AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.10.2 LIFE CYCLE ASSESSMENT AND RECYCLING (PACK 2)

SCORE	PERCENTAGE
/137	%

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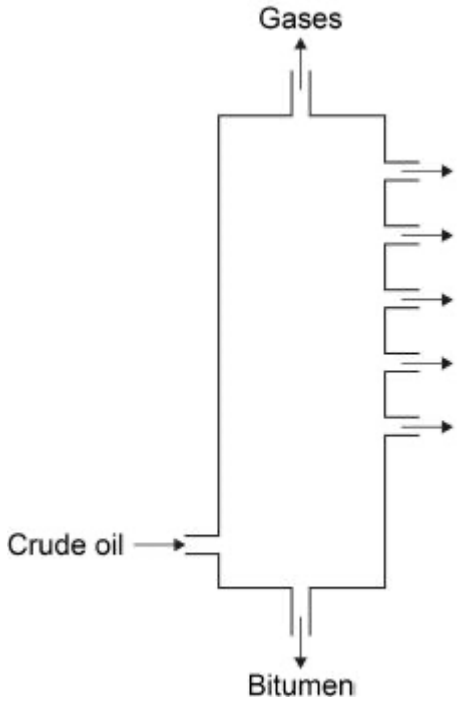
Q1.

Crude oil is a mixture of hydrocarbons.

(a) The hydrocarbons in crude oil are separated into fractions by fractional distillation.

Figure 1 shows a fractional distillation column.

Figure 1



Crude oil vapour passes up the column.

Complete the sentence.

Choose the answer from the box.

condenses	**dissolves**	**freezes**	**melts**

Each fraction _____ at a different level.

(1)

(b) Why do the fractions separate?

Tick **one** box.

The fractions have different boiling points. ☐

The fractions have different flammability. ☐

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The fractions have different melting points. ☐

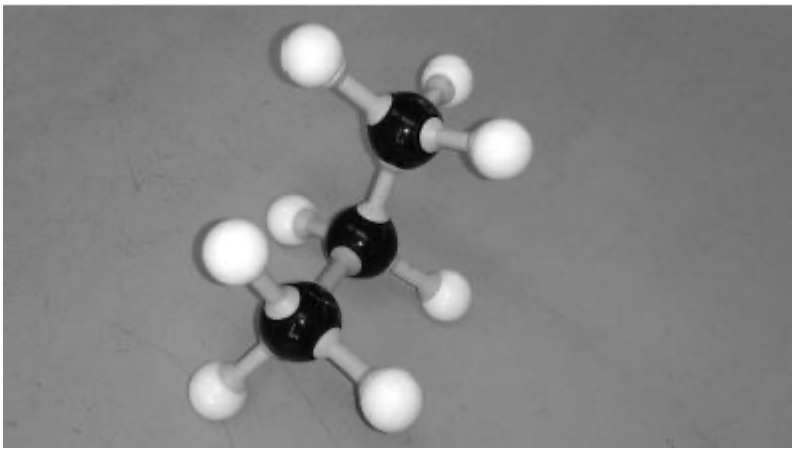
The fractions have different viscosity. ☐

(1)

Most of the hydrocarbons in crude oil are alkanes.

(c) **Figure 2** represents an alkane molecule.

Figure 2



Name the alkane.

_____

(1)

(d) Methane (CH_4) is an alkane.

What is the general formula for alkanes?

Tick **one** box.

C_nH_n ☐

C_nH_{2n} ☐

C_nH_{2n-2} ☐

C_nH_{2n+2} ☐

(1)

(e) Alkanes burn in oxygen.

Balance the equation for methane burning.

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_____ CH_4 + _____ O_2 → _____ CO_2 + _____ H_2O

(1)

(f) Ethene is an alkene.

Which reagent is used to test for alkenes?

Tick **one** box.

Anhydrous copper sulfate ☐

Bromine water ☐

Damp litmus paper ☐

Limewater ☐

(1)

The table below shows data from a life cycle assessment (LCA) for the disposal of 10 000 biodegradable plastic bags.

	Burning and using the energy to generate electricity	**Landfill**
Mass of carbon dioxide produced in kg	25	15
Mass of solid residue in kg	0.050	0.070
Mass of sulfur dioxide produced in kg	0.20	0.30

(g) Why are life cycle assessments (LCA) done?

_____

_____

(1)

(h) Compare the **two** methods for the disposal of biodegradable plastic bags.

