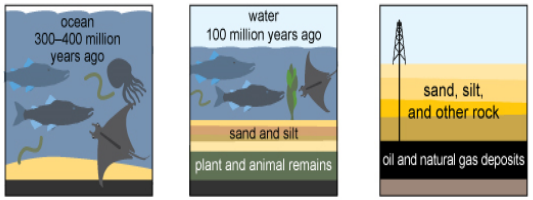
Petroleum and natural gas formation

Tiny marine plants and animals died and were buried on the ocean floor. Over time, the marine plants and animals were covered by layers of silt and sand.

Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned the remains into oil and natural gas.

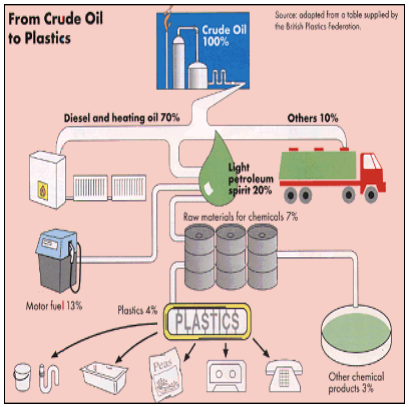
Today, we drill down through layers of sand, silt, and rock to reach the rock formations that contain oil and natural gas deposits.



Source: Adapted from National Energy Education Development Project (public domain)

Oil is thought to have formed over **millions of years** from the break down of tiny **dead creatures.** Natural gas is formed alongside oil. The dead organisms sank to the bottom of lakes or seas and became **trapped** in muddy sediments. As the sediments built up, the lower layers were under pressure. They eventually turned to rock. If there was no oxygen in the sediments, **heat and pressure** turned the remains of the organisms into oil and natural gas.

The large majority of plastics we use today are formed from oil. Crude oil is separated into separate batches of different compounds by heating it in a process called fractional distillation



Oil and pollution

There are many risks involved with the extraction and processing of oil. Oil spills from oil rigs, pumping stations and oil tankers can cause huge environmental problems for both marine and land habitats.
Airborne pollution from oil refineries contributes towards both acid rain and increasing carbon dioxide in the atmosphere. This can impact on peoples health, have a negative effect on the environment, damage habitats and contribute towards climate change.

Thermoplastics are a group of plastics (polymers) that as they are heated become soft and **CAN be moulded** over and over again. These plastics then harden as they cool. The Polymers in Thermoplastics do not form strong bonds so they can move over each other and be reshaped when subjected to heat.

Advantages
•Highly recyclable
•Aesthetically-superior finishes
•High-impact resistance
•Remolding/reshaping capabilities
•Chemical resistant
•Eco-friendly manufacturing

Disadvatages
•Generally more expensive than thermoset
•Can melt if heated

Thermoset plastics are a group of plastics that once they have been moulded and set **CANNOT be remoulded.** Once moulded, they do not soften when heated and they cannot be reshaped. Its polymer chains are joined together by cross-links, so they cannot slide past each other easily.

As a result of this resistance to heat **Thermosetting plastics** are suitable where a degree of heat resistance is required, such as engines, electrical components and fittings, saucepan handles etc.

Advantages
•More resistant to high temperatures than thermoplastics
•Highly flexible design
•Excellent aesthetic appearance
•Cost-effective

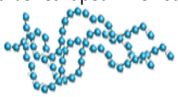
Disadvantages
Cannot be recycled
More difficult to surface finish
Cannot be remolded or reshaped

Tips for exams

- If it's a **drinks bottle its PET.**
- If it's a **chemical** container its probably **HDPE.**
- If it's a **thin film** its probably **PVC** or **LDPE** – both would be accepted.
- If its **safety** equipment its **PC.**
- If its **anything else** it could be **ABS** because they cant prove otherwise**.**
- If its **packaging** it is **expanded polystyrene.**
- If its around **food** it will be **PET, HDPE, LDPE**

There are many types of plastics that are used for a huge variety of different tasks. These plastics can be divided into two main groups; Thermosetting plastics and Thermoplastics. Plastics are made up of long strings of monomers that bind together to form **polymers.**

Thermoplastics are a group of plastics (polymers) that as they are heated become soft and **CAN be moulded** over and over again. These plastics then harden as they cool. The Polymers in Thermoplastics do not form strong bonds so they can move over each other and be reshaped when subjected to heat.

