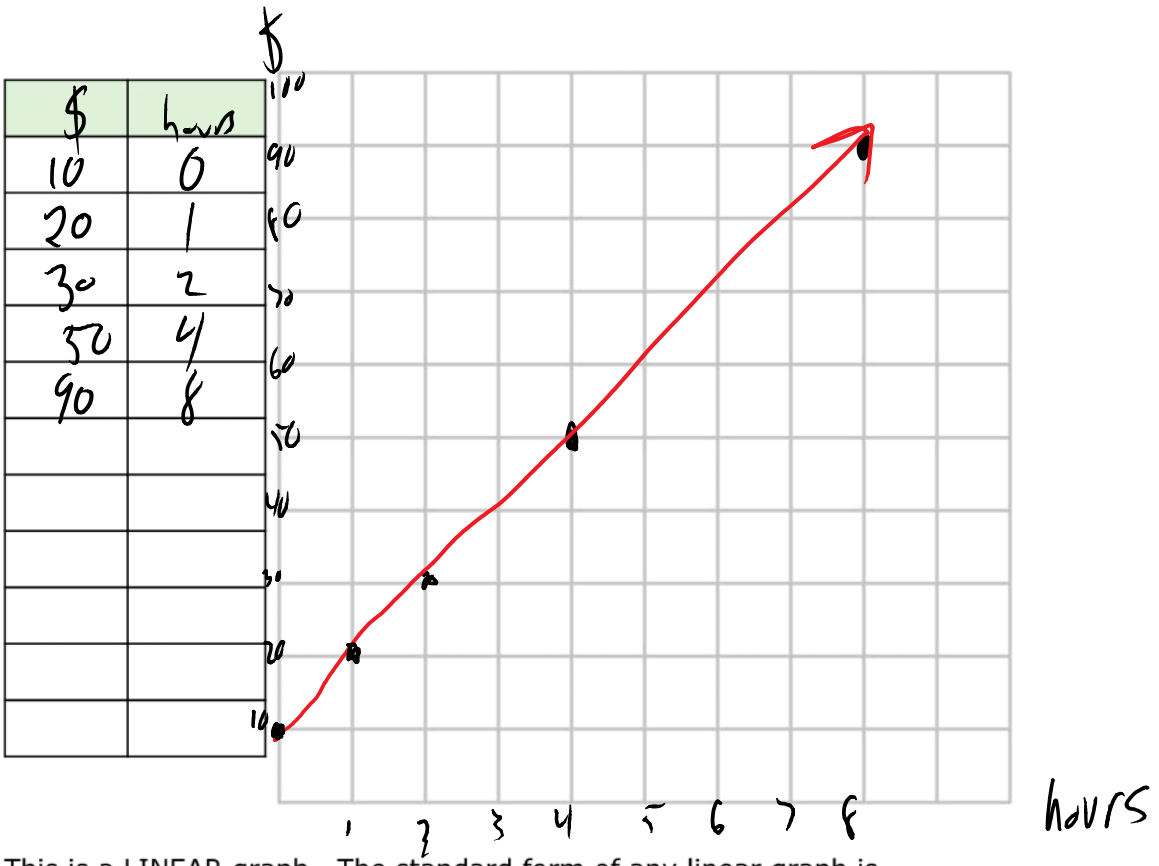
Graphing Skills

Let's graph an income:

BC minimum wage	≈ $10/hour
Allowance	= $10/week

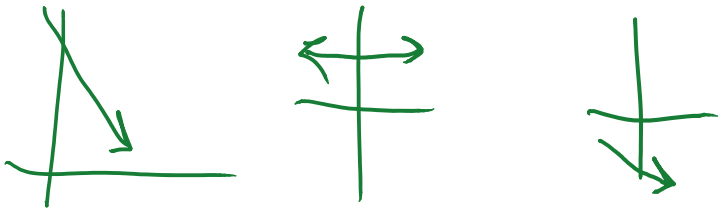
$	hours
10	0
20	1
30	2
50	4
90	8



This is a LINEAR graph. The standard form of any linear graph is

$y = mx + b$ $y = 10x + 10$

A linear graph is a straight line. In any direction. If it is straight - it's linear.