Use information from the table above.

_____

_____

_____

_____

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_____

_____

_____

_____

_____

_____

(4)

(Total 11 marks)

Q2.

This question is about the Earth's atmosphere.

(a) Carbon dioxide is a greenhouse gas.

What is another greenhouse gas?

Tick **one** box.

Argon ☐

Methane ☐

Nitrogen ☐

Oxygen ☐

(1)

(b) Greenhouse gases cause global climate change.

Give **two** effects of global climate change.

1. _____

_____

2. _____

_____

(2)

(c) 4.1 kg of a plastic, used to make plastic bottles, has a carbon footprint of 6.0 kg of carbon dioxide.

Calculate the carbon footprint of **one** plastic bottle of mass 23.5 g

_____

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Carbon footprint = _____ kg of carbon dioxide

(2)

(d) Give **one** way that carbon dioxide emissions can be reduced when a plastic bottle is manufactured.

(1)

(e) Explain how the percentages of nitrogen, oxygen and carbon dioxide in the Earth's atmosphere today have changed from the Earth's early atmosphere.

(6)

(Total 12 marks)

Q3.

A teacher extracted copper from copper oxide.

This is the method used.

1. Mix 1.30 g of zinc and 1.59 g of copper oxide.

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2. Heat the mixture strongly.

3. When the mixture starts to glow, stop heating.

4. Let the glow spread through the mixture.

5. Leave the mixture to cool.

(a) This reaction is exothermic.

Which part of the method shows the reaction is exothermic?

Tick **one** box.

Mix zinc and copper oxide ☐

Heat the mixture ☐

Let the glow spread ☐

Leave to cool ☐

(1)

The equation for the reaction between zinc and copper oxide is:

$$\underset{1.30\ g}{Zn(s)} + \underset{1.59\ g}{CuO(s)} \rightarrow \underset{1.62\ g}{ZnO(s)} + Cu(s)$$

(b) 1.30 g of zinc fully reacted with 1.59 g of copper oxide to produce 1.62 g of zinc oxide.

What mass of copper was produced?

_____

_____

Mass of copper produced = _____ g

(1)

(c) What is the physical state of zinc oxide in the reaction?

Tick **one** box.

Aqueous ☐

Gas ☐

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Liquid ☐

Solid ☐

(1)

(d) Which substance has been oxidised in the reaction?

Tick **one** box.

Copper ☐

Copper oxide ☐

Zinc ☐

Zinc oxide ☐

(1)

(e) What type of reaction takes place when zinc reacts with copper oxide?

Tick **one** box.

Combustion ☐

Crystallisation ☐

Displacement ☐

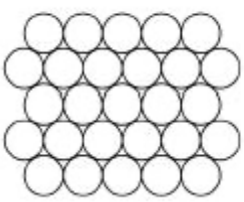
Neutralisation oxide ☐

(1)

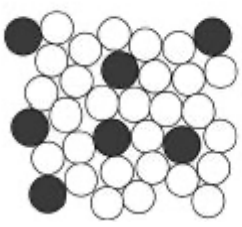
Copper is a metal.

(f) Which structure represents the arrangement of atoms in pure copper?

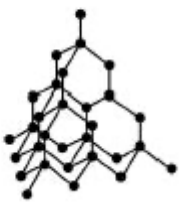
A



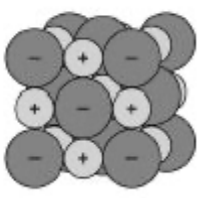
B



C



D



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Tick **one** box.

A ☐

B ☐

C ☐

D ☐

(1)

(g) Copper is used in electrical wiring.

Give **one** reason why.

_____

_____

(1)

(h) In the UK, 40% of the copper we use is recycled copper.

The other 60% is copper obtained by mining.

What is the simplest ratio of recycled copper to copper obtained by mining?

Tick **one** box.

2 : 3 ☐

2 : 5 ☐

4 : 10 ☐

6 : 4 ☐

(1)

(i) What are **two** advantages of recycling copper?

Tick **two** boxes.

Conserves copper ores ☐

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Increase in greenhouse gases ☐

Less energy used ☐

More jobs for miners ☐

More space used at landfill ☐

(2)

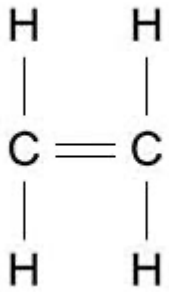
(Total 10 marks)

Q4.

