A truck that goes 62 m in 2.1 s is going what speed?

9. Sound travels at 343 m/s. What time does it take to go the 1609 m that are in a mile?

1) 3.87 m/s, 2) 149.6 f 3) 0.458 s, 4) 1.68 s, 5) 142.5 f, 6) 8.3 m/s, 7) 936 m, 8) 29.5 m/s, 9) 4.69 s

Unit Conversions (use your shortcuts from your formula packet)

10. Convert 26.82 m/s to km/hr.

11. Convert 26.82 m/s to mph.

12. Convert 26.82 m/s to f/s.

13. A Winchester .22 rim fire has a muzzle velocity of 1950 f/s. Convert that to m/s

14. A .30-30 center fire has a muzzle velocity of 2467 f/s. What is that in mph?

15. The speed limit in Montana is 80 mph. What is that in m/s?

16. The recommended maximum speed on the Autobahn is 130 km/hr. What is that in mph?

17. Rural roads in the EU often have a speed limit of 50 km/hr. What is that in f/s?

18. Convert 30 mph to f/s.

10) 96.6 km/hr, 11) 60 mph, 12) 88 f/s, 13) 594 m/s, 14) 1682 mph, 15) 35.8 m/s, 16) 80.8 mph, 17) 45.6 f/s, 18) 44 f/s

Physics
FA 2.1 - Speed

Name_____

When you have finished this, go to the website and check your answers. If you got a problem wrong, cross it off on the front, and do it correctly on the back.

1. A car goes 30.0 m in 1.80 seconds. What is its speed?

2. A car going 25 m/s goes 13.4 m. What time does it take?

3. A baseball going 41 m/s travels how far in 0.34 s?

4. Convert 55 mph to m/s

5. Convert 8.94 m/s to mph

Practice for 2.1 - Speed and unit conversions

(Optional – if you need extra practice!)

(Do the work for these on a separate sheet of paper.)

12.8 m/s	1. A car in front of the school goes 30.0 m in 2.35 seconds. What is its **speed**?
0.15 s	2. What **time** will it take a car going 88 f/s to go 13 feet?
68 f/s	3. My Tercel can go 92 f in about 1.35 seconds. What is its **speed**?
78 feet	4. A glacier moves at a rate of 5.6 feet/day. What **distance** does it go in two weeks?
49 mph	5. A trucker goes 345 miles in 7.0 hours. What is her **speed**?
0.36 s	6. A car moving 44 feet/second takes what **time** to travel 16 feet?
93 km/h	7. What **speed** must you average to go 280 km in 3.0 hours?
66 f/s	8. Convert 45 miles/hour to Feet/second
17 m/s	9. Convert 60 km/hour to m/s
24 m/s	10. Convert 80 feet/second to m/s
68 mph	11. Convert 110 km/hr to mph
96.6 km/hr	12. Convert 88.0 feet/sec to km/hr
9.6 s	13. A river current moves at 3.2 miles/hour. How many **seconds** will it take you to drift 45 feet? (Convert to feet/second first)
12 m/s	14. A car in front of the school travels 15 feet in 0.38 seconds. What is its speed in m/s?
6075 mph	15. A satellite travels at 5.4 miles in 3.2 seconds. What is its speed in miles/hour?
12240 mi 6.5×10^7 f	16. A space shuttle moves at 3.4 miles/second. What **distance** does it go in one hour? How many feet?

Physics

No Reason to Speed

One reason people give for speeding is that they want to save time. Since t = x/v, then a greater speed would save time. It turns out a spreadsheet is a perfect way to check out calculations that would otherwise be too time consuming to repeat over and over again.

Here's what to do:

