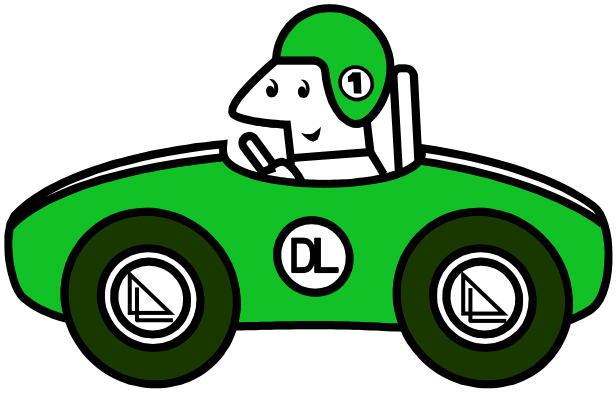
Intermediate 1

Int 1 Chemistry



Section 7

Fuels

7LO Section 7: Learning Outcomes

LO	Lesson	Text Book	Int 1: Section 7 Fuels Learning Outcome	Int1 Only
1	7.1	p109	A fuel is a chemical which is burned to produce energy.	
2	7.1	p109	When a substance burns it reacts with oxygen.	
3	7.1	p109	**Combustion is another word for burning.**	**Int1**
4	7.1	p109-p110	A fire needs a fuel, oxygen (usually from the air) and a temperature high enough to start the fire and keep it going; take away any one of the three and the fire goes out.	
5	7.2	p110-p112	Fire- fighting methods in the lab and the home include the use of a fire blanket, sand, water, and carbon dioxide gas and foam.	
6	7.2	p110-p112	Different methods are used in different situations.	
7	7.2	p113	Water must not be used with oil, petrol and electrical fires.	
8	7.3	p113	Fossil fuels are formed from animal and plant remains over a very long period of time.	
9	7.3	p113-p114	There are many examples of fossil fuels, including coal, natural gas, oil and peat.	
10	7.4	p115	Fossil fuels are finite resources, i.e. they cannot be replaced.	
11	7.4	p114	Over-use of fossil fuels may lead to a fuel crisis.	
12	7.4	p115	Oil spillages can cause great damage to marine life and the environment.	
13	7.5	p116	**The compounds which are found in fossil fuels are mainly hydrocarbons.**	**Int1**
14	7.5	p116	**A hydrocarbon is a compound which contains hydrogen and carbon only.**	**Int1**
15	7.5	p116	**Hydrocarbons burn in a plentiful supply of air to produce carbon dioxide and water.**	**Int1**
16	7.6	p116	**Methane, ethanol and hydrogen are renewable sources of energy, i.e. they can be replaced.**	**Int1**
17	7.6	p116-p117	**Methane is found in biogas which can be generated by the decomposition of waste plant material.**	**Int1**
18	7.6	p117	**Ethanol is obtained from sugar cane and can be mixed with petrol to make a fuel for cars.**	**Int1**
19	7.6	p118	**Hydrogen, which can be obtained from water, is a likely fuel for the future.**	**Int1**
20	7.7	p118	Crude oil is a mixture of hydrocarbons.	
21	7.7	p118	A fraction is a group of hydrocarbons with boiling points within a given range.	
22	7.7	p118	**Fractional distillation is the process used to separate crude oil into fractions according to the boiling points of the components in the fractions.**	**Int1**
23	7.7	p118	**Hydrocarbons which consist of smaller molecules tend to boil more easily than hydrocarbons which consist of larger molecules.**	**Int1**
24	7.8	p119	The different fractions are used as different fuels.	
25	7.9	p120	**The uses of the fractions are related to the ease of evaporation, viscosity, flammability and boiling point range of the fractions.**	**Int1**
26	7.10	p120-p121	**Fractional distillation of crude oil yields more long chain hydrocarbons than are useful for present-day industrial purposes.**	**Int1**
27	7.10	p121	**Cracking is an industrial method for producing a mixture of smaller, more useful molecules.**	**Int1**
28	7.11	p122-p123	Carbon, and carbon monoxide, a poisonous gas, can be produced when hydrocarbons burn in a low supply of oxygen.	
29	7.11	p123	**The burning of some fuels releases sulphur dioxide, a poisonous gas, into the atmosphere.**	**Int1**
30	711.	p124	**Nitrogen and oxygen from the air can react inside a car engine to form nitrogen dioxide which is a poisonous gas.**	**Int1**
31	7.11	p124	Lead compounds which are added to petrol cause pollution.	
32	7.11	p124	**Benzene fumes in unleaded petrol are toxic.**	**Int1**
33	7.11	p123	Soot particles produced by the incomplete combustion of diesel are harmful.	
34	7.11	p125	Air pollution from the burning of hydrocarbons can be reduced by the use of catalytic converters which convert the pollutant gases to harmless gases.	