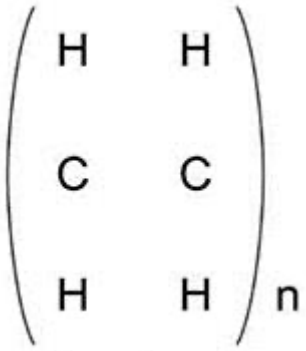
Supermarket carrier bags can be made from poly(ethene).

(a) Poly(ethene) is produced from ethene.

The structure of ethene is:



Complete the structure of poly(ethene).



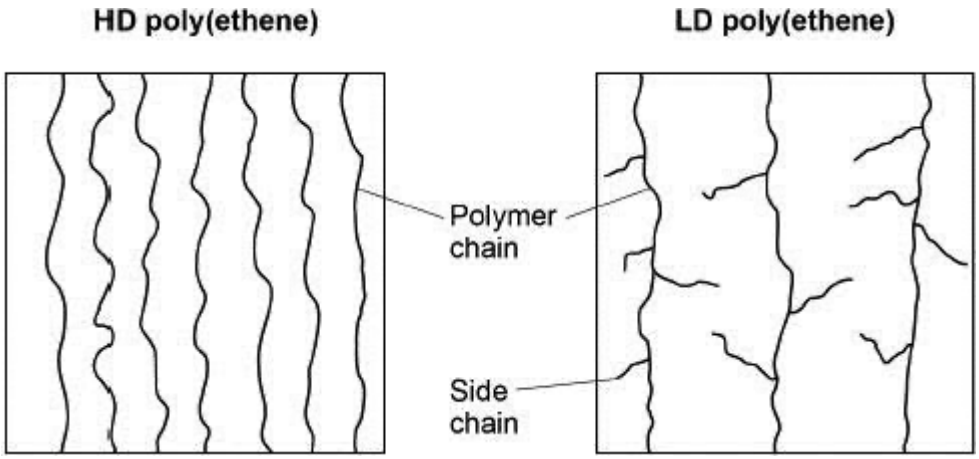
(2)

There are two types of poly(ethene): HD poly(ethene) and LD poly(ethene).

(b) **Figure 1** shows the polymer chains in HD poly(ethene) and LD poly(ethene).

Figure 1

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Describe the differences in the structure and arrangement of the polymer chains in the two types of poly(ethene).

(2)

A student investigated how poly(ethene) extends when a force is applied.

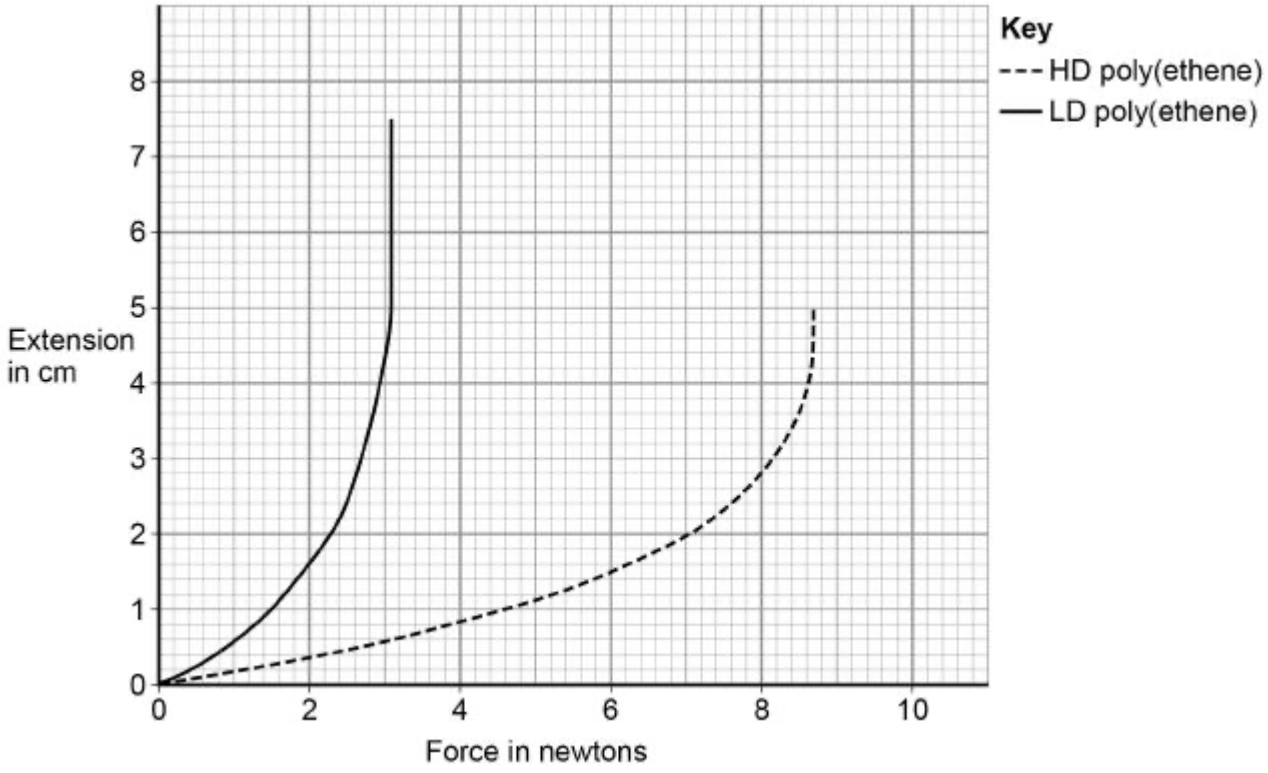
(c) Describe a method to investigate how the extension of poly(ethene) changes with the force applied.