1. Pick a driving route that you or someone close to you (A parent or sibling) makes nearly every day. This might be your drive to school.
2. Divide up the route into parts according to the speed limit. (On my drive home, I have a 35 mph, a 30 mph, a 35 mph, a 55 mph, a 40 mph a 30 mph and a 25 mph part) Your route should have at least 4 parts, and take at least 10 minutes to complete.
3. Drive the route home with a partner, and note the odometer reading before and after each part to measure the length of each part in miles. Round to the nearest tenth.
4. When you sit down at a computer, you should have a table that shows the speed limit and length of each part of the route you are analyzing.
5. Run Chrome, and create a new Google Sheet in your drive. Give it a name you will remember.
7. Type the words "Distance", "Speed", and "Time" in cells A1, B1, and C1 respectively. (Click on the cell, and type. Hitting the **Return** key or clicking on another cell makes it appear down below)
8. Enter your distance data in the "Distance" column, and your speed limit data in the "Speed" column.
9. Click in the first cell below "Time" (Cell C2) Make that cell equal to the distance divided by the Speed limit. (=A2/B2) Don't forget to hit return after entering your formula. Remember, the spreadsheet will "type" the cell names for you if you just click on the cell. (So click on cell C2, press "=", click on A2, press "/", click on B2, press return would work)
10. Click in the cell you just defined (C2) and notice that there is a handle in the lower right corner, place your cursor over this handle, and notice that your cursor changes. Drag the handle down to the bottom of your cells, and it will generalize the formula for those cells.
11. Click in the cell below the last calculated time in the "Times" column, and make that cell equal to the sum of the times. This would look like "=sum(C2:C10)" if C10 contained the last value for that column. (The spread sheet will type ranges like "C2:C10" for you if you drag the mouse. Type "=sum(", drag with the mouse from C2 to C10, and then type ")" and you're done.) I will henceforth call this cell the *Total time* cell.
12. Now the *Total time* cell (The cell you just changed in step 11) contains the time (In hours) that it takes to complete the route going the speeds listed in the "Speed" column.
13. Make the next cell down from the *Total time* cell equal to the *Total time* cell multiplied by 60, and the cell beneath that one equal to the cell above it times 60. Label these cells one cell to the right of them "Hours", "Minutes", and "Seconds".
15. Now you can select your spreadsheet so far, and paste three more copies of it. If you are clever, you can make this print out on one sheet of paper. (You will need to log into Chrome on a PC in the classroom to print. Always do a print preview before you print) In the three new copies, you can make the speeds 5, 10 and 15 miles per hour faster than the speed limit. The spreadsheet will automatically calculate the travel time in hour, minutes and seconds. You will want to subtract the three new travel times from the original travel time (at the speed limit) to answer the questions on the next page.
16. Answer these questions and **cite your data** directly in your answer to support your answers where applicable:
    1. **How much time in seconds do you save going 5, 10 and 15 MPH over the speed limit? (you will need to subtract to figure this out) Is it worth speeding to save this amount of time?**
    2. **Suppose you tried to obey the speed limit all the way home. Would the values from the spreadsheet be totally accurate? Why or why not? Would the time estimate from the spreadsheet be over or under what you would really do? (Is it possible to average the speed limit without exceeding it in a real traffic situation?)**
    3. **Tinker around with the speeds column. How fast do you have to go to cut the speed limit travel time in half? Is this realistic? Why or why not?**
    4. **In your opinion, is "saving time" a good reason to speed on short commuting trips? On longer trips?**

G Moving Plots

Here you will use a 60Hz tape timer to make position and velocity v time graphs of a wind up car, and analyze them with tangent lines. There is a very helpful website with videos on how to gather and analyze this data.

Getting a Tape:

1. You and one partner will need a dynamics car, a tape timer kit and some masking tape. If your group is three, you will need to analyze two tapes.
2. Find a spot in the hall near an electrical outlet, and tape your timer to the floor. Get a carbon paper disk (New ones are in an envelope in the tape timer box if you need it) and put it black side down on the pin and under the hammer, so that it is free to rotate.
3. Attach a piece of timer tape about 2 meters long to the back of the car, and thread it through the staples but under the carbon paper.
4. Remove any slack from the tape, and practice getting the car to tow the entire tape through the timer while you gradually speed up over a distance of about 50 cm, and then allow it to coast to a stop while the tape is still in the timer.
5. Repeat step 4 with the timer going. Your tape is a good one if you can see the marks on it, the first and last marks are separated by at least one meter of distance, and the tape stayed in the timer for the entire event. Mark the beginning of the tape. I will gladly give you an opinion about your tape before you spend 15 minutes taking data from it.

Analyzing the Tape:

1. Find a flat surface, and tape your timer tape next to two meter sticks that are also taped down so they won't move. Mark the first dot, and every sixth dot thereafter. Since the timer makes 60 dots per second, these marks you make represent the position of the car every tenth of a second.
2. Make a •table of elapsed time (by tenths of a second) and distance by measuring the distance each mark is from the first dot (t = 0 seconds, S = 0 cm).
3. Add a •column to the table whose contents are the difference between adjacent distances multiplied by 10. Start with zero velocity. You will have one less of these than you have distances, don't worry about it. (This is the velocity of the car in cm/s or in tens of cm/.1s Don't forget to label your columns with units and what they are)
4. Make two different nice graphs, one of •distance vs. time (horizontal), and one of •velocity vs. time (horizontal). Draw a nice smooth curve through the points - don't connect the dots.

Write up:

1. Pick a curvy part of the distance vs time graph. **•Draw a long tangent line with a ruler to the smooth curve you drew through the points.** The line should go off the plot frame at both ends. •By using the coordinates read from your axes of where your tangent line enters and exits the plot frame, **find the slope of the line you drew.** Show this calculation on the graph itself. •Your tangent line is tangent at a certain point in time. Read this from the axis of your graph. How does that slope compare the velocity at that time you calculated by subtracting distances? **(Compare the slope of the tangent line to the velocity at that time in your spreadsheet)** Repeat this for another point on the graph.
2. On your velocity graph draw two best fit lines, one representing the positive acceleration, and one the negative. **•Find the slope of the lines you drew. Show this on the graph itself**. This slope is the acceleration.
3. Look at the velocity graph. Where is the acceleration positive? Where is it negative? **•Label these on the graph. •Which one is greater in magnitude, the positive, or the negative?**

2.2 Quizlette – Acceleration **Name**_____

Acceleration

1. A Leaf gains 24 m/s of speed in 3.2 s. What is its acceleration?

2. A 2014 RAV4 accelerates at 4.5 m/s/s for 5.0 s. What is the change in velocity?

3. A car going 26.82 m/s can decelerate at -8.8 m/s/s. In what time can it stop?

4. An oil tanker going at its top speed of 8.3 m/s will coast to a stop in 20 minutes (1200 s).
What is the deceleration in m/s/s?