7.1 Fire & Burning

a) **Copy** the following passage into your jotter.

Burning fuels to make energy is a very important process:

We need energy for - heating

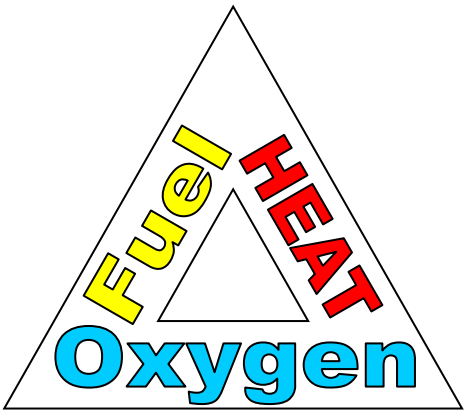
- movement/transport
- light

b) **Copy** and **complete** the following sentences using the word bank.

wordbank			
Burn	Combustion	Oxygen	Fuel

1. A …… is a substance which is burned to give out energy.
2. Burning is a chemical reaction where a substance chemically reacts (joins up) with the element …… .
3. The scientific term for burning is …… .
4. Oxygen is required for substances to …… .

c) **Copy** the following diagram into your jotter.



All 3 sides of triangle must be present for FIRE

- Remove one side of triangle and FIRE goes out

d) If you have time, **produce** a poster on the fire triangle for display.

7.2 Fire Fighting

a) **Copy** the following passage into your jotter.

Putting put fires involves removing any one of the sides of the FIRE TRIANGLE.

b) **Copy** and **complete** the following table in your jotter.

Type of Fire Extinguisher	Fire Triangle Broken by:		
	Oxygen removed	Heat Removed	Fuel Removed
Sand Bucket	✓	✘	✘
Fire Blanket			
Water			
Carbon Dioxide			
Foam			
Powder			

c) **Watch** the demonstration of water being added to an oil fire.

d) **Answer** the following questions in your jotter.

1. Why is water <u>not</u> used on oil/petrol fires?
2. What 2 steps would you take to put out a *chip pan* fire?
3. Which 2 types of fire extinguisher would you not use on an electrical fire?
4. Why can carbon dioxide fire extinguishers be ineffective outdoors?

7.3 Fossil Fuels

a) **Copy** the following passage into your jotter.

The biggest group of fuels we use are called the **Fossil Fuels**.

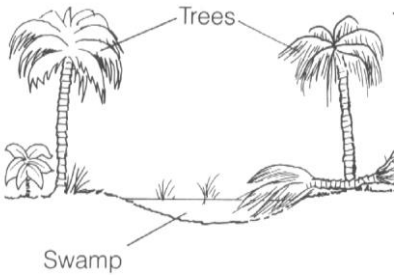
- Coal
- Oil
- Natural Gas
- Peat

b) **Collect** a copy of the diagram on the formation of fossil fuels and **stick** into your jotter.

