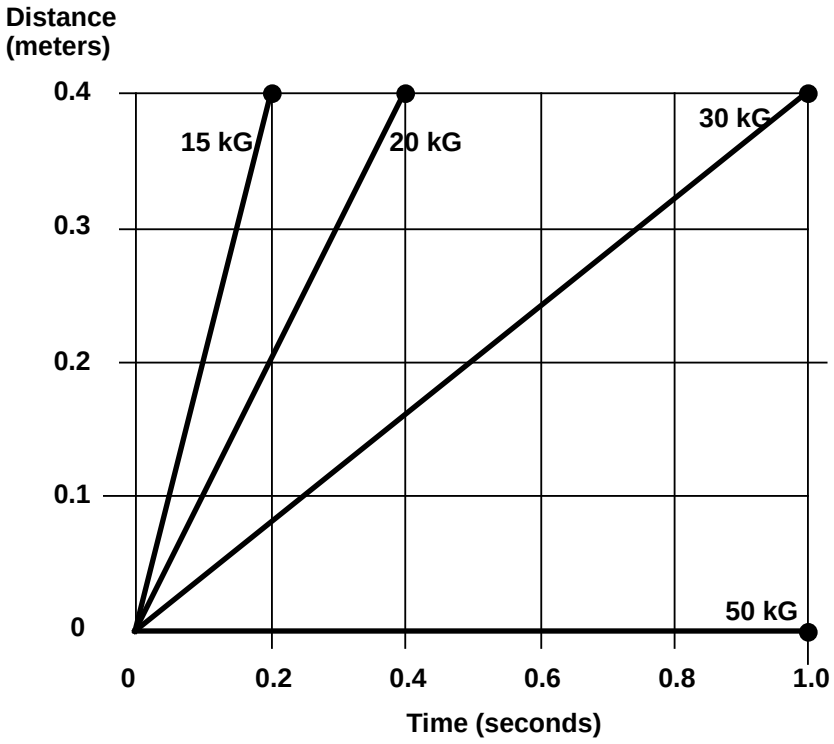
Exercise Physiology Questions:
Set #2 -- Basic Physics of Muscle Contraction

Imagine that someone is pressing (lifting from shoulder/chest to above head) a series of different weights. You record the time required to move the different weights -- notice that in each case the weight is moved the same distance (why?). You summarize your results as a graph (pleased note that we ignore the acceleration of the weight when the person first starts the press and when they finish the press).



Answer the following questions:
1. What does the distance 0 refer to (where is the weight being held)?
2. Where is the 0.4 meter distance measured from -- it is 0.4 m from what (the floor? Mars?, the lifters shoulders?)
3. How far did the person move the 50 kG mass?
4. In these graphs, are the individual weights depicted as having constant or variable velocity during the press? Explain (put another way -- what does the slope of each line represent and what units does it have).
5. There are actually two types of acceleration operating on the weights -- one that is exerted by the muscles of the lifter (but which is not shown in the graph above -- ask me if you don't understand this) and an acceleration that is constant throughout each lift (and before and after the lift). What is the constant acceleration acting on the weight?
6. Sketch what you think (based on your own experience of lifting any heavy weight) is a more accurate depiction of the distance vs. time than the one shown above (note that you only need to make a graph for one weight and you do not need actual times and distances -- thus I am asking for a **qualitative** graph as compared to the **quantitative** graph shown above).

7. Do you think friction with the air should be an important consideration in our problem? Why?

Some useful formulas and the names of some units (**Know all of these**) -- units are in parentheses and commonly used symbols are boldfaced :

Force (**n**ewtons) = **m**ass (**kG**) * **a**cceleration (meters/sec^2)

Work or **E**nergy (**j**oules) = **F**orce (**n**ewtons) * **d**istance (**m**eters)

Power (**w**atts) = **w**ork or **e**nergy (**j**oules) / **t**ime (**s**econds)

acceleration due to gravity = 9.8 m / s^2

8. Find: The force that our athlete is lifting against in each case. (Note that force is one manifestation of what we call weight; instead of pounds you will calculate the mks units of weight.)

9. Using the data given on the graph, you should realize that the velocity is constant for each lift. Find the velocity (m/s) for each lift.

10. Make a plot of velocity (m/s) vs. mass lifted (kg).

11. Find the work (joules) done in each lift (we are only interested in difference in energy between the resting point and the top of the lift).

12. Find the power in watts exerted by lifter with each weight. Make a graph of power vs. mass lifted.