5. A pitching machine accelerates a baseball from rest at 108 m/s/s for 0.37 s.
What is the final velocity of the baseball?

6. An Audi can accelerate at 9.72 m/s/s. What time will it take to go from rest to 26.82 m/s? (60 mph)

$V_f = V_i + at$ (Put the numbers in the formula in the parenthesis below the formula)

7. A car going 25 m/s accelerates at 3.2 m/s/s for 4.1 seconds. What is its final velocity?

V_f = V_i + (a)(t)

8. A freighter going 10.2 m/s reverses its screws and decelerates at -0.024 m/s/s for 112 seconds.
What is its final velocity?

V_f = V_i + (a)(t)

1) 7.5 m/s/s, 2) 22.5 m/s, 3) 3.05 s, 4) -0.00692 m/s/s, 5) 40 m/s, 6) 2.76 s, 7) 38.12 m/s, 8) 7.512 m/s

9. A Leaf can accelerate at 4.2 m/s/s. What time will it take to accelerate from 8.0 m/s to 32 m/s?

V_f = V_i + (a)(t)

10. An oil tanker can decelerate at -0.00694 m/s/s by coasting.
What time will it take to decelerate from 8.3 m/s to 2.4 m/s?

V_f = V_i + (a)(t)

11. A car speeds up from 12 m/s to 37 m/s in 3.5 s. What is the acceleration?

V_f = V_i + (a)(t)

12. A bicycle slows down from 20.2 m/s to 5.7 m/s in 12 s. What is the acceleration? (deceleration...)

V_f = V_i + (a)(t)

13. A car accelerates at 2.3 m/s/s for 4.3 s at the end of which it is going 38 m/s.
What was its initial velocity?

V_f = V_i + (a)(t)

14. A cop clocks a car going 17 m/s after having decelerated at -6.3 m/s/s for 2.5 s.
What was the initial velocity of the car?

V_f = V_i + (a)(t)

9) 5.71 s, 10) 850 s, 11) 7.14 m/s/s, 12) -1.21 m/s/s, 13) 28.1 m/s, 14) 32.75 m/s

Physics
FA 2.2 - Acceleration

Name_____

When you have finished this, go to the website and check your answers. If you got a problem wrong, cross it off on the front, and do it correctly on the back.

1. A car accelerates from rest to 21.0 m/s in 2.45 seconds. What is its acceleration?

2. A rock accelerates at 9.81 m/s/s for 1.25 s. What is its change in velocity?

3. A car can accelerate at 4.50 m/s/s. What time will it take to accelerate from rest to 12.0 m/s

4. A car goes from 37.0 m/s to 21.0 m/s in 3.50 seconds. What is its acceleration?

5. A car has a final velocity of 23.0 m/s after having accelerated at 1.75 m/s/s for 7.80 seconds. What was its initial velocity?

Practice for 2.2 – Acceleration (Optional – if you need extra practice!)

(Do the work for these on a separate sheet of paper.)

$a = \frac{\Delta v}{t}$ **:**

1. A car's brakes can make it slow at a rate of -6.70 m/s/s. What time will it take the car to stop if it is going 28.1 m/s? (4.19 s)
2. A drag racer reaches a speed from rest of 54.2 m/s in 1.83 seconds. What was its acceleration? (29.6 m/s/s)
3. A javelin is accelerated at 15.6 m/s/s for 1.30 seconds. What is its change in velocity? (20.3 m/s)
4. A runner accelerates at 4.80 m/s/s for 1.39 seconds. What is their change in velocity? (6.67 m/s)
5. What time will it take a rock accelerating at 32.0 f/s/s to reach 44.0 f/s? (1.375 s)
6. A car reaches a speed of 22.5 m/s in 2.70 seconds from rest. What is its acceleration? (8.33 m/s/s)
7. A giant lizard goes from rest to 4.50 m/s in 2.54 seconds. What is its acceleration? (1.77 m/s/s)
8. A rocket can accelerate at 6.97 m/s/s. What time will it take to change the velocity of the rocket by 1200 m/s? (172 s)
9. What is the change in velocity of a baseball if a pitcher accelerates it at 85.1 m/s/s for 0.320 seconds? (27.2 m/s)
10. What time will it take a baseball accelerated by a pitching machine at 92.0 m/s/s to reach 41.5 m/s from rest? (0.451 s)
11. A car at a stoplight accelerates from rest to 21.0 m/s in 4.81 seconds. What is its acceleration? (4.37 m/s/s)
12. A rocket accelerates at 45.0 m/s/s for 2.30 seconds. What is its change in velocity? (103.5 m/s)
13. A runner goes from rest to 8.10 m/s in 2.70 seconds. What is their acceleration? (3.00 m/s/s)
14. A tennis ball is accelerated at 160. m/s/s from rest to 78.0 m/s. What time does it take? (0.4875 s)
15. A train can accelerate at 0.382 m/s/s. What is its change in velocity if it accelerates at this rate for 120. seconds? (45.8 m/s)

