



Approximations

SACE Stage 2 Physics

“We lied to you”

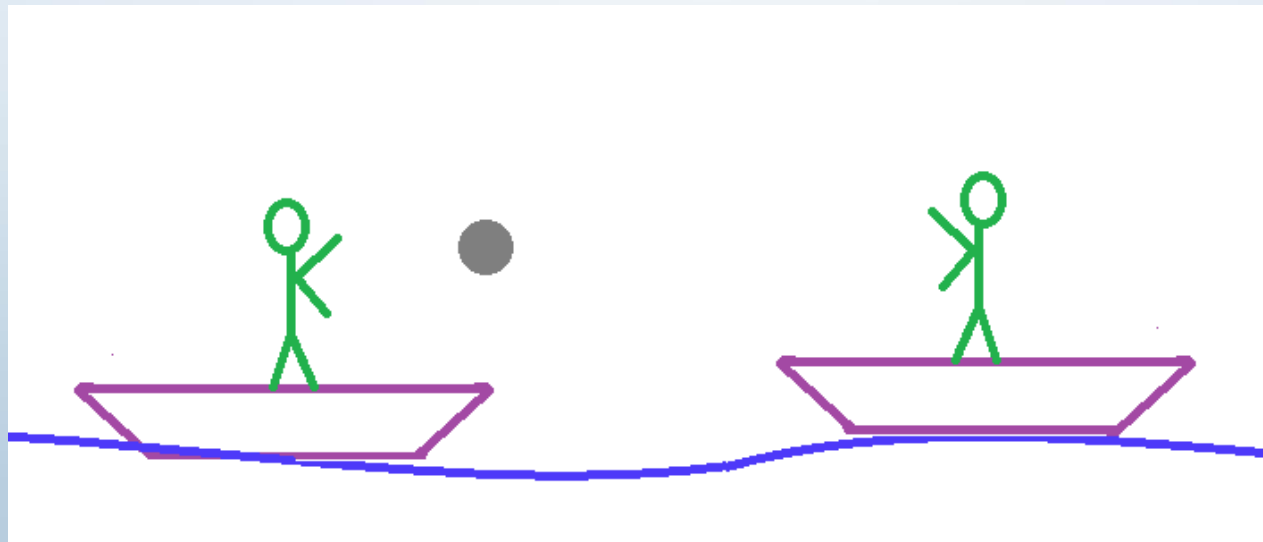
- You probably have gotten the idea that this is one of my favourite comments in stage 1 and 2 physics
- Well actually
 - Some things are simplifications
 - Some things are metaphors
 - Some are models
 - Some are lies

First - simplifications

- A **simplification** is an explanation that gives 'just enough' detail to provide an effective answer or description.
- Example
 - At the level of the everyday; electron flow is electricity, protons sit in the atomic nucleus and an atom is where the 'normal' number of protons is equal to the number of protons.
 - And that works fine. It explains electricity, electrostatic force existence (not its mechanism), and underpins atomic bonding.
 - Any discussion on quarks or photons does not add to comprehension

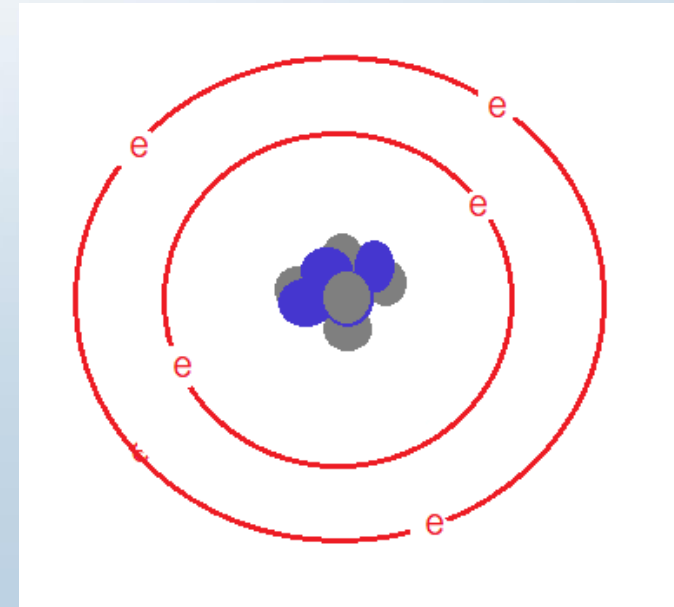
Second - metaphors

- A **metaphor** is where details of one thing is explained by reference to another
- Example;
 - You can explain the mechanism of electrostatic repulsion using the metaphor of two people in boats throwing balls at each other. With each throw or catch, a little bit of force is applied and the two boats move away from each other.