(4)

Figure 2 shows the results for HD poly(ethene) and LD poly(ethene).

Figure 2

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(d) Give **two** comparisons between the results for HD poly(ethene) and for LD poly(ethene).

Use **Figure 2**.

1. _____

_____

2. _____

_____

(2)

(e) Carrier bags in supermarkets used to be provided free. Supermarkets now make customers pay for carrier bags.

When they were free, 8.0 billion new carrier bags were used each year.

After supermarkets started making customers pay for carrier bags, the use of new bags dropped by 85%.

Calculate how many carrier bags are now used each year.

_____

_____

_____

Number of bags = _____

(2)

(f) There are two types of carrier bag in common use:

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- disposable bags
- bags for life.

Bags for life can be returned to the supermarket when no longer usable.

The supermarket replaces the bag for life free of charge and arranges for the bag to be recycled.

The table below shows data from a life cycle assessment (LCA) for the two types of carrier bag.

	Disposable bag	**Bag for life**
Type of polymer	HD poly(ethene)	LD poly(ethene)
Raw material from which polymer is made	Crude oil	Crude oil
Mass of waste material per bag from production in grams	0.42	0.17
Mass of carbon dioxide emitted per bag during production and transport in grams	1.6	6.9
Mean number of times used	1	6
Possible disposal methods	Landfill Incineration Recycling	Landfill Incineration Recycling

Evaluate the use of each type of carrier bag.

Use data from the table above and your own knowledge.

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_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 18 marks)

Q5.

Tablets to cure indigestion contain a mixture that has been designed as a useful product.

(a) Complete the sentence.

Choose the answer from the box.

catalyst	**formulation**	**hydrocarbon**	**solvent**

Tablets to cure indigestion are an example of a _____ .

(1)

The table shows the substances in one tablet.

Substance	**Mass in mg**
Sodium hydrogencarbonate	64
Calcium carbonate	522
Magnesium carbonate	68

(b) The total mass of these substances in the tablet is 654 mg

What is the approximate fraction of magnesium carbonate in the total mass of these substances?

Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{100}$ ☐ $\frac{1}{1000}$ ☐ $\frac{1}{10\,000}$ ☐

(1)

(c) The tablets also contain sugar.

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Suggest why.

_____

_____

(1)

(d) Sodium hydrogencarbonate cures indigestion by reacting with acid in the stomach.

What type of reaction is this?

Tick **one** box.

Combustion ☐

Displacement ☐

Neutralisation ☐

(1)

A student adds an indigestion tablet to dilute hydrochloric acid.

(e) The gas produced is bubbled through limewater.

The gas turns the limewater milky.

Name the gas produced.

_____

(1)

(f) Water is also produced.

Which **two** statements are reasons why water is a liquid at room temperature?

Tick **two** boxes.

Water has a boiling point of 100 °C ☐

Water has a giant covalent structure ☐

Water has a melting point lower than room temperature ☐

Water has delocalised electrons ☐

Water is made of ions ☐

(2)

(g) Calcium chloride is also produced.

