WJEC Level 1-2 Engineering Unit 2: Solving applied engineering problems

Using mathematical techniques

Engineers use mathematical techniques to solve areas of engineering design problems across a wide range of areas, such as:

Area and volume is often required to be calculated to understand material us, cost, weight, etc.

Ohm's Law is commonly used in electronics for calculating the correct resistor to use with an LED or the amount of amps of a circuit.

Estimates are created to predict prices of material and production rates.

Ratios are calculated by equations to determine mechanical advantage in gears, levers and pulleys.

Linear dimensions often need to be calculated to ascertain a total dimension size on a drawing.

Scale may be applied to enlarge and reduce parts and components on engineering drawings.

Costings should be used to calculate the price totals of a range of items on a design such as:

- cost of electronic components to be used in a circuit
- unit process on parts created from stock sizes
- quantity process of components parts such as nuts, bolts, washers, etc.

Justifying suitable materials for use in an engineered final solution

Engineers must specify what materials are to be used to produce each component part within their design solution.

The materials must be appropriate and fit for purpose to meet the requirements placed upon them such as friction, torsion, loads, etc.

To successfully achieve this, testing should be undertaken to ensure that the selected or proposed materials are suitable for the task intended. Test can include destructive and non-destructive tests such as:

- **Impact testing:** how the material reacts to being struck by a weight or load.
- **Tension testing:** how the material responds to forces pulling in opposing directions.
- **Compression test:** the materials ability to resist deforming when squeezed together.
- **Shear test:** the materials ability to resist snapping (sheering) when a load is applied to it.

All of these tests are in indications of a materials characteristics such as:

- hardness
- density
- ductility
- elasticity
- plasticity

Justifying suitable processes for manufacturing the final engineered solution

Engineers need to suggest or select appropriate manufacturing techniques for their engineered solutions. These should include:

Method for material removal should focus on how forms can be achieved using cutting and filing techniques or using equipment such as lathes and millers.

Methods for shaping material should make recommendations to tools and equipment, which could be used to fabricate shapes through bending or forming. This could include the use of a sheet metal bender, vacuum former, strip heater for plastics, etc.

Joining methods covers both permanent and temporary fixings. Brazing, soldering and welding could be applied as well as riveting or using nuts and bolts or other temporary methods.

Assembly methods should look at how components and parts are put together. Is there a sequence? Does one part need to be assembled before another can be but in place?

Heat and chemical treatments should focus on the need to anneal or temper materials. Chemicals can be applied to clean or etch metals.

Finishing should state what finish is to be applied to a part such as knurling or painting.