High Demand Questions QUESTIONSHEET 1

A gas barbecue uses butane (C_4H_{10}) as a fuel. The butane is stored as a liquid in a container. When the burner is turned on, the liquid turns to a gas and is lit by pushing a button to create a small spark.

(a) Suggest **one** advantage and **one** disadvantage of using butane compared to charcoal as a source of heat.

.....

..... [2]

(b) Describe the arrangement and movement of molecules in butane when it is:

(i) a liquid

.....

..... [2]

(ii) a gas

.....

..... [2]

(c) What term is used to describe the change of state from liquid to gas?

..... [1]

(d)(i) Draw a diagram to show the structural arrangement of the atoms in a molecule of butane.

[2]

(ii) How does the structure of butane explain why it has a low boiling point?

..... [1]

(e) Explain why a spark is needed to start the butane burning.

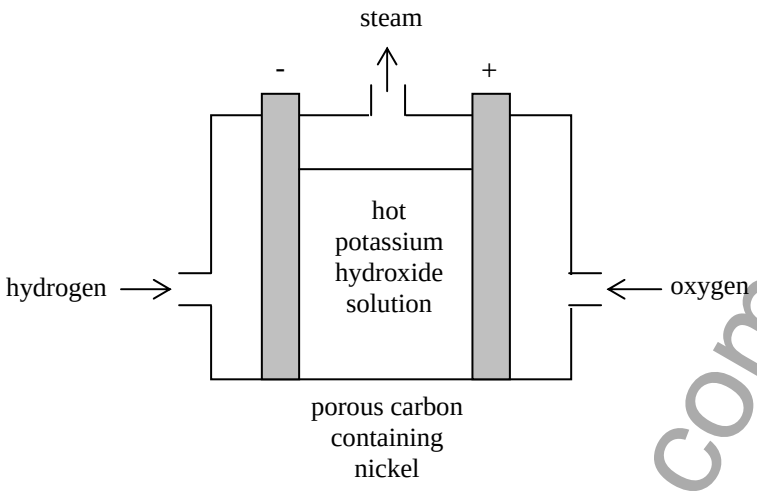
.....

..... [2]

TOTAL / 12

High Demand Questions QUESTIONSHEET 2

Fuel cells are often taken into space to supply energy. They turn the energy of a fuel directly into electricity.



FUEL CELL

(a) (i) Why are porous electrodes needed in a fuel cell?

.....

..... [1]

(ii) Why is nickel included in the electrodes?

..... [1]

(b) What is the main way in which fuel cells differ from other electrochemical cells?

.....

..... [1]

(c) Write an equation for the overall reaction taking place in a fuel cell.

..... [2]

(d) Give **two** reasons why fuel cells are more suitable than dry cells for use in spacecrafts.

.....

..... [2]

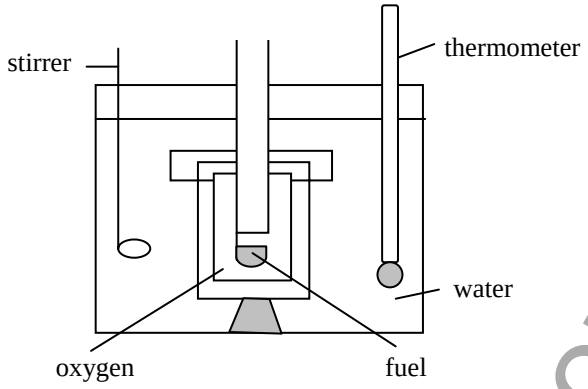
(e) What other type of cell could be used in a spacecraft?

..... [1]

TOTAL / 8

High Demand Questions QUESTIONSHEET 3

A bomb calorimeter is used to burn small, weighed samples of fuels in an atmosphere of oxygen.
The energy produced is transferred to the surrounding water. The fuels are electrically ignited.
A bomb calorimeter is often used to find the energy values of foods.



BOMB CALORIMETER

(a) (i) What is the advantage of burning the fuel in oxygen rather than in air?

.....[1]

(ii) What is the advantage of surrounding the bomb calorimeter with water?

.....[1]

(b) A bomb calorimeter was used to measure the energy value of glucose.
When 2 g of glucose was burned, 31 200 J of energy were released.

(i) Complete the equation for the combustion of glucose.

$C_6H_{12}O_6 + 6O_2 \rightarrow$ ——— + ——— [2]

(ii) Calculate the energy value of glucose in kJ per 100 g.

.....

.....

.....[2]

TOTAL / 6

High Demand Questions QUESTIONSHEET 4

(a) Cold packs are used to treat sports injuries.
A pack contains water and ammonium nitrate crystals.
When mixed, rapid cooling takes place.