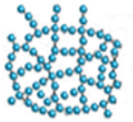


Thermoplastic

Common Thermoplastic Polymers

Some of the most commonly found thermoplastic polymers include polyethylene, polypropylene (PP), polyvinyl chloride (PVC), polystyrene, polytetrafluoroethylene (PTFE, commonly known as Teflon), Acrylonitrile butadiene styrene (ABS plastic), and polyamide (commonly known as nylon).

Thermoset plastics are a group of plastics that once they have been moulded and set **CANNOT be remoulded.** Once moulded, they do not soften when heated and they cannot be reshaped. Its polymer chains are joined together by cross-links, so they cannot slide past each other easily.



Thermoset

As a result of this resistance to heat Thermosetting plastics are suitable where a degree of heat resistance is required, such as engines, electrical components and fittings, saucepan handles etc.

Common Thermoset Polymers

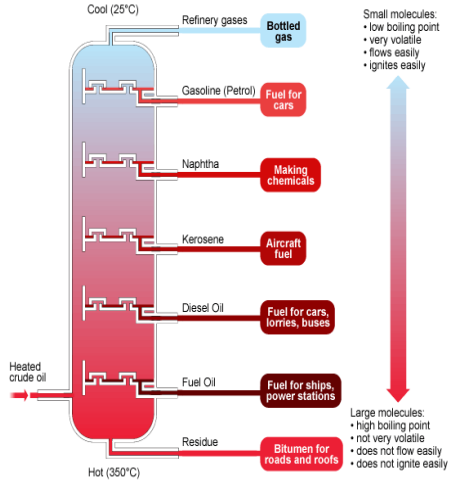
Some of the most commonly found Thermosetting polymers include Epoxy Resin, Melamine Formaldehyde, Polyester Resin and Urea Formaldehyde

Fractional distillation of crude oil

Crude oil is a **mixture** of many thousands of different compounds with different properties. They are called **hydrocarbons** because they only contain the elements hydrogen and carbon.

To make crude oil useful, batches of similar compounds with similar properties need to be sorted. These batches are called **fractions** and they are separated by **fractional distillation.**

The theory behind this technique is that some of the compounds in crude oil are easily vaporised, for example, they are volatile due to their low boiling points. Others are less volatile and have higher boiling points.



Tips for exams

- **If its electrical - it Urea Formaldehyde**
- **If its worktop or flooring – it Melamine Formaldehyde**
- **If its GRP or carbon fibre – Its Polyester Resin**

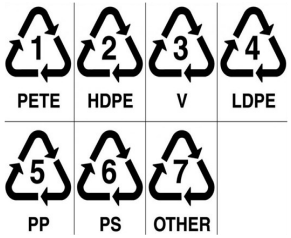
Thermoplastics

The majority of plastics that are used each day are Thermoplastics. Due to the fact they are easy to mould, can be recycled and have a wide variety of uses.
A large proportion of plastics can be identified by their **Resin Identification Code.** This is normally stamped on the product so we can identify the type of plastic it is made from.

Look on the bottom of your bottle of water, you will see this symbol. It is made up of the recycling symbol we are all familiar with, a number and sometimes letters. The number and letters identify plastic in the picture as 1 (PET) **Polyethylene terephthalate.** PET is fine in all exam situations!!!!

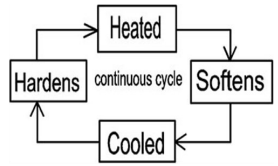
Resin identification codes

These were introduced in 1988 to help identify the main groups of plastics to help with recycling. They identify 6 named types of plastic and all others are grouped as number 7



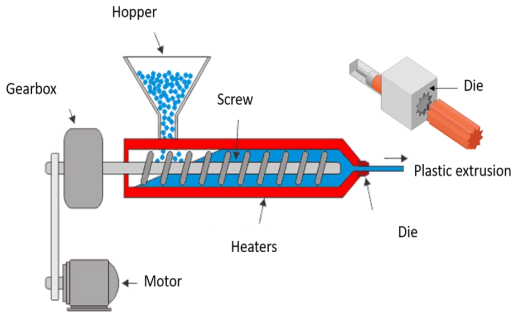
7 – OTHER

These days we use such a wide variety of different plastics that a large proportion of products will fall into the 'OTHER' category. For example Other **acrylic, nylon, polycarbonate (PC), and Acrylonitrile Butadiene Styrene (ABS)**