- The formula for a calcium ion is Ca^{2+}

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- The formula for a chloride ion is Cl^-

What is the formula of calcium chloride?

Tick **one** box.

$CaCl$ ☐ Ca_2Cl ☐ $CaCl_2$ ☐ Ca_2Cl_2 ☐

(1)

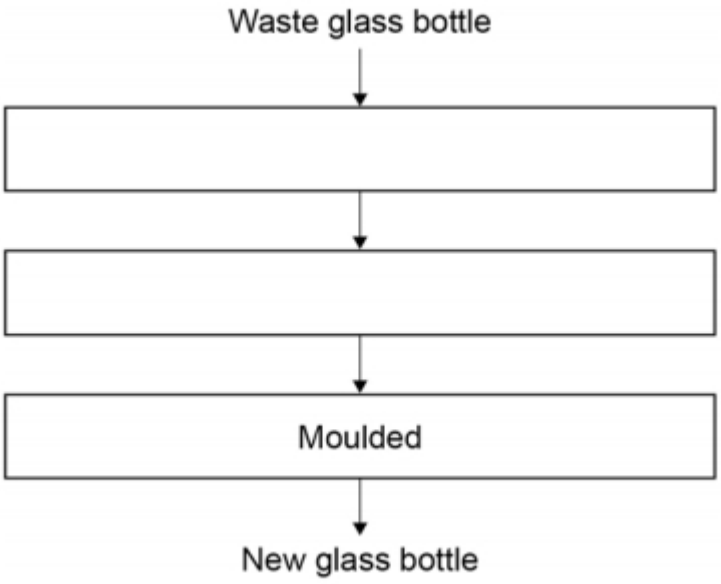
(h) The tablets are stored in glass bottles.

The flow chart shows part of a flowchart for recycling glass.

Complete the flow chart.

Choose the answers from the box.

crushed	**electrolysed**	**frozen**	**melted**	**oxidised**



(2)

(Total 10 marks)

Q6.

Crude oil and natural gas are natural resources in many countries.

The table shows percentages of hydrocarbons in natural gas from three different countries.

Hydrocarbon	**Percentage (%) of hydrocarbon in natural gas**		
	Country X	**Country Y**	**Country Z**
Methane	78.03	88.10	94.36
Ethane	9.70	5.30	2.37

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Propane	4.82	2.16	0.15
Butane	1.33	0.72	0.02
Pentane	0.30	0.18	0.00

(a) Calculate the mean percentage of propane from countries **X**, **Y** and **Z**.

Give your answer to 2 decimal places.

_____

_____

_____

Mean percentage of propane = _____ %

(2)

(b) Suggest why natural gas from different countries has different percentages of hydrocarbons.

_____

_____

(1)

(c) Complete the sentence.

Choose the answer from the box.

an atom	**an electron**	**an ion**	**a molecule**

The formula CH_4 represents _____ of methane.

(1)

(d) Complete the sentence.

The hydrocarbons in the table belong to the homologous series of

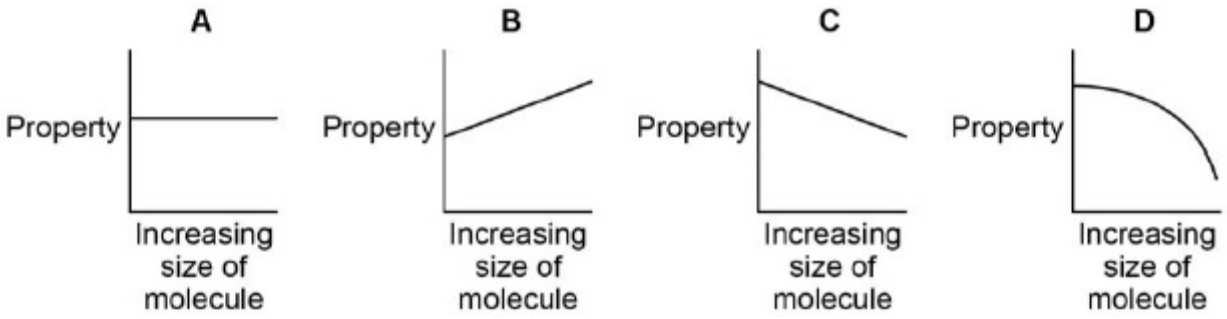
_____ .