(i) Draw an energy level diagram to show the process occurring in the cold pack.
Explain your diagram.

[3]

(ii) Explain in terms of bonding why this process takes in heat.

.....

.....

..... [3]

(b) A company has recently invented 'cook-in-the-box' meals.
To start the cooking process a tab is pulled which lights a match.
The match starts a reaction which continues without further heating.

A reaction which could be used is that between aluminium and iron(III) oxide, to produce aluminium oxide and iron.

(i) Write a symbol equation for the reaction between aluminium and iron(III) oxide.

..... [2]

(ii) Explain why the match is needed to start the reaction, but once started it continues without further heating.

.....

.....

..... [2]

TOTAL / 10

High Demand Questions QUESTIONSHEET 5

A Sumo wrestler eats more than 7 kg of steak every day, together with fresh vegetables.
An Olympic rower's lunch would be something like 350 g steak, vegetables, treacle pudding and unsweetened lemon juice.

(a) Why does the rower eat treacle pudding, but the sumo wrestler does not?

.....

..... [2]

(b) In view of your answer to (a), why is the rower's lemon juice unsweetened?

.....

..... [2]

TOTAL / 4

High Demand Questions QUESTIONSHEET 6

When hydrogen reacts with iodine, we can show the reaction as follows:

$$H – H + I – I \rightarrow 2\,(H – I)$$

(a) Given the following bond energies, calculate the heat of reaction.

(H – H = 436 kJ, I – I = 151 kJ, H – I = 298kJ)

.....

.....

..... [3]

(b) Is the reaction exothermic or endothermic?

..... [1]

(c) Draw an energy level diagram for the reaction.

[3]

TOTAL / 7

High Demand Questions QUESTIONSHEET 7

When 10 cm^3 of 0.1M hydrochloric acid reacts with 10 cm^3 of 0.1M sodium hydroxide solution, the temperature rises from 20°C to 35°C.

(a) Use the formula
heat energy = 4.2 5 temperature change 5 mass of reactants (in grams)
to calculate the energy in kilojoules from the reaction.
The density of both dilute hydrochloric acid and sodium hydroxide is 1g/cm^3.

.....

.....

..... [2]

(b) How many moles of 0.1M hydrochloric acid are in 10 cm^3 of 0.1 M solution?

.....

..... [2]

(c) Write a symbol equation for the reaction between hydrochloric acid and sodium hydroxide.

..... [1]

(d) How much energy would you get by reacting 1 mole of hydrochloric acid?

.....

..... [2]

TOTAL / 7

High Demand Questions QUESTIONSHEET 8

The reactions between bromine (Br_2) and hydrogen (H_2) to make hydrogen bromine (HBr) can be represented by the following equation:

Br-Br + H-H $\prod$ H-Br +H-Br

(a) Use the following bond energies to answer questions (i), (ii) and (iii).

Br-Br: 193 kJ/mol; H-H: 436 kJ/mol; H-Br: 366 kJ/mol

(i) Calculate the total energy required to break bonds in this reaction.

.....

.....

Answer ..... kJ/mol
[2]

(ii) Calculate the total energy released when bonds are formed in this reaction.

.....

.....

Answer ..... kJ/mol
[2]

(iii) Calculate the overall energy change for this reaction.

.....

.....

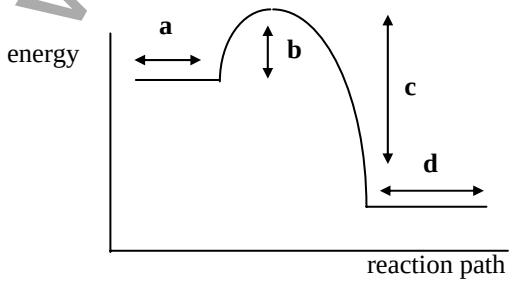
Answer ..... kJ/mol
[2]

(b) Explain what the sign of the answer you calculated in (a) part (iii) tells you about the reaction.

.....

..... [1]

(c) Below is the energy level diagram for the reaction between hydrogen and bromine.



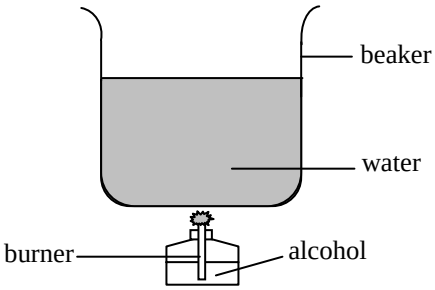
Write down the letter which represents the activation energy

..... [1]

TOTAL / 8

Medium Demand Questions QUESTIONSHEET 9

Lucy was trying to compare the amount of energy released when three different alcohols were burned. She used the apparatus shown below.



