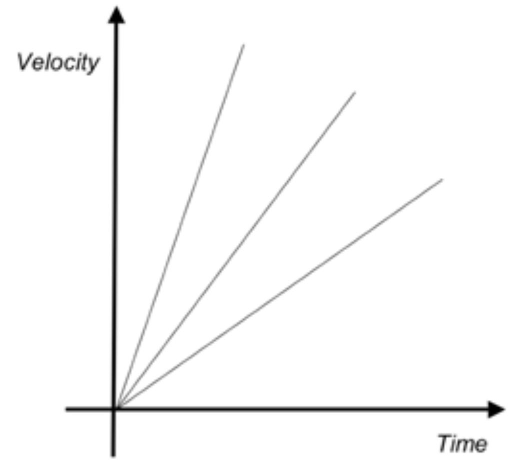
Interpreting graphs and equations

Tutorial section________________

I. Graphs

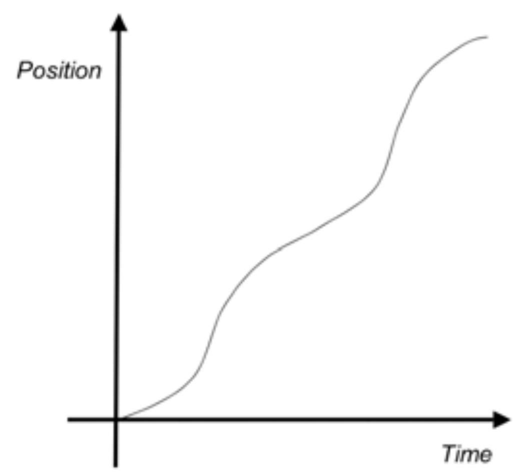


A. On the velocity vs. time graph at right:

1. What do the three different lines represent?

2. What is the interpretation of the slope of each line?

3. What is the interpretation of the intercept of each line (the place where it crosses the vertical axis)?



B. Suppose a small ball rolling along a track produced the motion represented on the graph at right. What might the track have looked like? Sketch an arrangement of tracks you might set up in lab to produce that motion. Describe the motion in words.

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II. Interpretations

Two cars start from the same place on the same road but at different times. Car 1 travels with constant velocity v_1 for a distance d and then stops. Car 2 starts at time t after car 1, travels with constant velocity v_2 until it has gone the same distance d, and then stops.

Give an interpretation of each of the following expressions, if such an interpretation exists. (Some expressions may have no interpretation relevant to the motions described.)

A. d/v_2

B. $v_1 t$

C. d/t

D. $v_2 t$

III. Algebraic expressions

A. A bug is 10 feet away from the base of a tree at noon. It is creeping slowly but steadily away from the tree at a constant speed v.

1. Write an algebraic expression for the bug's distance from the tree at time t, where t is the time that has passed since noon.

2. If the bug is 30 feet from the tree at 12:50 P.M., when will it be 60 feet from the tree?

B. A traveler left home on a trip across the desert. He took along enough provisions for a 19-day journey. He is able to travel with a constant speed s. After 15 days, he is still 100 km from his destination.

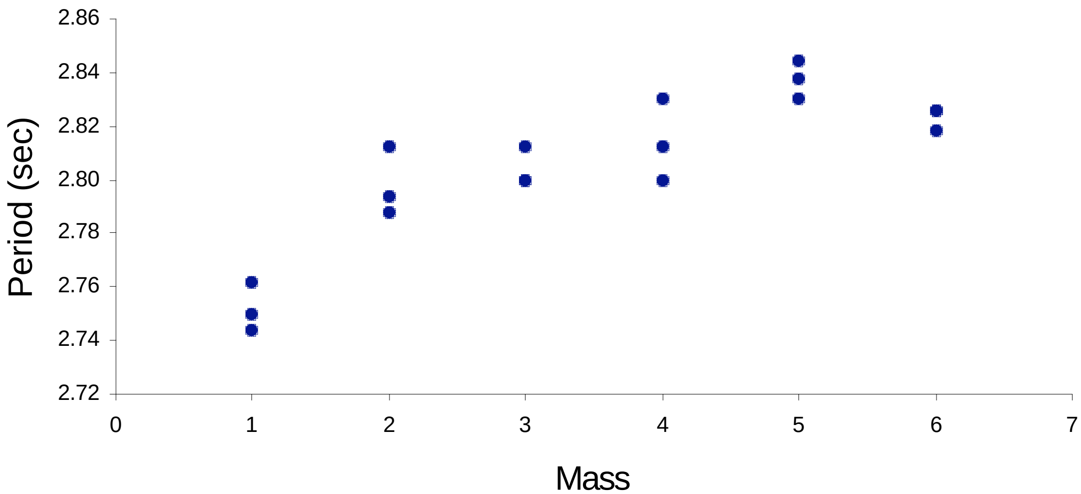
1. Write an expression for the number of days of provisions he will have left when he arrives. Explain your reasoning in detail.