(1)

Figure 1 shows how properties vary with the increasing size of molecule in this homologous series.

Figure 1

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(e) Which graph shows how boiling points vary?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(f) Which graph shows how viscosity varies?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(g) Crude oil is fractionally distilled.

Fractions with larger molecules are cracked.

Describe **two** differences between fractional distillation and cracking.

1. _____

_____

2. _____

_____

(2)

(h) Ethene is a product of crude oil.

Complete the sentence.

Ethene polymerises to produce _____ .

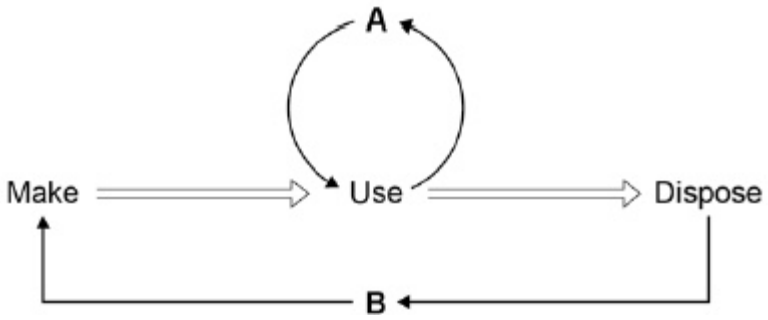
(1)

(i) The production of plastic bags uses limited resources.

Figure 2 shows two ways (**A** and **B**) of saving limited resources.

Figure 2

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Name **A** and **B**.

Choose the answers from the box.

recycle	**reduce**	**release**	**reuse**	**reverse**

A _____

B _____

(2)

(Total 12 marks)

Q7.

(a) The hydrocarbon $C_{16}H_{34}$ can be cracked.

Balance the equation for cracking $C_{16}H_{34}$

$C_{16}H_{34}$ → _____ C_2H_4 + C_8H_{18}

(1)

(b) Describe the differences between cracking and distillation.

_____

_____

_____

_____

(2)

(c) What type of reaction is cracking?

Tick **one** box.

Combustion ☐

Decomposition ☐

Neutralisation ☐

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Precipitation ☐

(1)

(d) Ethene is used to make poly(ethene).

Poly(ethene) is used to make plastic bags.

the table below shows data from a Life Cycle Assessment (LCA) for a plastic bag and a paper bag.

	Plastic bag	**Paper bag**
Raw materials	Crude oil or natural gas	Wood
Energy used in MJ	1.5	1.7
Mass of solid waste in g	14	50
Mass of CO_2 produced in kg	0.23	0.53
Volume of fresh water used in dm^3	255	4 520

A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'.

Evaluate this statement. Use your knowledge and the information from above the table above.

(6)

(Total 10 marks)

Q8.

Iron is a metal that has many uses.

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(a) Iron is extracted from iron ore. Part of the process involves reduction of the ore with carbon monoxide.

Iron ore contains iron oxide (Fe_2O_3).

Write a balanced equation for the reaction of iron oxide with carbon monoxide.

(3)

(b) Explain why this reaction is a redox reaction.

(2)

Steel is an alloy of iron. Steel is used to make cars.

After its useful life a car is taken to a scrapyard for recycling.

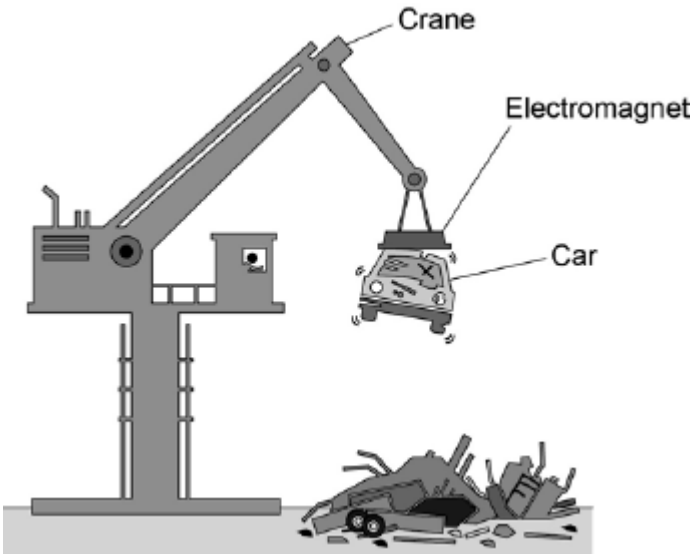
(c) Suggest **four** benefits of recycling a car body.