Formation of Fossil Fuels

a) Formation of Coal

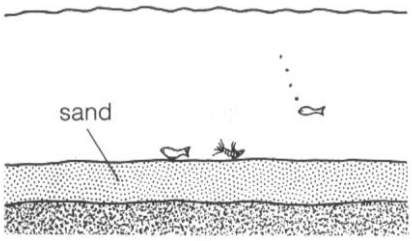
1.



- Tree and plant materials die
- Tree and plant materials fall to bottom of swamp.
- Dead materials get covered in mud.

b) Formation of Oil and Gas

1.

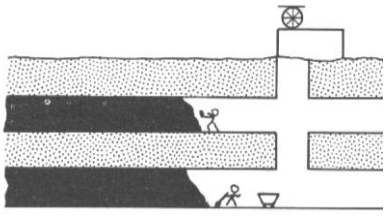


- Sea organisms die
- Sea organisms fall to bottom of sea.
- Dead organisms get covered in sand.

2. Dead materials get compressed by heavier and heavier layers of rock.

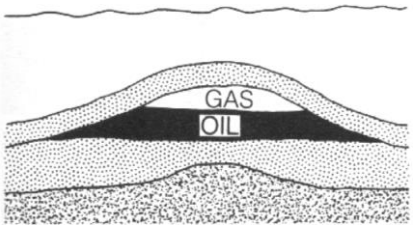
3. Over <u>millions</u> of years, dead material turns into coal, oil or gas
(it depends on the starting material)

4.



Coal mined out of the ground

4.



Fuel Companies Drill to Collect Oil/Gas

7.4 Problems With Fossil Fuels

a) **Copy** the following passage into your jotter.

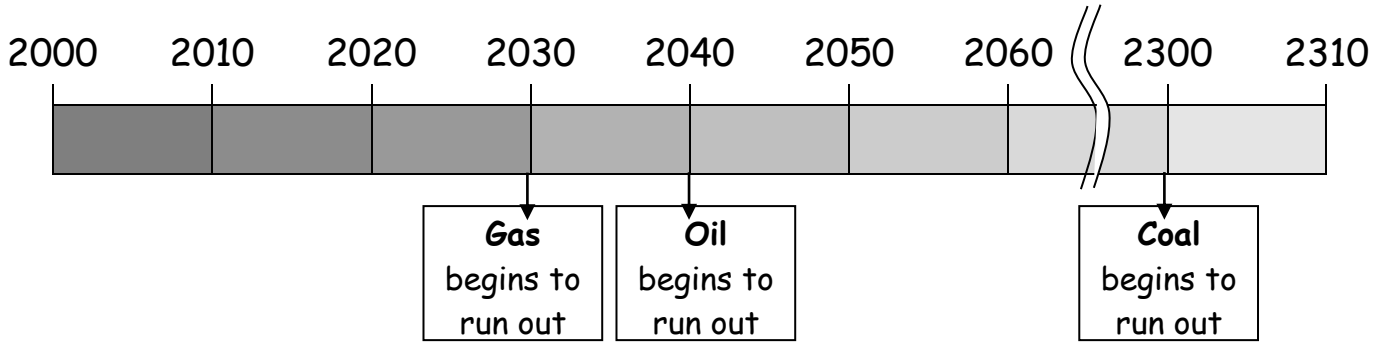
Fossil fuels (coal, oil and natural gas) will eventually run out if we use them too much.

- Fossil fuels are **finite** resources (they will run out eventually)
- A fuel crisis may occur as oil and natural gas start to run out.

b) **Copy** the following table into your jotter.