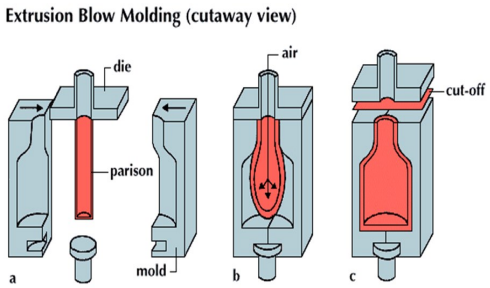
Extrusion

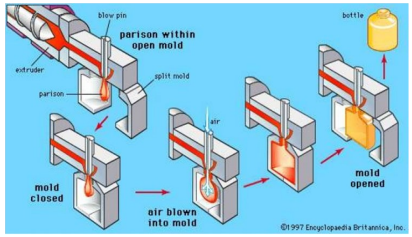
Extrusion is the starting point for other forms of plastic moulding as will be seen later. Extrusion is generally used to form of plastic moulding. It is used to form pipes, moulded sections and trunking. Plastic granules are fed into the screw barrel by a hopper, as they pass along they are heated and for a semi liquid homogenous mass. This is then forced out under pressure through the DIE, what ever the shape of the die the plastic adopts. It is then cooled rapidly in water baths to stop it deforming and cut to the required length.



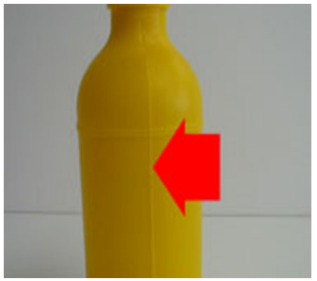
Blow Moulding

Blow moulding is a plastic moulding process that is often used to form hollow products such as bottles. A plastic tube is extruded following the extrusion process discussed earlier. This tube is known as a **parison**. The parison is clamped between two halves of a mould and air is blown in through one end. The hot, flexible plastic is blown out and takes on the shape of the mould. The steel mould helps the plastic cool rapidly. When cooled the mould opens and the bottle falls out.



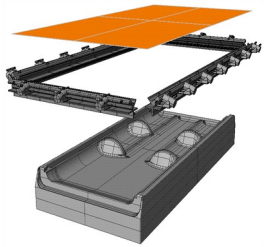


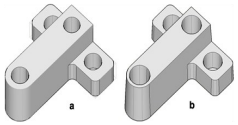
Products that are blow moulded often have a visible line down them on opposite sides, this is where the mould opens, it is known as a split line.



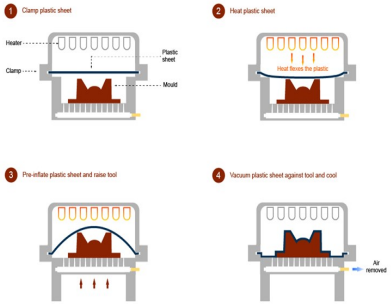
Vacuum Forming

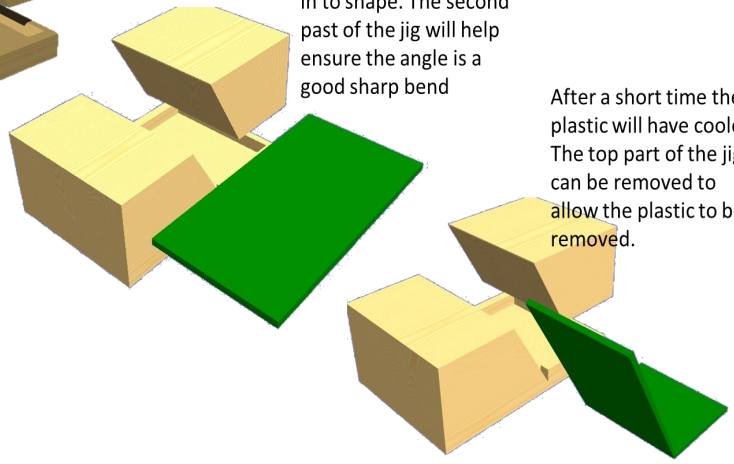
The vacuum forming process involves heating a plastic sheet until soft and then dropping it over a mould. A vacuum is applied sucking the sheet into the mould. The finished sheet is then taken from the mould.
The table that moves the mould up in to the soft plastic sheet is called the plattern. As the plattern is pushed up and the plastic starts to form the shape of the mould the vacuum is turned on actually sucking the plastic tight over the mould.





All moulds must have a **DRAFT** angle to allow them to be removed from the formed plastic. The sides must have an angle of around 5º to allow the parts to separate.