(4)

(d) **Figure 1** shows an electromagnet being used to lift a car in a scrapyard.

Figure 1

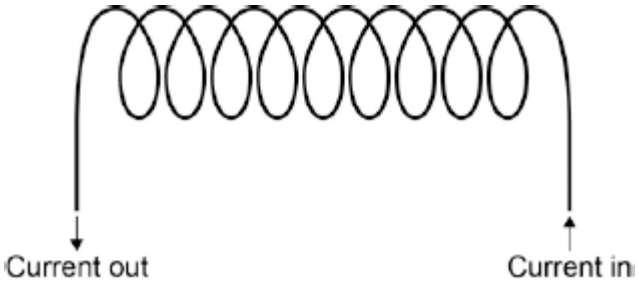
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An electromagnet is made up of a solenoid.

Figure 2 shows a solenoid.

Figure 2



Draw the magnetic field of the solenoid on **Figure 2**.

(2)

(e) In a scrapyard, an electromagnet is used to lift and release cars so they can be moved around.

Suggest **two** ways a solenoid could be made to lift and release cars in a scrapyard.

Explain why each suggestion would be useful in the scrapyard.

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(4)
(Total 15 marks)

Q9.

Hydrocarbons are used to make useful products.

(a) What are the elements in hydrocarbons?

Tick **one** box.

Carbon and hydrogen only ☐

Carbon, hydrogen and oxygen ☐

Carbon and nitrogen only ☐

Carbon, nitrogen and oxygen ☐

(1)

(b) **Table 1** gives some information about four hydrocarbons.

Table 1

Hydrocarbon	Melting point in °C	Boiling point in °C
Methane	–183	–162
Ethene	–169	–104
Octane	–57	+126
Decane	–30	+174

What are two correct statements about the four compounds?

Tick **two** boxes.

Methane has the lowest boiling point and decane has the highest melting point ☐

Methane and decane are both gases at 20 °C ☐

Ethene and octane are both alkanes ☐

Decane and ethene are both liquids at 0 °C ☐

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Octane is liquid over a larger temperature range than methane ☐

(2)

(c) Ethene can be produced from long-chain hydrocarbons by cracking.

Give the conditions needed for cracking.

(2)

(d) Poly(ethene) is a polymer made from ethene. Poly(ethene) is used to make plastic bags.

Table 2 is from a life cycle assessment comparing paper bags and plastic bags.

Table 2

	Paper bag	**Plastic bag**
Raw material	Wood (renewable)	Oil or gas (non-renewable)
Energy used to make in MJ	1.7	1.5
Solid waste produced in g	50	14
Carbon dioxide produced in kg	0.23	0.53

Evaluate which type of bag is more environmentally friendly.

Use data from **Table 2** and your own knowledge to support your answer.

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(6)

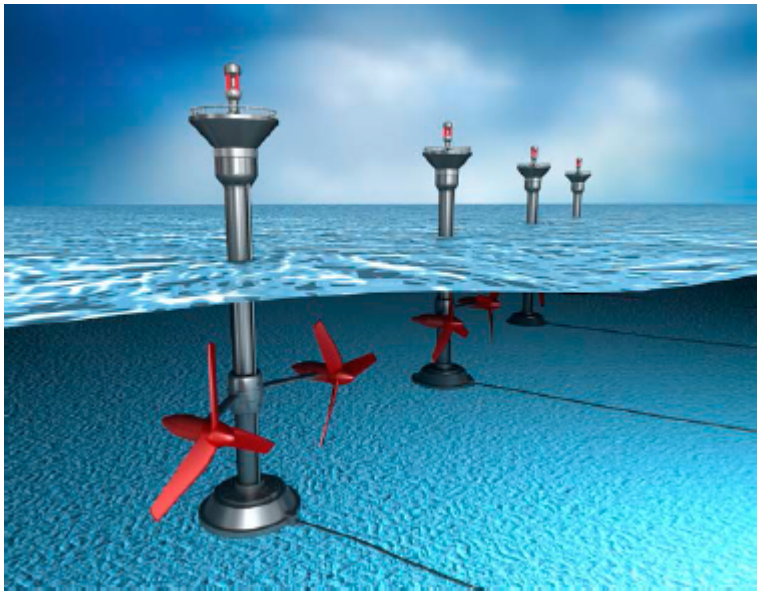
(Total 11 marks)

Q10.