Type of Fossil Fuel	Approximate Date Fuel will Start to Run Out
Coal	
Oil	
Natural Gas	

c) Use the information in following diagram to **complete** your table.



d) **Answer** the following question fully in your jotter

1. Why do oil spills cause so much damage to the environment?

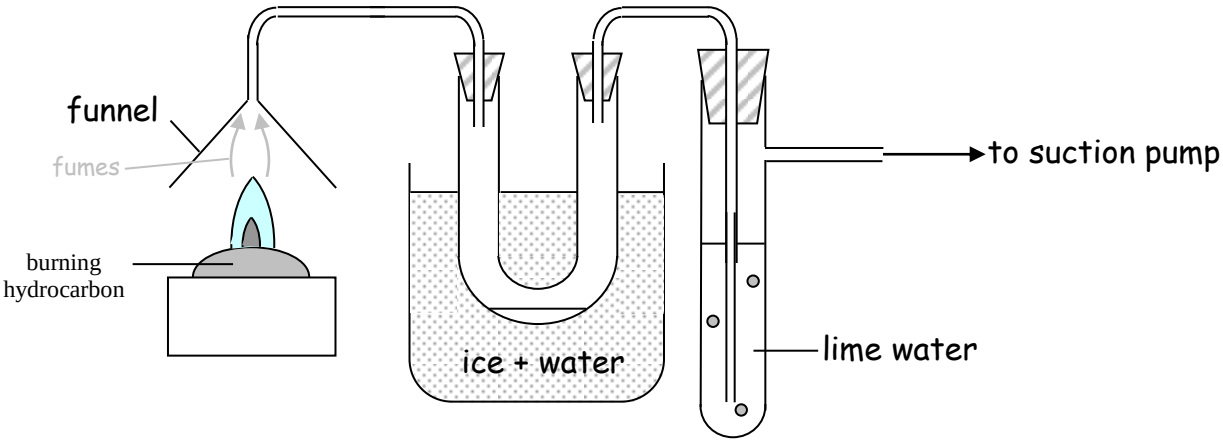
7.5 Hydrocarbons

a) **Copy** the following passage into your jotter.

Fossil fuels are mainly made of chemical called **hydrocarbons**.

- Hydrocarbons are compounds
- Hydrocarbons contain *only* the elements carbon and hydrogen.
    - Natural gas, petrol and diesel are hydrocarbon fuels

b) Collect a **copy** of the following diagram and **stick** it into your jotter.



c) **Copy** and **complete** the following passage into your jotter.

NB. Burning of hydrocarbons *must* have a plentiful supply of oxygen for **complete combustion**.

…… is detected by condensation (water droplets) in the cold U-tube.

…… is detected by the limewater in test tube turning milky.

Burning hydrocarbons produces the products …… and …… .

7.6 Renewable Resources

a) **Copy** the following passage into your jotter.

Fossil fuels are **finite** and are non-renewable resources.

There are fuels which are renewable fuels.

- Renewable fuels can be sustained into the future and will not run out.

b) **Copy** and **complete** the following table in your jotter.

- Use the word bank to complete the table.

wordbank		
hydrogen	biogas	ethanol

Renewable Fuel	Source of Fuels	Reason for Use of Fuel
…… (mainly methane)	Decomposition of waste plant material, mainly methane gas	Methane is slowly released over a number of years and can provide methane gas for small towns
……	Water (H_2O) can be split to give hydrogen by a process called electrolysis.	Burns cleanly to form water and does not produce carbon dioxide gas to contribute to the Greenhouse Effect (Global Warning)
……	Fermentation of sugar cane	Can be added to petrol so less petrol is used and lasts longer.

c) **Watch** the demonstration of biogas (methane), ethanol and hydrogen releasing energy.