(a) Lucy weighed the burner before and after burning the alcohols. She stirred the water throughout.

(i) Explain why she weighed the burner before and after.

..... [1]

(ii) Why did Lucy stir the water?

..... [1]

(iii) What else would Lucy need to measure before and after burning the alcohol?

..... [1]

(iv) What **two** things would Lucy need to keep the same if she was to make a fair comparison between the alcohols?

.....

..... [2]

(b) Lucy calculated the temperature rise for each gram of alcohol which was burned.

alcohol	**temperature rise**	**mass burned**	**temperature rise per gram burned**
methanol	16°C	2 g	8°C/g
ethanol	33°C	3 g	11°C/g
propanol	48°C	4 g	

(i) Complete the table. [1]

(ii) Which alcohol releases the most energy per gram?
Suggest an explanation.

.....

.....

..... [3]

TOTAL / 9

Medium Demand Questions QUESTIONSHEET 10

When a small piece of calcium is added to water in a beaker a reaction occurs.

(a) What would you observe?

.....

..... [2]

(b) 50 cm^3 of water was heated from 20°C to 25°C in the reaction.
(heat energy = 4.2 × temperature change × mass of water in grams)

(i) Calculate the energy given off.

.....

..... [2]

(ii) Is the reaction exothermic or endothermic?

..... [1]

(c) Write the equation (symbols) for the reaction between calcium and water.

..... [2]

TOTAL / 7

Medium Demand Questions QUESTIONSHEET 11

(a) When the fuel methane is burnt in a Bunsen burner heat energy is released to the surroundings. The amount of heat given out from the Bunsen burner is controlled by the position of the air hole.

(i) Is the flame of a Bunsen burner hottest when the air hole is closed or open?

..... [1]

(ii) Explain your answer to part (i).

..... [1]

(b) Methane is a part of a group of chemicals called hydrocarbons.

(i) Which two elements do hydrocarbons contain?

1. .....

2. .....

[2]

(ii) When any hydrocarbon burns which two chemical compounds are formed?

1. .....

2. .....

[2]

(c) The methane does not burn until it is lit by a naked flame. The energy supplied by the flame is called activation energy.

(i) Explain what is meant by the term 'activation energy'.

.....

..... [2]

(ii) The rate of some chemical reactions can be increased by using a catalyst. Use the idea of activation energy to explain how a catalyst works.

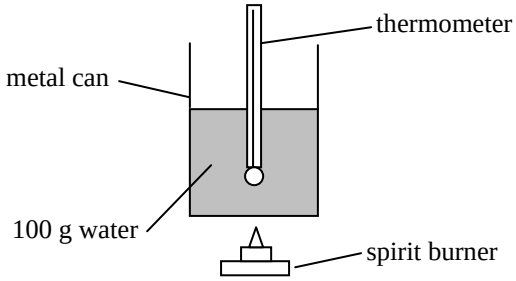
.....

..... [1]

TOTAL / 9

Medium Demand Questions QUESTIONSHEET 12

The following experiment was used to compare how much heat energy three different fuels gave out when they were burnt.



(a) Here are the results when 1.0 g of each fuel was burnt.

fuel	temperature of water at start	temperature of water at end
ethanol	19°C	36°C
paraffin	20°C	47°C
white spirit	18°C	41°C

(i) Are the reactions exothermic or endothermic?

.....

Explain your answer.

..... [2]

(ii) What was the temperature change when 1.0 g of ethanol was burnt?

..... [1]

(iii) Which fuel released the most energy when it was burnt?

..... [1]

(iv) Why it is important to burn 1.0 g of each fuel in each experiment?

..... [1]

(b) When fuels burn they react with a gas in the air. Write down the name of this gas.

..... [1]

(c) When ethanol burns in excess air, carbon dioxide is released into the atmosphere.
Describe one problem that this may cause in the environment.

.....

.....

..... [2]

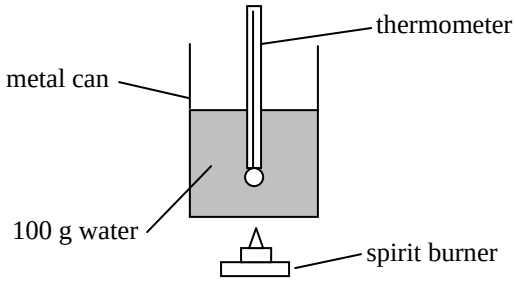
(d) When ethanol burns in a shortage of air another gas is formed which is highly toxic.
Write down the name of this toxic gas.

..... [1]

TOTAL / 9

Medium Demand Questions QUESTIONSHEET 13

Look at the diagram. It shows the apparatus used to calculate the energy released when fuel is burnt.