Electricity in the UK is generated in many ways.

The figure below shows an undersea turbine.

The undersea turbine uses tidal energy to generate electricity.



© alex-mit/iStock/Thinkstock

(a) What is the original source of energy for tidal power schemes?

(1)

(b) Explain **two** advantages of using undersea tidal turbines to generate electricity rather than burning fossil fuels.

(4)

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(c) Some power stations burn wood instead of fossil fuels to generate electricity.

A coal-burning power station burns 6 million tonnes of coal per year.

Coal has an average energy value of 29.25 MJ per kg.

Wood chip from willow trees has an energy value of 13 MJ per kg.

A hectare of agricultural land can produce 9 tonnes of dry willow wood per year.

If this power station burned dry willow wood instead of coal, how much agricultural land would be needed to grow the willow?

Amount of land needed = _____ hectares

(3)

(d) The table below shows the carbon dioxide emissions of four fuels used to generate electricity.

Fuel	**Direct CO_2 emissions in kg per MWh**	**Lifecycle CO_2 emissions in kg per MWh**
Coal	460	540
Natural gas	185	215
Oil	264	313
Wood	2 100	58

Direct CO_2 emissions are the amounts of carbon dioxide released when the fuel is burned.

Lifecycle CO_2 emissions is the total amount of carbon dioxide released during all stages from fuel extraction to when the fuel has been used.

Use the data from the table above to explain why wood is considered to be a low carbon dioxide emitting fuel.

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_____

_____

(2)

(Total 10 marks)

Q11.

Read the information about production of copper.

- World demand for copper in 2014 was about 22 million tonnes.
- World reserves of copper are about 700 million tonnes.
- Most of the copper today is obtained from copper ores. The ores are mined.
- Copper ore is heated in a furnace to produce copper sulfide. The furnace is heated by burning fossil fuels. Air is blown through the hot copper sulfide to produce copper and sulfur dioxide.
- Some copper is extracted from low-grade ores by phytomining. Phytomining uses plants to absorb copper compounds. The plants are burned and copper is extracted from the ashes.

A scientist stated:

'more copper should be extracted by phytomining.'

Use the information to justify the scientist's statement.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q25.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Aluminium is used to make many items.

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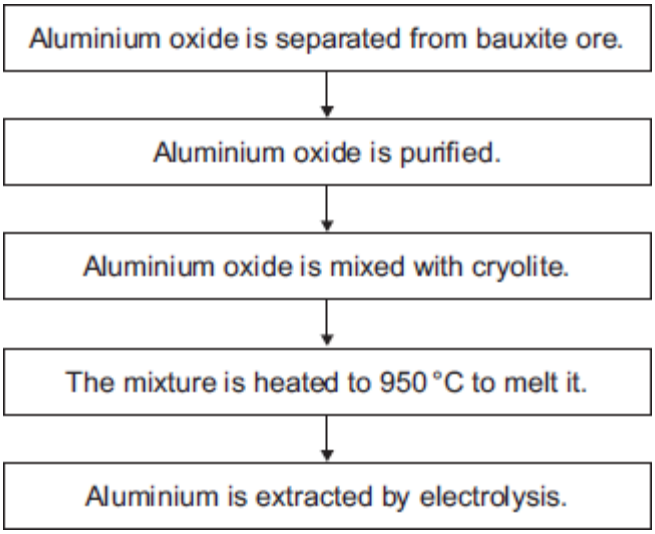




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Aluminium is extracted from aluminium ore. Aluminium ore is called bauxite, which is impure aluminium oxide.

The flow chart shows the main steps in the extraction of aluminium from aluminium ore.



Most aluminium is recycled.

Aluminium is recycled by melting scrap aluminium at 700 °C.

Use your own knowledge and the information given to answer the question.

Suggest why most aluminium is recycled.

(Total 6 marks)

Q26.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

There are millions of plastic bags in use. After use most of these plastic bags are buried in landfill sites. The amount sent to landfill could be reduced if the plastic bags:

- could be reused
- could be recycled by melting and making them into new plastic products
- could be burned to release energy.

Use the information above and your knowledge and understanding to give the positive and negative environmental impacts of using these methods to reduce the amount of plastic bags sent to landfill.

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(Total 6 marks)

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