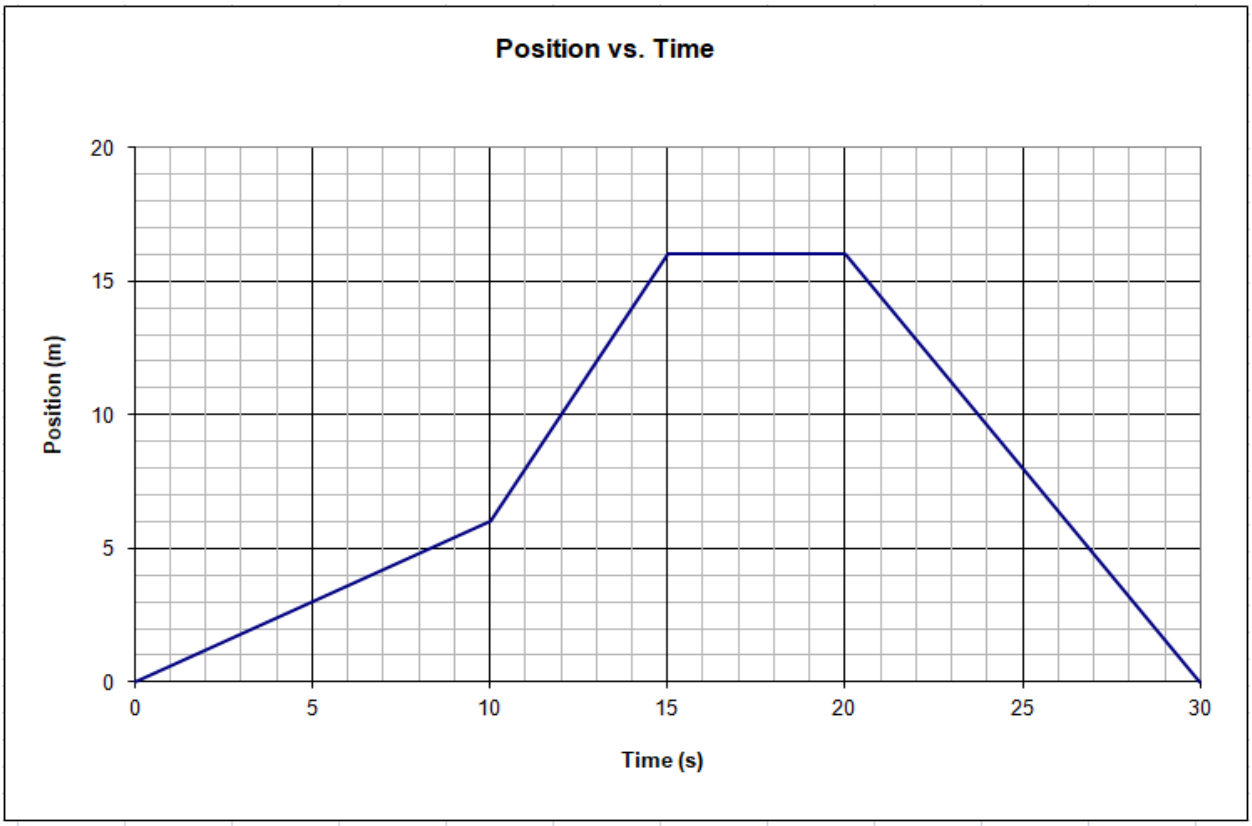
$v_f = v_i + at$:

16. A car accelerates at 3.54 m/s/s from 22.0 m/s to 35.0 m/s. What time does it take? (3.67 s)
17. A car accelerates from 17.4 m/s to 36.1 m/s in 6.00 seconds. What is its acceleration? (3.12 m/s/s)
18. A car coasts along the road, slowing from 23.0 m/s to 12.0 m/s in 18.2 seconds. What is its acceleration? (-0.604 m/s/s)
19. A train going 34.8 m/s decelerates at a rate of -1.40 m/s/s for 18.2 seconds. What is its final velocity? (9.32 m/s)
20. An oil tanker accelerates from 4.30 m/s to 14.8 m/s at a rate of 0.172 m/s/s. What time does it take? (61.0 s)
21. A bullet going 816 m/s decelerates at -151 m/s/s for 1.20 s. What is its final velocity? (634.8 m/s)
22. A car accelerates at 5.75 m/s/s for 2.68 seconds. At the end, it is going 28.0 m/s, so what was its initial velocity? (12.6 m/s)
23. A car going 15.7 m/s accelerates at 4.35 m/s/s for 9.00 seconds. What is its final velocity? (54.85 m/s)
24. A car going 27.2 m/s is slowed at -5.30 m/s/s to 12.9 m/s. What time does it take? (2.70 s)
25. A car is decelerating at -7.46 m/s/s, and is still going 11.5 m/s after 2.60 seconds. What was its initial velocity? (30.9 m/s)

Name_____

Graphs of Motion - Answer the questions below it, and show any calculations you made. Don't freak out if you don't get my exact answer – you should be within 0.1 or 0.2 of the right answer.