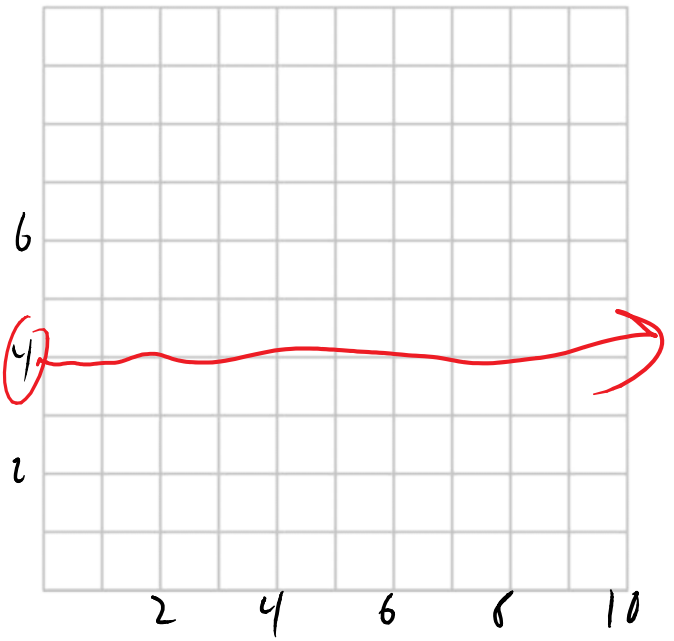
You can control how many hours you work (somewhat) but not how much you make per hour. More hours equals more income. In other words; your income is dependent on the hours you work.

Hours = independent
Income = dependent

We put the dependent variable on the x-axis and the independent variable on the y-axis. This is the custom / convention.

Let's try a couple others. You are stopped at a red light. The light turns green and you accelerate at 4 m/s^2

a	t
4	1
4	2
4	5
4	10

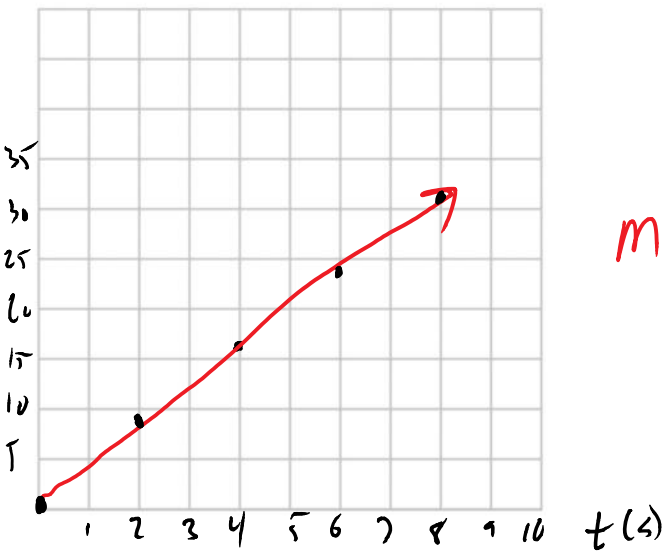


$a = 4 \frac{m}{s^2}$

So, your acceleration is the same, but it is you velocity that increases. Let's look at a graph of velocity.

$v = at$ $\quad y = mx + b$

v	t
0	0
8	2
16	4
24	6
32	8

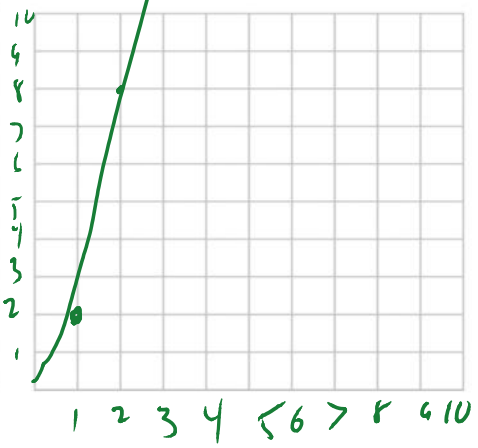


$m = 4$

That's pretty neat. But how far have you travelled? Let's look at distance.