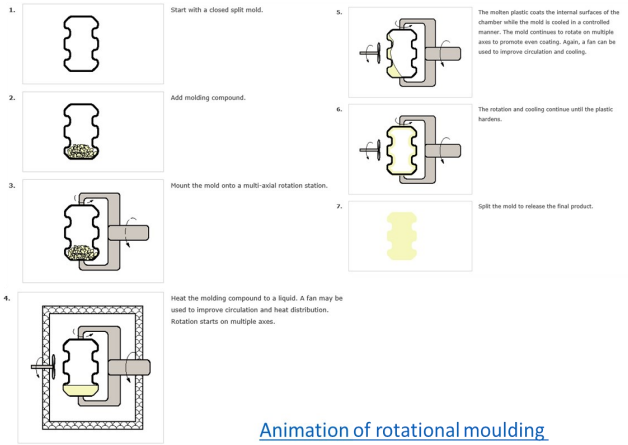
A jig is used in manufacturing to allow us to make the same part exactly the same over and over again.
In this case to put the first bend in a piece of plastic. This is a two part jig.

Once the plastic has been heated on the line bender it is placed into the jig and gently bent in to shape. The second past of the jig will help ensure the angle is a good sharp bend

After a short time the plastic will have cooled. The top part of the jig can be removed to allow the plastic to be removed.

Rotational Moulding

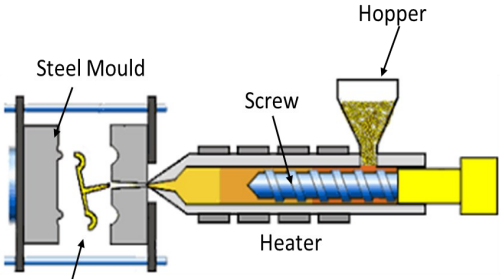
Rotational moulding is a plastic moulding process commonly used to make large, hollow products.
Plastic powder or granules are loaded into an open mould. The mould is then sealed and heated. The mould then spins around 3 axis so the plastic sticks to the cooling metal mould. Layers are built up by adding more plastic following each cooling process.



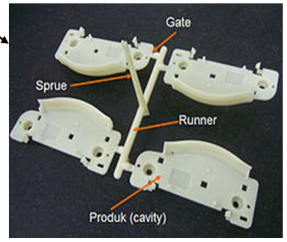
Animation of rotational moulding

Injection Moulding

Injection Moulding along with extrusion ranks as one of the main processes for producing plastics articles. It is a fast process and is used to produce large numbers of identical items from high precision engineering components to disposable consumer goods.
The process is similar to the extrusion process in terms of the hopper and screw, how ever rather than the plastic being pushed through a die it is injected under pressure into a steel mould.

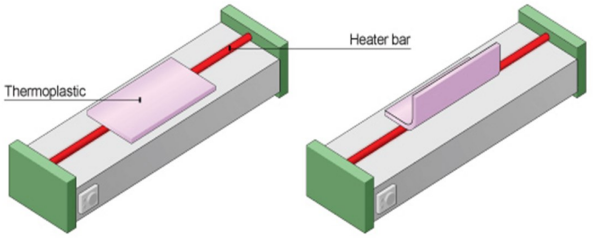


Injection moulded product



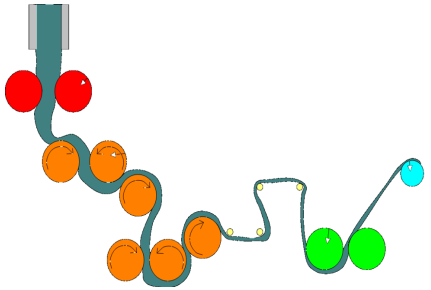
Line Bending/Strip heating

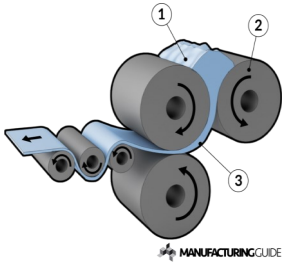
Line bending/strip heating is a simple process often used with ACRYLIC to bend a straight line in the plastic.
The acrylic is heated slowly over a heated bar or wire. This softens the plastic which then allows it to be reformed (bent) along the heated line.
Simple angles can be completed easily and with some planning some more complex shapes can be achieved. To ensure accurate bends a jig should be used to hold the soft plastic at the desired angle until it has hardened.