1. The position of a car is shown on the graph below. Answer the questions below it, and show any calculations you made.



This is a position question – you can just read the graph

a) What is the car's position at 15 seconds? 25 seconds? How about 6 s? 26 s?

b) At what time(s) is the car at 8 m? 16 m? 5 m?

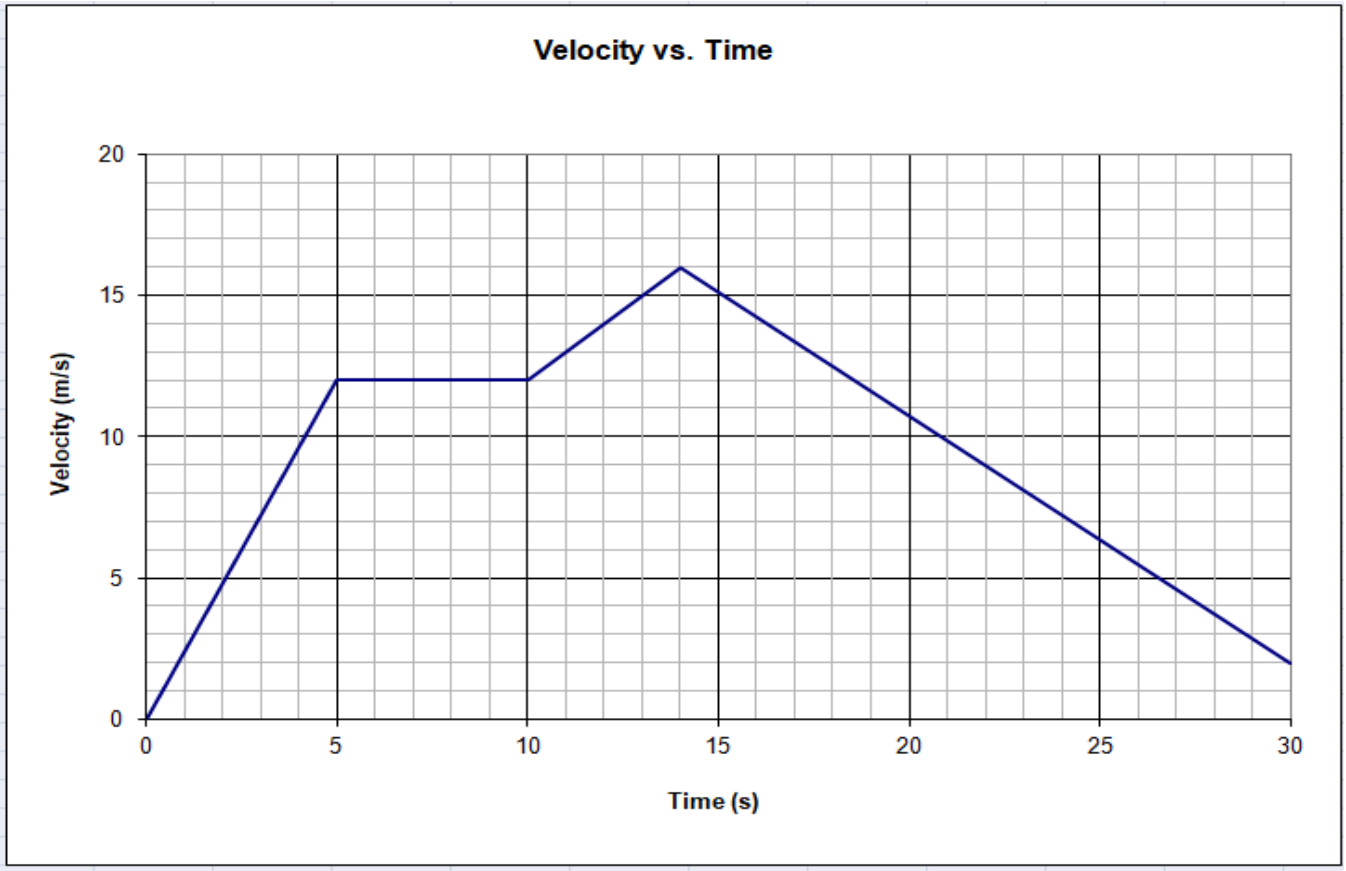
The next few questions are about velocity. Velocity is slope on this kind of graph.

c) What is the velocity at 5 seconds? (Use the whole line segment to find the slope – from 0 – 10 s)

d) What is the velocity at 12 seconds? at 17 seconds? At 25 seconds? (Use the whole line segment)

Answers: (a: 16 m, 8 m, ≈3.6 m, ≈6.3 m) (b: 11 s and 25 s, 15 s-20 s, 8.3 s and 26.9 s) (c: 0.60 m/s) (d: 2.0 m/s, 0.0 m/s, -1.6 m/s)

2. – This is a velocity vs. time graph for a different car.