$d = \frac{at^2}{2}$

d	t
2	1
8	2
18	3
32	4
50	5
72	6



Types of graphs:

We saw a linear graph at the start. It is shown as an equation as:

$$y = mx + b$$

We also saw an EXPONENTIAL graph. This is the distance v time graph above. In equation form it looks like this:

$$y = ax^2 + b$$

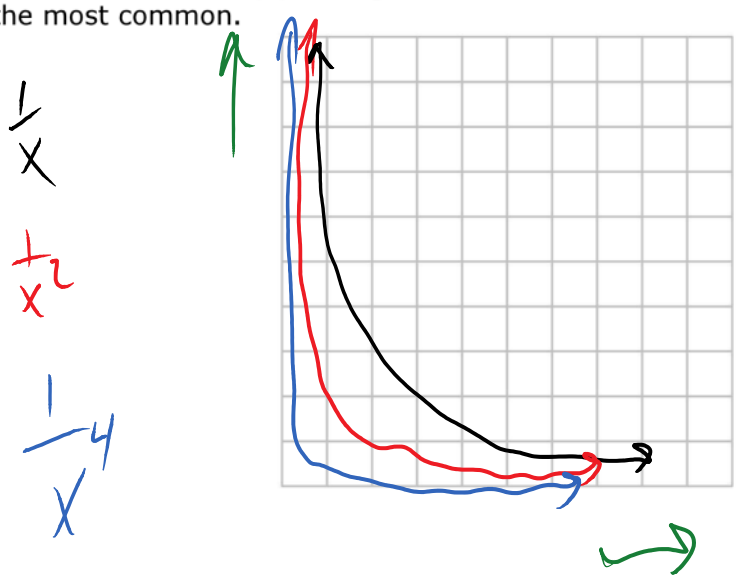
Though we should note that the *x* does not need to be raised to the power of two. It can be any number greater than one. Two is very common and it will come up a lot in both physics and in mathematics. Because of this it gets a special name for the function: Quadratic. As well as a special name for the shape of the graph: Parabola.

The last type of graph that you need to know about is called an inverse. This is when the variable '*x*' is in the denominator.

$$y = \frac{1}{x} \text{ or } y = \frac{a}{x^2}$$

asymptote

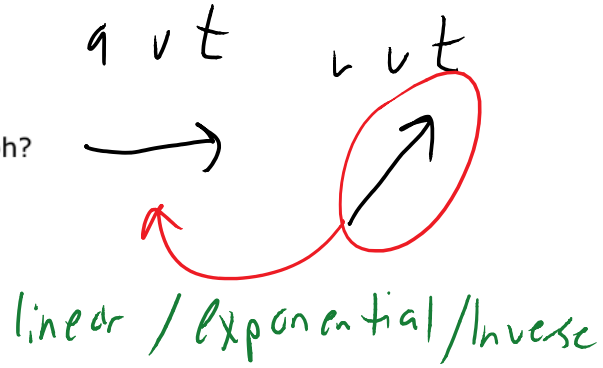
It doesn't have to be a one on top. It could be any number. Such as '*a*'. Also, it can have any power greater than one on the x. One and two are just the most common.



Last thing about graphs:

The slope. Remember our velocity v time graph?

Let's find the slope.



What type of graphs are these?