Calendaring

Calendaring is the process of squeezing a soft (melted) plastic between several rollers. The careful control and space between thee rollers will determine the eventual thickness of the plastic film.
The original plastic is extruded from the same as we looked at in the extrusion process. This melted extrusion is then dropped onto the first few sets of rollers to position and start the cooling process. The other rollers in the process stretch and adjust the thickness of the desired film.

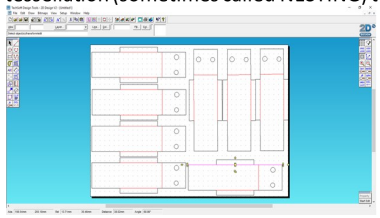




Laser cutter

Although technically not a moulding process the laser cutter is often used in schools and industry to shape plastic.
The laser cutter is a 2 Dimensional cutting machine that can also engrave on to a range of materials.
In schools laser cutters are used to cut a variety of materials, but acrylic is widely used. This **CAM (Computer Aided Manufacture)** process is quick, easy and produces a finished edge when cutting acrylic.

A design is produced in a **CAD (Computer Aided Design)** package and sent to the laser cutter. A popular CAD program would be **2D Design.** This CAD design would identify which parts of the plastic are to be cut and which engraved. If multiple products are needed the designs should be collected together in a tessellation (sometimes called NESTING) to save material.



As discussed previously the majority of plastics are made from oil. This causes problems fom the environment through the process of extracting oil from the ground or under the sea. There are also problems with the processing of oil into compounds we can use as plastics and the pollution these produce.

Plastic also creates problems following our use and its **final disposal**. Plastic is generally not biodegradable, meaning it is not easily broken down naturally by animals and enzymes digesting it. Plastics have only been around for about 70 years. So microorganisms simply haven't had much time to evolve the necessary biochemical tool kit to latch onto the plastic fibres, break them up into the constituent parts and then utilise the resulting chemicals as a source of energy and carbon that they need to grow.

Disposing of plastic

According to National Geographic only 9% of plastic is recycled.
The vast majority—79%—is accumulating in landfills or discarded in the natural environment as litter. Meaning: at some point, much of it ends up in the oceans, the final sink.

Environmental impact of disposal.

- Most plastic ends up in landfill, land that cannot be used again as plastic does not natural degrade.
- A large proportion is simply litter damaging habitats.
- Much will finally end up in the ocean as small pieces where it is ingested and will enter the food chain.

Can plastics be environmentally friendly?

If we recycled 100% of all plastic produced then there is every chance the use of plastics would become sustainable, but we don't. Alternatives are needed to allow us to continue to use this versatile material.

I order to make plastic more environmentally friendly we need to look at:

- **Bioplastics** made from natural materials such as corn starch
- **Biodegradable** plastics made from traditional petrochemicals, which are engineered to break down more quickly
- **Eco/recycled plastics**, which are simply plastics made from recycled plastic materials rather than raw petrochemicals.

Bioplastics

The theory behind bioplastics is simple: if we could make plastics from kinder chemicals to start with, they'd break down more quickly and easily when we got rid of them.

The most familiar bioplastics are made from natural materials such as **corn starch** and sold under such names as *EverCorn™* and *NatureWorks*. Some bioplastics look virtually indistinguishable from traditional petrochemical plastics.

Polylactide acid (PLA) looks and behaves like polyethylene and polypropylene and is now widely used for food containers.

Biodegradable plastic is **plastic** that decomposes naturally in the environment. This is achieved when microorganisms in the environment metabolize and break down the structure of **biodegradable plastic**. The end result is one which is less harmful to the environment than traditional **plastics**

Some supermarkets now use what are described as **photodegradable**, **oxydegradable**, or just **biodegradable bags** (in practice, whatever they're called, it often means the same thing). As the name suggests, these biodegradable plastics contain additives that cause them to decay more rapidly in the presence of light and oxygen (moisture and heat help too). Unlike bioplastics, biodegradable plastics are made of normal (petrochemical) plastics and don't always break down into harmless substances: sometimes they leave behind a toxic residue and that makes them generally (but not always) unsuitable for composting

Mr Evans 2018

Eco/recycled plastics

One easy solution to the problem of plastic disposal is to recycle old plastic materials (like used milk bottles) into new ones (such as items of clothing). A product called ecoplastic is sold as a replacement for wood for use in outdoor garden furniture and fence posts. Made from high-molecular polyethylene, the manufacturers boast that it's long-lasting, attractive, relatively cheap, and nice to look at.