7.7 Crude Oil & Fractional Distillation

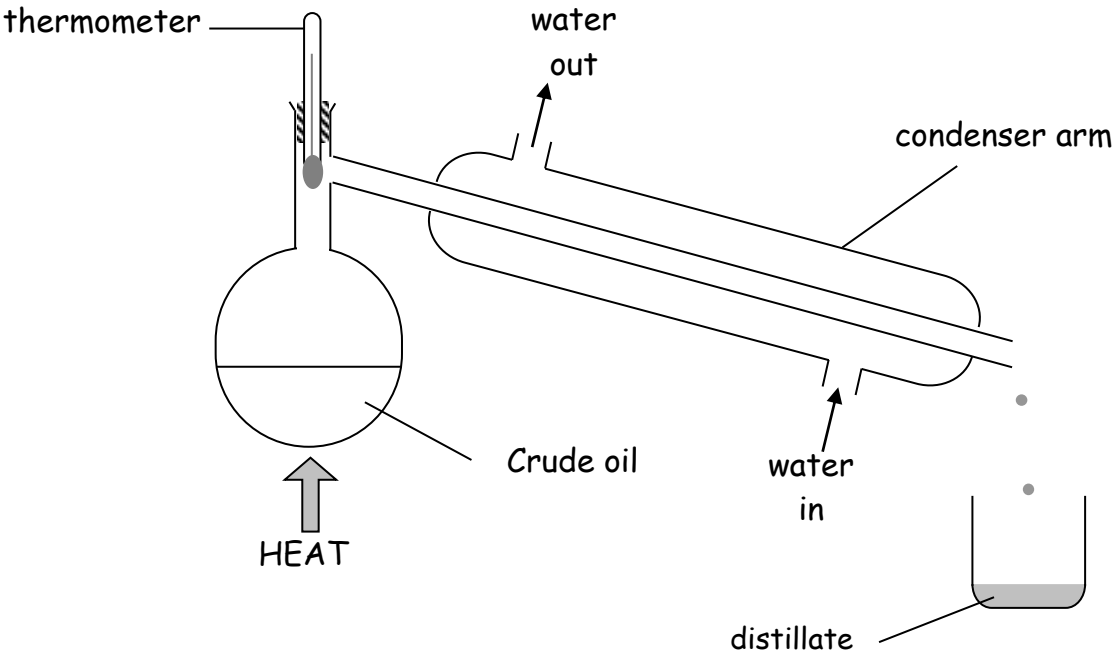
a) **Copy** the following passage into your jotter.

Crude oil is a mixture of different hydrocarbon compounds which boil at different temperatures:

- The different hydrocarbons have different boiling points due to:
  - Molecules have different sizes
  - Molecules have different shapes
- The mixture of chemicals can be separated by *fractional distillation* to produce different fractions
  - A fraction is a group of compounds with a similar boiling point.

b) **Collect** a copy of the following diagram.

- **Stick** the diagram into your jotter
- **Label** your diagram in your jotter.



c) **Watch** the demonstration of distillation.