2. Can your expression ever be negative? What would that mean and why?

<u>You need to bring a copy of this completed question to Lab 3.</u>

IV. Pre-lab question

Elizabeth and Lydia have just finished the pendulum lab, where they measured the period of a pendulum with different masses. They made a two-meter long pendulum, used six different masses and measured the period three times for each mass. Though they had a wonderful time measuring the period, they aren't happy with just knowing whether or not the period depends on the mass. They want to know what function describes the dependence.



Lizzie: I think the graph looks like a square root function, $T = C_1\sqrt{m}$.

Lydia: How do you know? It could just as easily be a cube root, $T = C_2\sqrt[3]{m}$

Lizzie: Well, if either function fits, then C_1 or C_2 must be constant for all of our data.

Lydia: Hmm?

Lizzie: If we use each of our data points to calculate the constant, then, if our data fits a function perfectly, we'll get the same constant for all our data. Let's see, so $C_1 = T / \sqrt{m}$ and $C_2 = T / \sqrt[3]{m}$.

Lydia: Look – the cube root only varies from 1.67 to 2.57, but the square root varies from 0.99 to 2.38. I think the cube root fits the data.

Lizzie: But they're supposed to be constant. That's not constant.

Lydia: Nothing's going to be perfect in real life. That's as close to constant as we're going to get – we had to time these by hand with stopwatches.

Mass (g)	Period (sec)	$C_1 = T / \sqrt{m}$	$C_2 = T / \sqrt[3]{m}$
1.34	2.75	2.38	2.56
1.34	2.74	2.37	2.55
1.34	2.76	2.38	2.57
2.68	2.79	1.70	2.18
2.68	2.81	1.72	2.20
2.68	2.79	1.70	2.18
4.02	2.80	1.40	1.98
4.02	2.80	1.40	1.98
4.02	2.81	1.40	1.98
5.36	2.83	1.22	1.86
5.36	2.81	1.21	1.85
5.36	2.80	1.21	1.84
6.70	2.84	1.10	1.77
6.70	2.83	1.09	1.76
6.70	2.84	1.10	1.77
8.04	2.83	1.00	1.68
8.04	2.83	1.00	1.68
8.04	2.82	0.99	1.67

Lizzie: No – look, we measured each period three times, so we know how scattered the data is going to be. For mass 2, our period was from 2.79 to 2.81 seconds. This made C_1 go from 1.70 to 1.72 and C_2 go from 2.18 to 2.20. So our range from timing can only cause a range in the constants of about 0.02. The constants have a lot larger range than that, so they aren't constant.

Lydia: What?

Lizzie: In an ideal world, we'd get the same thing every time we measured the period, and the function that fit would have exactly the same constant for all the data.

Lydia: Yeah, that's what I was saying, it's not an ideal world. The constants are not going to be perfectly the same, so the function that has the smallest range of constants is the one that fits the best.

Lizzie: Right, but we know how 'un-ideal' we are because we measured the period three times for each mass. This range in periods tells us how much the constant can vary and still be judged 'constant' because of the variation in periods. We need to find a function whose constants have a range that is just as big as the range caused by the three different periods for one mass.

Answer the following questions. Since this is completely new material, you are not expected to give a perfect answer. The point is to get you thinking about issues that will arise in lab. Please don't spend more than 30 minutes on this.

A. Which function, if either, fits? Elaborate on arguments made in the discussion above to make your point.

B. Guess another function that might fit this data. Use this method to see if it fits the data. Include your calculations and reasoning. (Continue on back, if needed.) Does it fit? If not, is it a better or worse fitting function than the two tried earlier? (If you use a spreadsheet program to answer this question, please print out and attach all relevant pages.)

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