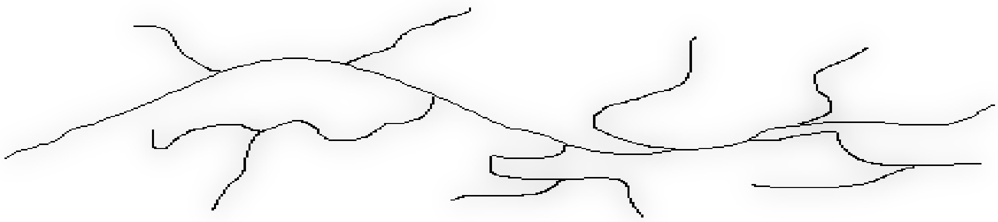
1.8 Describe the uses of the polymers made from the above monomers in terms of their properties

Polyethene:

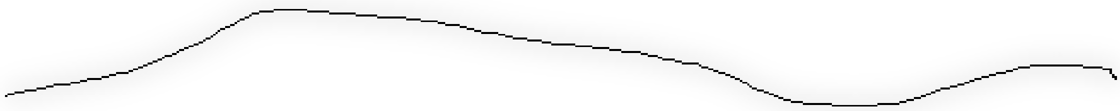
Polyethene is a generally non-toxic, waterproof plastic that is a good insulator and is chemically resistant. There are 2 main types of polyethene that can be formed:

1. LDPE:
   - Highly branched carbon chains create weaker dispersion forces and low density because molecules are less tightly packed (therefore less intermolecular forces)
   - This leads to a soft, flexible polymer with a low melting point (lower tensile strength and increase ductility
   - Thus, it is suitable for use in cling wrap, plastic shopping bags, squeeze bottles and electrical insulation, which all require flexibility and light weight but not high durability



A molecule of branched polyethylene, or LDPE

2. HDPE:
   - Unbranched, longer carbon chains pack more tightly therefore creating stronger dispersion forces (low degree of branching creates stronger intermolecular forces)
   - HDPE is thus more rigid with a stronger tensile strength, crystalline and has a higher melting point and boiling point
   - It is therefore used in plastic crates, rubbish bins, freezer bags and chemical containers as it is more durable and tougher than LDPE



A molecule of linear polyethylene, or HDPE

PVC:

- PVC has a chlorine side chain, which gives it less flexibility and makes it tougher. It is also generally chemically resistant, waterproof and is a good insulator. Pure PVC is not useful as it readily decomposes in UV and is quite brittle, and therefore, additives (e.g. plasticisers and titanium) are added to improve the properties
- Depending on the type of additive, there are 2 types of PVC:
  1. Flexible PVC is used for garden hoses, electrical insulation and chemical bottles, which require some degree of durability as well as flexibility
  2. Rigid PVC is used for gutters, credit cards, water pipes and floor tiles. These also require some degree of durability but not flexibility

Polystyrene:

- Polystyrene has a very bulky benzene side chain, which makes it hard and inflexible. It comes in 2 forms:
    1. Crystalline polystyrene can be used for medicine cups, CD cases, drinking glasses and screwdriver handles → these applications require a very durable, strong lightweight plastic
    2. Expanded polystyrene is formed when gases are blown through liquid polystyrene. As it cools, a foam plastic is produced. This is an excellent lightweight insulator as well as a good shock absorber due to the trapped air → it is therefore used in insulating cups, eskies and packing materials

Recap:

Polymer	Use	Property
Polyvinylchloride (PVC)	• Electrical Wire Coating	Good electrical insulator, tough and flexible
	• Water Pipes	Impermeable, does not corrode, flexible, durable and easy to manufacture in long tubes

Polymer	Use	Property
Polystyrene	• Foam Cups	Good thermal insulator of heat
	• Packaging	Light (as its full of air), cheap, absorbs impact and is strong in compression
	• Tools	Brittle and hard

Polymer	Use	Property
Low-Density Polyethylene (LDPE)	• Plastic Cling Wrap	Flexible and non-toxic
	• Disposable Shopping Bags	Cheap and relatively strong
	• Milk Bottles	Non-Toxic, cheap, inert and recyclable
Polymer	**Use**	**Property**
High-Density Polyethylene (HDPE)	• Kitchen Utensils	Strong and inert
	• Building Materials	Hard and rigid
	• Rubbish Bins	Hard and slightly flexible

Analyse the benefits and problems associated with the use of radioactive isotopes in identified industries and medicine -

Benefits	Limitations
Medicine: - Allows us to study many things we couldn't before (e.g. radio-imaging, chemical processes, leaks) - Allows us to treat certain medical conditions (e.g. through radiotherapy) - Allows us to detect and diagnose diseases within the human body without surgery **Industry:** - Allows us to irradiate (sterilise) foods and equipment - Allows us to date fossils and rocks - Allows food to be preserved for a greater amount of time, saving money in the long-run (increases the "shelf-life") - Used to detect irregularities in the thickness of certain materials - Domestic smoke alarms use americium-241	• Ionising radiation may disrupt cellular processes and affects the structure of enzymes → leading to cancer • Modifies sex cells, inducing mutations, affecting births • Radioisotopes that become incorporated into the body are particular dangerous • Nuclear reactors produce considerable amounts of nuclear waste, which we have no way of disposing safely, thus last for thousands of years, for future generations • Radioisotopes can cause malfunction of electronic devices • Depleted material have significant half-lives and take a longer time to decompose (hundreds of years) • They are difficult to store and thus are costly (need thick concrete and lead) • Radioactive material must also be labelled with the universal nuclear warning symbol, which is expensive

Describe recent discoveries of elements –

1. **Ununhexium:**
   - **Element 116 was synthesised in Dec 2000 by the Joint Institute for Nuclear Research in Russia. It was produced through the fusion of curium-248 and calcium-48. The atom decayed 48milliseconds after production and as such, there are no apparent uses and its atomic mass is unknown.**
2. **Ununpentium:**
   - **Element 115 was synthesised in Feb 2004 by the Joint Institute for Nuclear Research as well as the Lawrence Livermore National Laboratory in America. It was produced through the fusion of americium-243 and calcium-48. The atom then underwent Alpha decay, to form element 113 (a new element). There are no apparent uses of the element and its mass is unknown.**
3. **Ununoctium:**
   - **Element 118 is the most recently produced element, and is also the heaviest element. It was produced by the fusion of californium-249 and calcium-48 at the Lawrence Berkeley National Laboratory. It has unknown mass and no apparent uses.**