This is a velocity question – you can just read the graph.

a) When is the velocity 12 m/s? What is the highest velocity it has? What is the velocity at 20.0 s?

The next question is an acceleration question. Acceleration is the slope of a velocity graph.

b) What is the acceleration at 3 seconds? at 6 seconds? at 12 seconds? at 25 seconds? Use the whole line segment to calculate the slopes.

These are displacement questions. Displacement is the area under this kind of graph.

c) What is the displacement of the car between 5 and 10 seconds?

d) What is the displacement of the car between 0 and 5 seconds?

EC) What is the displacement for the whole graph? (0-30 s) – show every step

Answers: (a 5-10s and 18.6s, 16 m/s, 10.8 m/s) (b 2.4 m/s/s, 0, 1 m/s/s, -0.875 m/s/s) (c 60 m) (2d 30 m) (e 290 m)

2.3 Quizlette – How Far **Name**_____

1. A car going 11.0 m/s accelerates at 0.890 m/s/s for 15.0 s. How far does it go in this time?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

2. A runner accelerates from rest at 3.40 m/s/s to a final velocity of 9.40 m/s. What distance do they go?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

3. A tennis ball cannon rolls to a stop covering a distance of 3.80 m in 7.20 s. What was its initial velocity?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

4. What is the acceleration of a car that accelerates from 17.0 m/s to 11.0 m/s in 3.40 s?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

1) 265 m, 2) 13.0 m, 3) 1.06 m/s, 4) -1.76 m/s/s

5. An accident scene investigator determines by measuring skid marks, that a car strikes a parked car at 8.20 m/s after having decelerated at -9.60 m/s/s for a distance of 17.0 m. What was the initial velocity of the car?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

6. A car covers 113 m accelerating at 0.640 m/s/s for 14.0 s. What was its initial velocity?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

7. A racecar is going 34.0 m/s after decelerating for 242 m for 4.50 s. What was its deceleration?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formulas - hint - find Vi first Show your steps

8. A car going 20.0 m/s accelerates at 0.920 m/s/s. What time does it take to cover 123 m?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formulas - hint - find Vf first Show your steps

5) 19.8 m/s, 6) 3.59 m/s, 7) -8.79 m/s/s, 8) 5.46 s

2.3 Quizlette – How Far - Two Part Problems **Name**_____

1. An airplane reaches a speed of 52.0 m/s from rest on a runway that is 890. m long. What is its speed when it has gone only 100. m down the runway?

A. An airplane reaches a speed of 52.0 m/s from rest on a runway that is 890. m long. (solve for acceleration)

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

B. What is its speed when it has gone only 100. m down the runway? (use the acceleration from part A)

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

2. A car reaches a speed of 27.0 m/s from rest in 6.20 s. What distance did it travel as it accelerated from 18.0 m/s to 24.0 m/s?

A. A car reaches a speed of 27.0 m/s from rest in 6.20 s. (solve for acceleration)

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

B. What distance did it travel as it accelerated from 18.0 m/s to 24.0 m/s? (use the acceleration from part A)

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

1A) a = 1.519 m/s/s, 1B) 17.4 m/s, 2A) a = 4.354 m/s/s, 2B) 28.9 m

Physics
FA 2.3 - Basic Kinematics

Name_____

Circle your answers, and label them with units.

When you have finished this, go to the website and check your answers. If you got a problem wrong, cross it off on the front, and do it correctly on the back.

1. A car has an acceleration of 1.20 m/s/s for 3.50 seconds, at the end of which it is going 24.0 m/s. What was its initial velocity?

2. A car moves 214 m with an acceleration of 4.80 m/s/s in 6.00 seconds. What was its final velocity?

3. A dragster starts from rest and moves 180. m in 4.30 seconds. What is its acceleration?

4. A bike coasts from 12.5 m/s to rest in a distance of 27.2 m. What is its acceleration?

5. An airplane coasts with a uniform acceleration from 92.5 m/s to rest over a distance of 624 m. What was its velocity when it had covered only 200. meters of that distance?

How Far for A2.3 (Optional – if you need extra practice!)