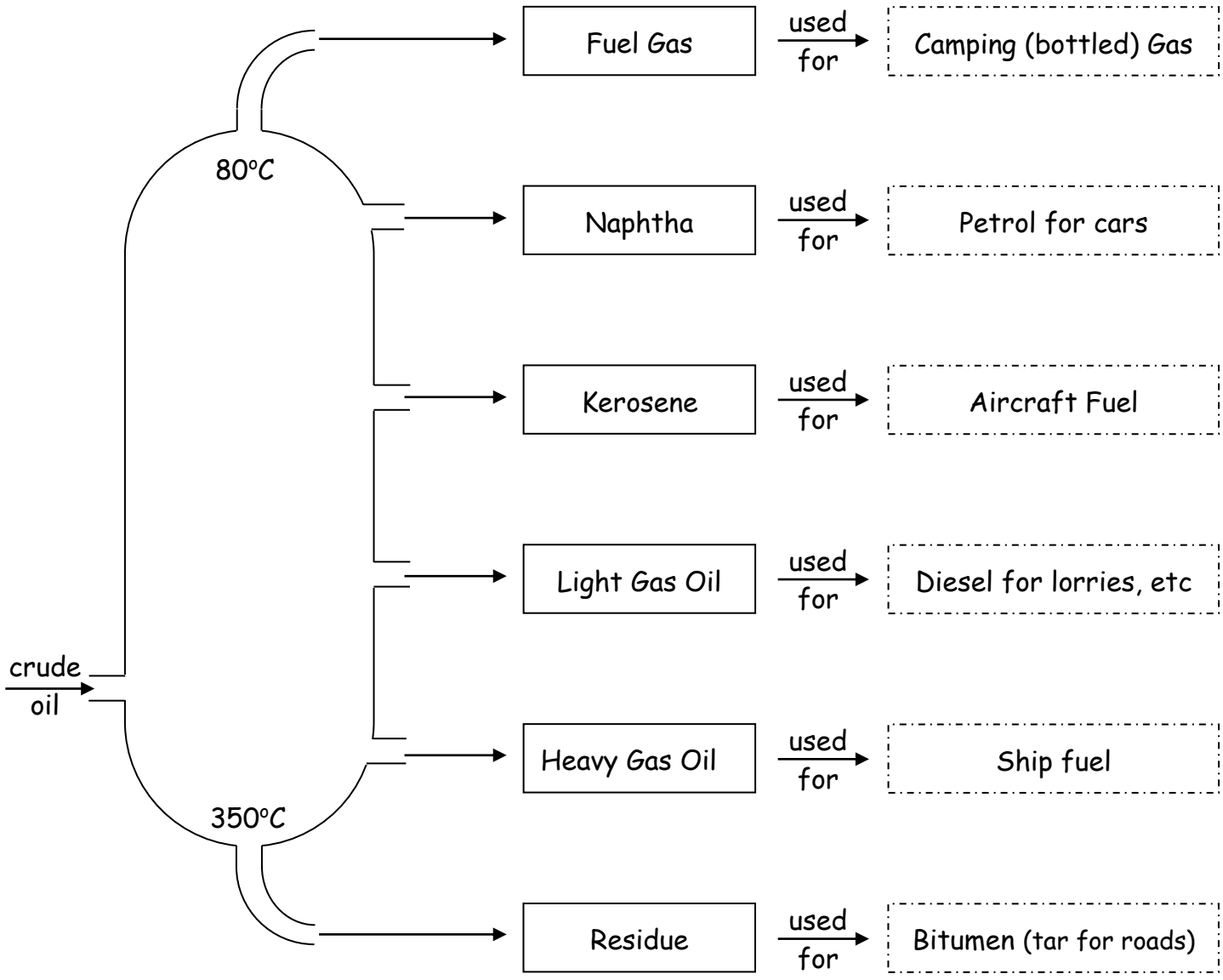
7.8 Fractions from Crude Oil I

a) **Copy** the following passage into your jotter.

The fractions produced by distillation of crude oil have different properties and uses.

e.g. small hydrocarbons have a lower boiling point than larger hydrocarbons.

b) **Collect** the following diagram.



c) **Stick** the diagram into your jotter.

d) **Complete** the diagram in your jotter.

7.9 Fractions from Crude Oil II

a) **Copy** the following diagram into your jotter.

Property	Fuel Gas	Naphtha	Kerosene	Light Gas Oil	Heavy Gas Oil	Residue
Size of Molecule	Low →					High
Viscosity (thickness)	……					……
Ease of Evaporation	……					……
Flammability	……					……
Boiling point	……					……

b) **Complete** the table in your jotter.

c) **Answer** the following questions into your jotter.