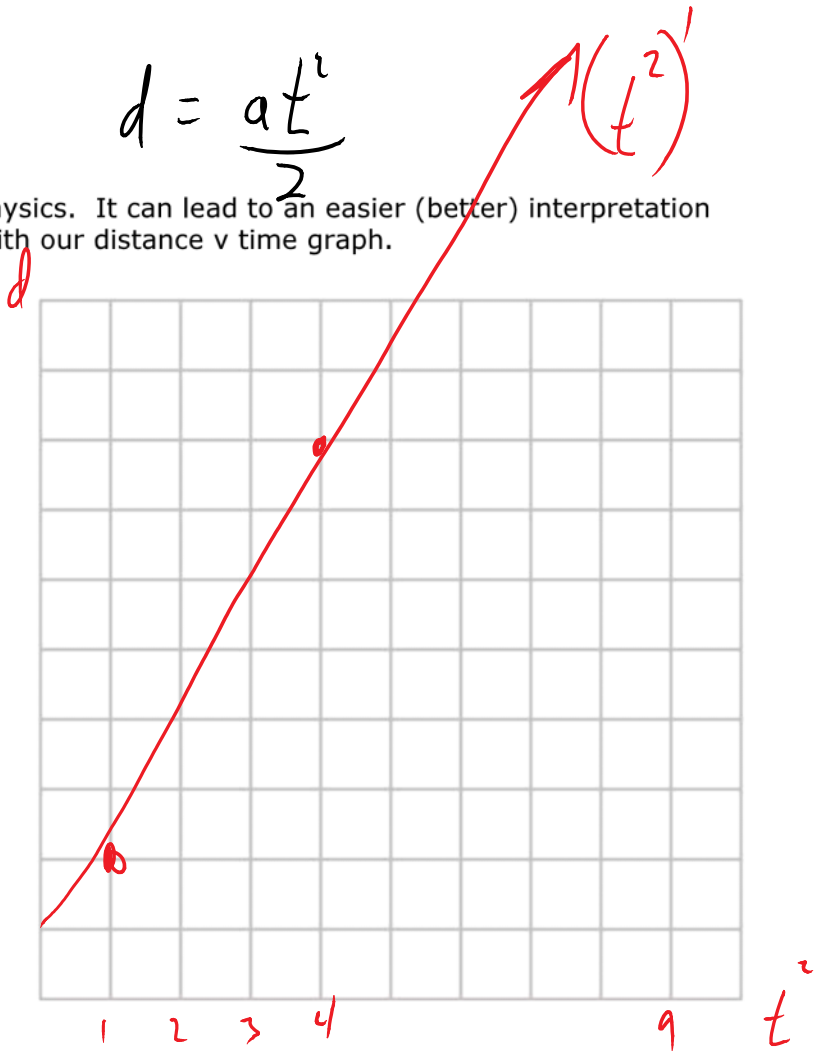
$v_f = v_0 + at$ linear	$p = mv$
$V = IR$ linear	$F = ma$
$d = d_0 + vt + \frac{at^2}{2}$ exponential	$F_g = G\frac{m_1 m_2}{r^2}$
$A = Pe^{rt}$	$F_c = \frac{mv^2}{r}$

$$d = \frac{at^2}{2}$$

Linearize:

We do this often in physics. It can lead to an easier (better) interpretation of data. Let's try it with our distance v time graph.

d	t^2
2	1
8	4
18	9



Plot these graphs.

- ➔ You will need between 5 and 10 points on your graph to accurately see the shape of the graph.
- ➔ For each graph state what type of graph it it.
  - ◆ If the graph is linear: Find the slope.
- ➔ Record the y intercept for each graph.

1) The acceleration of the Space Shuttle is approximately $5.25\frac{m}{s^2}$. Plot this acceleration vs time.
2) How long will it take to reach escape velocity? Remember v=at. Plot the graph of v vs t and see how long it will take to reach escape velocity (11,000 m/s) Hint: it will take a lot of seconds to get there! Use multiples of 200 seconds, or change the units to minutes.
3) Now find out how far the shuttle has travelled. Plot distance vs time of the shuttle. See how far the shuttle travelled by the time it got to escape velocity. Remember: $d = \frac{at^2}{2}$.
4) The population of Kelowna is growing by 1.8%/year. Start in 2015 with a population of 106 000 people.
5) Gravity is strong close and weak far away. Plot the attraction of you and your friend as you get closer together. $F_g = G\frac{m_1 m_2}{r^2}$.
   G $= 6.6x10^{-11}\frac{m^3}{kg*s}$
6) When the police find a body one of the ways that time of death is determined is by the temperature. Alive people have a temperature of 37℃. Newton gave us a formula for how quickly an object cools. Let's say a body was found at 30℃ and the surrounding air was at 22℃. $Temperature = T_s + (T_0 - T_s)0.8^t$. Plot Temp vs time. T_s is the surrounding temperature and T_0 is the temperature of the object. t is time.