	Regular one step or two step problems:
11.2 m	1. A Pirate Ship accelerates uniformly from 1.80 m/s to 5.60 m/s with an acceleration of 1.25 m/s/s. What was its displacement?
8.28 m/s	2. A lemur going 3.45 m/s accelerates at 1.52 m/s/s for 3.18 s. What is its final velocity?
-8.85 m/s/s	3. A giant lizard stops in 5.85 m in 1.15 s. What was its acceleration?
12.4 s	4. A tuna going 2.35 m/s accelerates at 0.208 m/s/s covering a distance of 45.0 m. What time did it take?
7.27 m	5. A lemming speeds up from rest to 5.19 m/s in 2.80 s. What is its displacement during this time?
21.6 m/s	6. An accident scene detective knows that a car with a deceleration of -7.14 m/s/s was brought to rest in 32.8 m. What was the initial velocity?
-1.22 m/s/s	7. What is the acceleration of an ATV that goes from 12.0 m/s to 7.50 m/s in 3.68 s?
41.9 m	8. A XC runner accelerates uniformly for 8.20 s at 0.540 m/s/s having a final velocity of 7.32 m/s. What is their displacement during this time?
22.8 m/s	9. A racecar accelerates at 5.13 m/s/s for 3.35 s covering a distance of 105 m. What was its initial velocity?
21.9 m/s	10. A car avoiding an accident is brought to rest over a distance of 56.0 m in 5.12 s. What was its initial velocity?
-4690 m/s/s	11. A baseball going 38.0 m/s decelerates to rest over a distance of 0.154 m. What was its deceleration? (It's big)
-2.01 m/s/s	12. A car goes from 27.2 m/s to 14.7 m/s in 6.23 s. What is its acceleration?
458 m	13. A train going 45.0 m/s decelerates at -2.17 m/s/s for 17.9 s. What is its displacement during this time?
4.36 m/s	14. A hamster going 2.7 m/s accelerates uniformly for 6.52 s, covering a distance of 23.0 m. What was its final velocity? (it's riding a hamster scooter)
2.33 s	15. A car is going 15.0 m/s after having decelerated at -6.25 m/s/s over a distance of 52.0 m. What time did it take?
-25.1 m/s	16. A hot pocket accelerating at -9.81 m/s/s from rest falls downward -32.1 m. What is the final velocity?
18.2 m/s	17. A car accelerates uniformly for 8.70 s with a final velocity of 31.5 m/s over a distance of 216 m. What was its initial velocity?
2.39 s	18. A car that can brake at -8.92 m/s/s will take what time to decelerate from 33.1 m/s to 11.8 m/s?
81.6 m	19. A rollercoaster car going 8.60 m/s decelerates at -0.215 m/s/s for 11.0 s. What was its displacement during this time?
47.1 s	20. A space probe is going 615 m/s after having decelerated at -0.147 m/s/s over a distance of 29,100 m. What time did it take?
	Two-Part Kinematics:
39.2 m	21. A dragon accelerates from 1.13 m/s to 3.60 m/s in 4.13 seconds. Over what distance could it accelerate from rest to 6.85 m/s if it had the same acceleration?
4.98 s	22. A car accelerates uniformly from rest, covering 65.0 m in 5.62 seconds. What time would it take the same car to go from 8.90 m/s to 29.4 m/s if it had the same acceleration?
7.73 m/s	23. A runner covers 21.5 m accelerating uniformly from rest to 9.94 m/s. What was their speed when they had covered only 13.0 m?
2.84 s	24. A train decelerates from 35.0 m/s to 22.0 m/s in 42.0 seconds. What time did it take it to cover 98.0 meters from the beginning?
17.5 s	25. A car accelerates from rest to 23.0 m/s over a distance of 231 m. What time would it take it to accelerate from rest to 20.0 m/s if it accelerated at the same rate?

2.4 Quizlette – Free Fall Problems **Name**_____

Make the direction down negative, and use g = -9.80 m/s/s for the acceleration of gravity.

1. Red Elk drops a rock from a 12.0 m tall cliff. What time does it take the rock to hit the water, and what is the velocity of impact with the ground. (Make down negative)

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formulas Show your steps

2. Steve Apt's group claimed that they jumped from a cliff that was so high it took them 2.70 s to hit the water. How high was this cliff? What was their velocity of impact with the water?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formulas Show your steps

3. Red Elk drops a rock from a cliff that hits the water with a downward velocity of 25.0 m/s. How high is this cliff? What time did it take the rock to hit the water after he dropped it?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formulas Show your steps

1) t = 1.56 s, v = -15.3 m/s 2) x = 35.7 m, -26.46 m/s 3) x = 31.9 m, t = 2.55 s

4. A student launches an air rocket from the ground straight upwards at a speed of 23.5 m/s. To what height does the rocket rise before going back down? What total time does the rocket spend in the air? (Time up plus the time down)

$X =$
$V_i =$
$V_f =$
$a =$
$t =$

Formulas

Show your steps

5. A batter pops a ball straight up that rises 21.0 m above the bat, before coming back down and being caught by the catcher at the same elevation the bat hit it. What was the initial upward velocity of the ball? What total time did the ball spend in the air?

$X =$
$V_i =$
$V_f =$
$a =$
$t =$

Formulas

Show your steps

6. Tom Duggan shoots a rocket into the air from the ground at some velocity. It spends 8.40 s in the air before striking the ground again. What was its launch velocity from the ground? What was its height at the top?