1. Which of the following hydrocarbons has the highest flammability?

   A. C_2H_6 B. C_4H_{10} C. C_6H_{14} D. C_8H_{18}

2. Which of the following fractions has the highest viscosity?

   A. Naphtha B. Residue C. Kerosene D. Light Gas Oil

3. Which of the following fractions has the smallest molecules?

   A. Naphtha B. Residue C. Kerosene D. Light Gas Oil

4. Which of the following hydrocarbons will be the easiest to evaporate?

   A. C_2H_6 B. C_4H_{10} C. C_6H_{14} D. C_8H_{18}

5. Which of the following hydrocarbons will have the lowest boiling point?

   A. C_2H_6 B. C_4H_{10} C. C_6H_{14} D. C_8H_{18}

7.10 Cracking

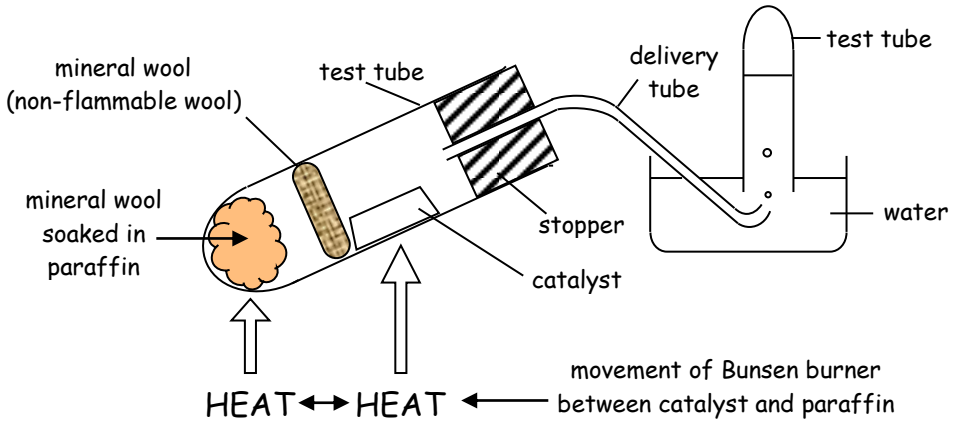
a) **Copy** the following passage into your jotter.

Fraction distillation produces more long-chain hydrocarbons than are required.

Cracking allow long-chain hydrocarbons to be turned into shorter, more useful hydrocarbons.

b) **Collect** a copy of the following diagram.

- Stick the diagram into your jotter.
- Complete the labels on your diagram.



c) **Copy** and **complete** the following examples of cracking.

example $C_{20}H_{42} \longrightarrow C_{12}H_{26} + C_8H_{16}$

1. $C_{10}H_{22} \longrightarrow C_6H_{14} +$ .....

2. $C_8H_{18} \longrightarrow C_5H_{12} +$ .....

d) **Copy** the following passage into your jotter.

The shorter hydrocarbons produced by cracking can be used for

1. petrol for motor vehicles
2. making plastics

7.11 Sources of Pollution

a) **Copy** the following passage into your jotter.

Burning fuels can cause a variety of pollution problems for the environment.

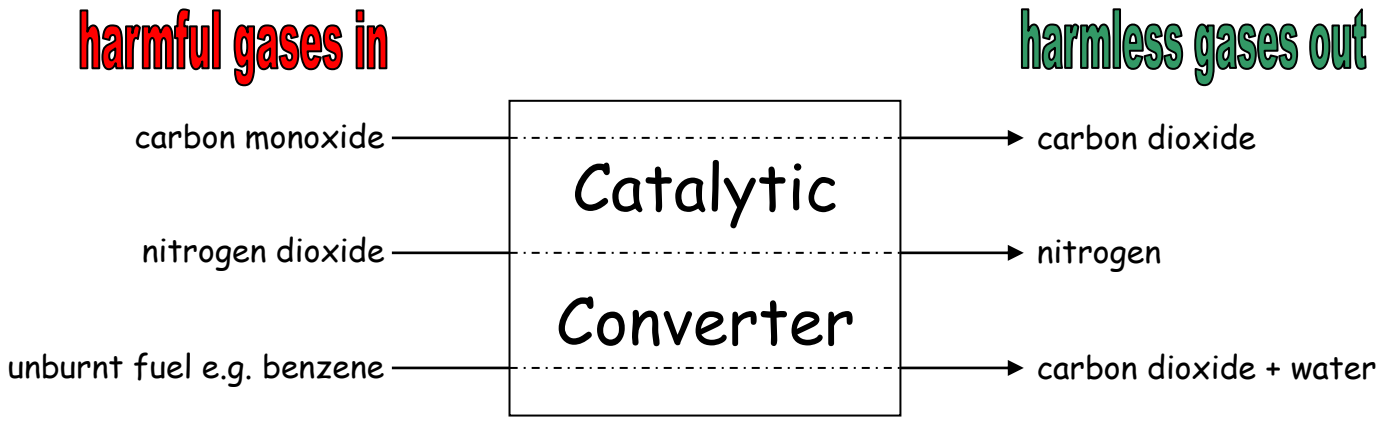
b) **Copy** and **complete** the following table in your jotter using the word bank.

