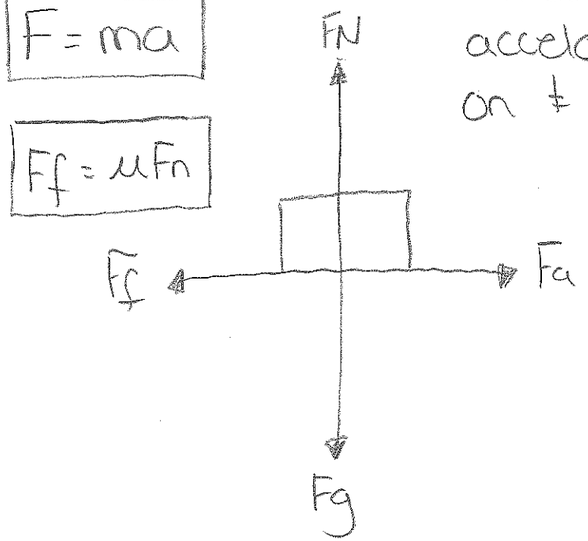
Review

Physics 11
Unit 8.1 - Special Relativity

Newton's 2nd Law: if an unbalanced force acts on an object, ↑ object will accelerate at a rate dependant on ↑ force & inversly on ↑ mass.

$F = ma$

$F_f = \mu F_n$



New Einstein

$E = mc^2$

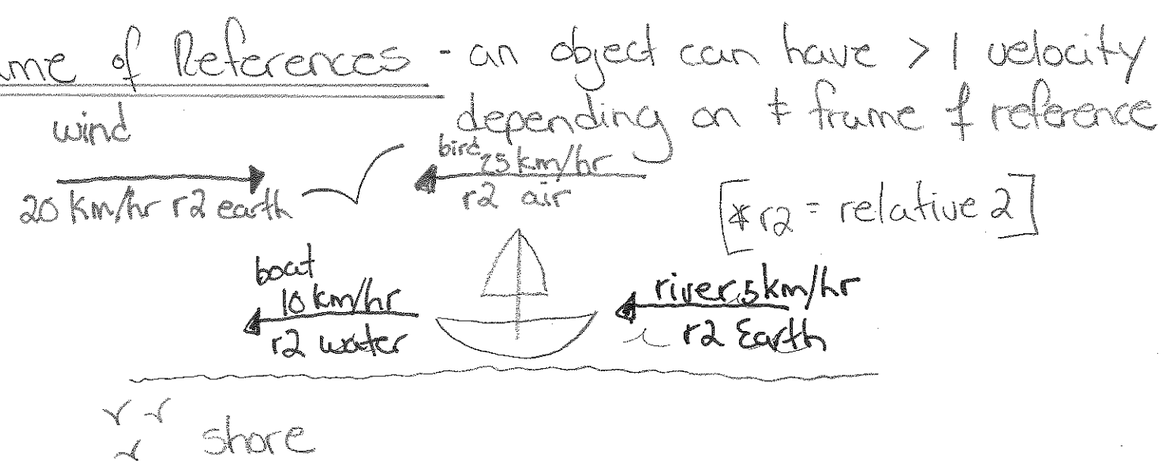
only some of his work:

a) wave/particle duality ↑ light

b) mass ⟷ energy [used i/t atomic bomb]

c) special theory ↑ relativity

Frame of References - an object can have > 1 velocity depending on ↑ frame ↑ reference



Do you have velocity when sitting on a moving train?

a) relative 2 ≠ train - NO

where it is being observed from

b) relative 2 ≠ earth - YES (300km/hr)

c) relative 2 ≠ space station - Yes 300 km/hr + velocity of rotating earth

d) relative 2 ≠ sun - Yes 300 + earth rotating + earth orbiting

Is there a frame of reference that is truly 'fixed'

* The speed of light is fixed and it is ≠ same for all observers, regardless of frame of reference

[predicted by Einstein, proven by Michelson & Morley]

Time Dilation [your time ≠ my time]

Einstein: a moving clock (time) will run slower ∴ stretching time → time dilation!

$$t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}}$$

t = time of observer (observing ≠ moving object)

t_o = time of ≠ moving object

v = velocity of ≠ object relative to ≠ observer

Example How much time is expanded or dilated from a fixed observers point of view, if a spaceship is moving at $v = \frac{1}{2}c$?

$$t = \frac{t_o}{\sqrt{1 - \frac{(0.5c)^2}{c^2}}} = \frac{t_o}{\sqrt{1 - \frac{0.25c^2}{c^2}}} = \frac{t_o}{\sqrt{0.75}} = t_o\left(\frac{1}{\sqrt{0.75}}\right) = \boxed{1.15\,t_o}$$

Length Contraction - length of an object is shorter when it is moving

$$l = l_o\sqrt{1 - \frac{v^2}{c^2}}$$

* l = length of moving object

l_o = length of object at rest

How long would a metre stick appear if it was moving past you @ a $v = 0.995c$

$$l = 1.00m\sqrt{1 - \frac{(0.995c)^2}{c^2}} = 1m\sqrt{1 - \frac{0.990c^2}{c^2}}$$

$$l = 1m\sqrt{1 - 0.990} = 1m\sqrt{0.01} = 1m(0.1)$$

$$\boxed{l = 0.10m \text{ or } 10cm}$$