$X =$
$V_i =$
$V_f =$
$a =$
$t =$

Formulas

Show your steps

4) h = 28.2 m, t = t = 4.80 s 5) v = 20.3 m/s, t = 4.14 s 6) v = 41.16 m/s, h = 86.4 m

2.4 Quizlette – Free Fall (Red Elk) **Name**_____

Ignore air friction and use the convention that **down is negative.** g = 9.8 m/s/s

1. **An air rocket is launched from the ground straight up, and on the way down is strikes a light tower that is 23.0 m tall with a downward velocity of 11.0 m/s**. What was its initial upward velocity?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

2. **An air rocket is launched straight up at 31.0 m/s.** What time elapses between the launch, and the point on the way down where it has a downward velocity of 17.0 m/s?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

3. **An air rocket is launched straight upwards at 26.0 m/s.** What is its velocity at a time of 4.80 s?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

4. **An air rocket is launched straight up with a speed of 24.0 m/s and strikes a 18.0 m tall light tower on the way down.** What is the velocity of impact with the light tower?

$X =$ $V_i =$ $V_f =$ $a =$ $t =$	Formula Show your steps

1) +23.9 m/s, 2) 4.90 s, 3) -21.04 m/s, 4) -14.94 m/s

Physics
FA 2.4 – Free Fall Kinematics

Name_____

Circle your answers, and label them with units. Ignore air friction and use the convention that **down is negative**. g = 9.8 m/s/s
When you have finished this, go to the website and check your answers. If you got a problem wrong, cross it off on the front, and do it correctly on the back.

1-2: An air rocket is launched vertically upward at a velocity of 28.0 m/s.

1. What total time will it be in the air?

2. What is the greatest height it reaches?

3-4: A rock falls from rest off a cliff that is 24.0 m tall

3. What time does it take to reach the ground?

4. What is its velocity of impact? (careful of the sign)

5. An air rocket leaves the ground at 34.0 m/s going straight up and strikes the ceiling of the gym going 26.0 m/s. How tall is the ceiling in the gym?

Physics

Free Fall Practice Problems for A2.4 (Optional – if you need extra practice!)

Ignore air friction and use the convention that **down is negative.** g = 9.8 m/s/s

1.
a-b: A baseball is popped straight up in the air at a velocity of 42.0 m/s
a. What is the greatest height it reaches? (90.0 m)
b. What time does it spend in the air before reaching the same elevation from which it was popped up? (8.57 s)
c-d: A rock is dropped from rest from the top of a cliff and strikes the ground after 2.10 seconds.
c. What is its velocity of impact with the ground? (-20.6 m/s)
d. What is the height of the cliff? (21.6 m)
e. An air rocket is launched from the ground straight up, and on the way down is strikes a light tower that is 16.0 m tall with a downward velocity of 12.0 m/s. What was its initial upward velocity? (+21.4 m/s)

2.
a-b: A soccer ball is kicked straight up from the ground, and reaches a height of 23.0 m before coming back down.
a. What time does it spend in the air (total)? (4.33 s)
b. What was its initial upward velocity leaving the ground? (+21.2 m/s)
c-d: A golf ball is dropped from a cliff and strikes the ground with a downward velocity of 34.0 m/s.
c. How high is the cliff? (59.0 m)
d. What time did it take the ball to strike the ground? (3.47 s)
e. An air rocket is launched straight up at 36.0 m/s. What time elapses between the launch, and the point on the way down where it has a downward velocity of 21.0 m/s? (5.82 s)

3.
a-b: A steel marble is launched straight up from the ground at some velocity, and stays in the air for a total time of 8.20 s before striking the ground again.
a. What was its initial launch velocity? (+40.2 m/s)
b. To what height does the marble rise before going back down again? (82.4 m)
c-d: A hot pocket is dropped from the top of a 52.0 m tall building in Manhattan.
c. What time does it take to reach the sidewalk below? (3.26 s)
d. What is the velocity of impact with the sidewalk? (-31.9 m/s)
e. An air rocket is launched straight upwards at 27.0 m/s. What is its velocity at a time of 4.80 s? (-20.0 m/s)

4.
a-b: A giant lizard jumps straight upwards from the ground at 4.30 m/s.
a. To what height does the lizard rise before going back down again? (0.943 m)
b. What total time does the lizard spend in the air? (0.878 s)
c-d: A frozen blueberry falls from a counter top and strikes the floor with a downward velocity of 4.50 m/s.
c. What is the height of the counter top? (1.03 m)
d. What time does it take the blueberry to strike the ground? (0.459 s)
e. An air rocket is launched straight up with a speed of 31.0 m/s and strikes a 12.0 m tall light tower on the way down. What is the velocity of impact with the light tower? (-26.9 m/s)

5.
a-b: A bowling ball is launched using black powder from a well casing and goes straight up 320. m before coming back down again.
a. For what time does the bowling ball stay in the air? (16.2 s)
b. What was its initial upward velocity of launch? (+79.2 m/s)
c-d: A person falls from a bridge that is 18.0 m above the water.
c. What time does it take them to reach the water? (1.92 s)
d. What is the velocity of impact with the water? (-18.8 m/s)
e. An air rocket is launched straight up and lands on the roof of a building 3.80 s later with a downward velocity of 8.60 m/s. What was its initial velocity of launch from the ground? (+28.6 m/s)