wordbank

Sulphur dioxide	Benzene	Soot (carbon)	Nitrogen Dioxide	Lead compounds	Carbon monoxide

Harmful Chemical	
	Harmful black solid formed by incomplete combustion of fuels e.g. diesel.
	Poisonous gas formed by incomplete combustion of fuel due to lack of enough air/oxygen to burn completely
	Poisonous harmful gas released into atmosphere by burning fuels which contain sulphur. Forms acid rain.
	Nitrogen in air joins up with oxygen. Caused by the ignition sparks in an engine. Poisonous gas which forms acid rain in the atmosphere.
	Used to be added to petrol but caused environmental pollution. Stops catalytic converters in cars from working
	Toxic, cancer-causing chemical found in petrol. Released from exhaust fumes of cars which are not services regularly

c) **Copy** the following diagram into your jotter.



Revision
7.12

Access 3 Level Revision Questions

1. Which of the following is a fossil fuel?

crude oil or **ethanol**

2. Which is a renewable fuel?

hydrogen or **coal**

3. Which gas is required for burning?

hydrogen or **oxygen**

4. Fossil fuels are *finite resources*. This means that they:

will run out or **will not run out**

5. Which of the following is a mixture of chemicals?

crude oil or **hydrogen**

6. A group of hydrocarbons with a similar boiling point are known as:

a fuel or **a fraction**

7. When fuel burns in a low supply of oxygen, which gas is formed?

soot or **carbon monoxide**

8. Give a use for:

a) the naphtha fraction

b) the kerosene fraction

c) residue

Revision 7.13

Intermediate 1 Level Revision Questions

1. Which of the following represents fossil fuels only?

A. coal, oil & nuclear B. coal, nuclear & gas C. coal, oil & gas D. nuclear, oil and gas

2. Which is not a renewable energy source?

A. ethanol B. hydrogen C. petrol D. biogas (methane)

3. Which is not a side on the fire triangle?

A. heat B. oxygen C. fuel D. flames

4. Which type of fire is it safe to use a water fire extinguisher?

A. chip pan fire B. electrical fire C. wood fire D. petrol fire

5. Name the poisonous gas produced by the sparking of air in a petrol engine?

A. carbon monoxide B. sulphur dioxide C. carbon dioxide D. nitrogen dioxide

6. Name the poisonous gas found in car exhaust fumes?

A. oxygen B. carbon monoxide C. carbon dioxide D. hydrogen

7. Hydrocarbon compounds only contain the elements:

A. carbon + hydrogen B. carbon + oxygen C. hydrogen + oxygen D. carbon + hydrogen + oxygen

8. When a hydrocarbon burns in a plentiful supply of oxygen, which substances are formed?

A. carbon monoxide + water B. carbon dioxide + water C. carbon monoxide + hydrogen D. carbon dioxide + hydrogen

9. Name the process used to separate crude oil into different fractions with different boiling points?

A. boiling B. cracking C. condensation D. distillation

10. Name the process used to turn less useful, larger hydrocarbons into more useful, shorter hydrocarbons?

A. boiling B. cracking C. condensation D. distillation

11. How is crude oil formed?

12. Copy and complete the following equation

$$C_8H_{18} \xrightarrow{\text{cracking}} C_5H_{12} + \text{.....}$$