Third - models

- A **model** is a description that focusses of presenting specific properties rather than fully describing the entity
- Example;
 - An orbital or planetary model of atomic structure can be effectively used to explain chemical bonding and chemical reactions
 - It cannot account for electrostatic repulsion or conservation of energy, however, so what if the topic is valence and bonding.

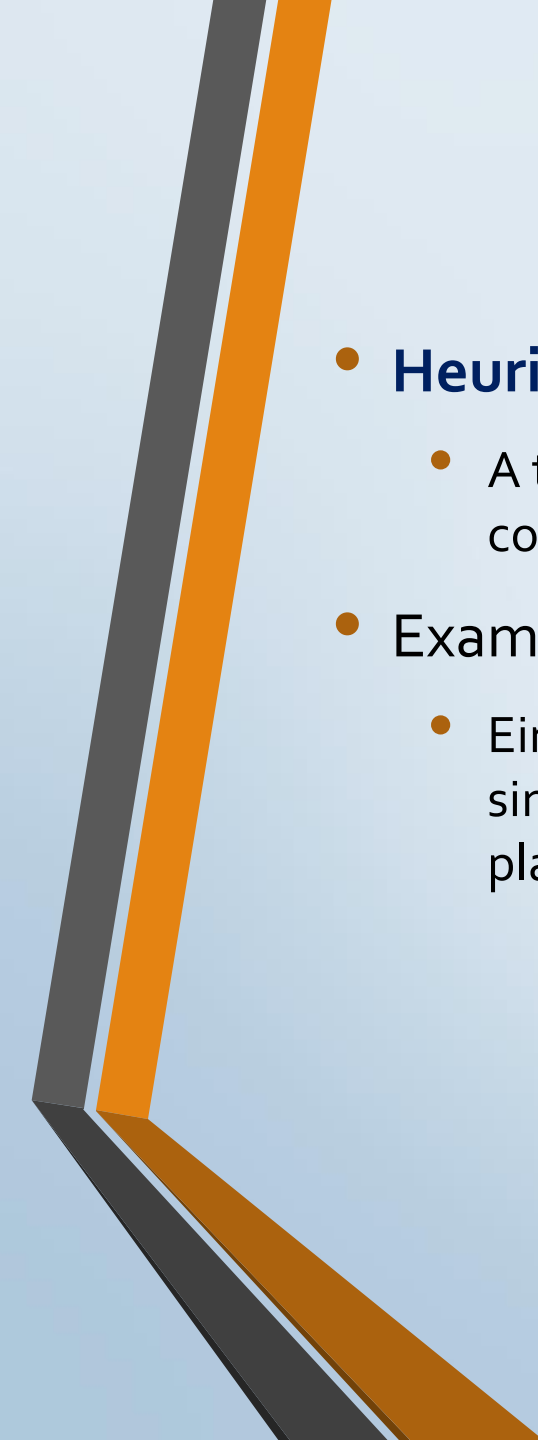


Fourth - lies

- Never happened

A few specific techniques you will hear

- **Parsimony** (definition)
 - Adoption of the simplest assumption
 - Don't add complexity unless you need to
 - Example
 - On this Earth, everything is moving in 3 dimensions that are changing in time on top of a revolving sphere (which induces an acceleration on everything) that is hurtling through the universe in a corkscrew trajectory
 - And yet, most motions can be analysed (within significant figure constraints) in one or two dimensions, ignoring the motion of the earth through the universe and its rotation around both the sun and its own axis.



- **Heuristic** (or heuristic technique)

- A technique that is not designed to be optimal or perfect. It may not even be considered rational. However, it will give a result that can be used for further decisions.

- Example

- Einstein used thought experiments to explain key parts of relativity which were simplistic, could not be replicated as an experiment and could never have 'numbers' placed on them, but which clearly portrayed concepts.

Occam's Razor

- A heuristic technique (often used by scientists). Which, as the name suggests, is aimed at 'slicing' off anything unnecessary
- As a result of Occam's razor, scientists should always favour the simplest explanation that any data set suggest. If further data does not support that explanation, the explanation is reviewed to the next most complex explanation.
- NOTE: Occam's Razor is not a law or irrefutable part of nature, it is however one of the tools scientists may choose to use.