The table below shows the results when 1.0 g of each fuel is burnt.

fuel	temperature of water at start	temperature of water at end
ethanol	20°C	40°C
paraffin	19°C	58°C
petrol	21°C	42°C

(a) Which fuel released the least amount of heat energy?

.....

Explain your answer

..... [2]

(b) Why is it important for there to be 100 g of water in the metal can for each reaction?

.....

..... [2]

(c) Calculate the energy transferred when 2.0 g of paraffin burns. (The specific heat capacity of water is 4.2 $J\,g^{-1}\,K^{-1}$)

.....

.....

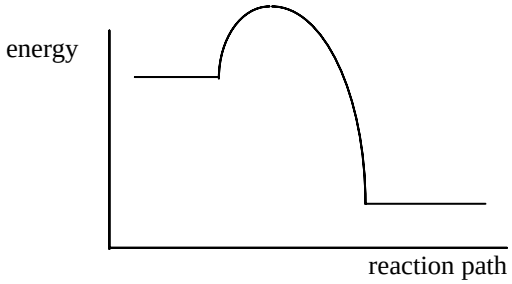
.....

..... [3]

TOTAL / 7

Medium Demand Questions QUESTIONSHEET 14

The following diagram represents the energy level diagram for the reaction between magnesium (Mg) and oxygen (O_2) to form magnesium oxide (MgO).



(a) On the energy level diagram write the words **reactants** and **products** in the correct places. [1]

(b) Indicate on the energy level diagram the **activation energy**. [1]

(c) The reaction between magnesium and oxygen may be represented by the following symbol equation:

$$2Mg + O_2 \rightarrow 2MgO$$

(i) Calculate the mass of magnesium required to produce 100 g of magnesium oxide.
(Relative atomic masses: O = 16, Mg = 24)

.....

.....

.....

..... [3]

(ii) It is known that 32 g of oxygen takes up 24 dm^3 of space at 25°C. Calculate the volume of oxygen that is needed to react completely with 12 g of magnesium.

.....

.....

.....

..... [3]

TOTAL / 8

Medium Demand Questions QUESTIONSHEET 15

(a) In the laboratory a Bunsen burner is used as a heat source. The gas which is burnt in a Bunsen burner is called methane.

(i) When methane is burnt heat energy is released into the surroundings. What name is given to this type of reaction?

..... [1]

(ii) Methane is called a non-renewable fuel. Explain what is meant by a non-renewable fuel.

.....

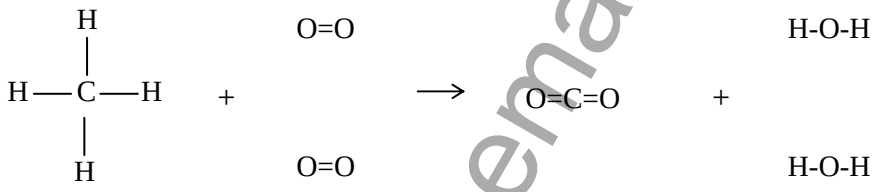
..... [2]

(iii) Name two fuels which are renewable.

1. ..... [1]

2. ..... [1]

(b) The reaction between methane (CH_4) and oxygen (O_2) which takes place during burning produces carbon dioxide (CO_2) and water (H_2O). It may be represented using the following display formulae.



(i) Name two different bonds which are broken during the reaction.

1. ..... [1]

2. ..... [1]

(ii) Which two bonds are made during the reaction?

1. ..... [1]

2..... [1]

(iii) Calculate the overall energy change for the reaction between methane and oxygen.
The bond energies are C-H: 435 kJ, O=O: 497 kJ, C=O: 803 kJ, H-O: 464 kJ)

.....

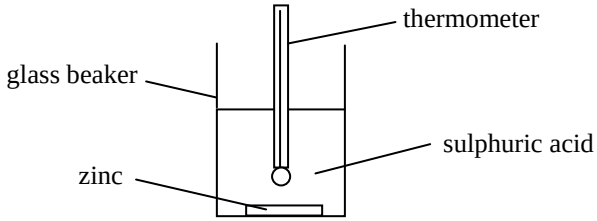
.....

..... [4]

TOTAL / 13

Medium Demand Questions QUESTIONSHEET 16

The equipment below was used to measure the temperature change when the metal zinc was placed into sulphuric acid. During the reaction heat energy is transferred to the surroundings.



(a) What would you see happen to the reading on the thermometer during the experiment?

..... [1]

(b) The experiment was repeated but this time a catalyst was also added.

(i) Explain what a catalyst is.

.....

..... [2]

(ii) What would you see happen to the reading on the thermometer during this second experiment?

.....

..... [2]

TOTAL / 5

Low Demand Questions QUESTIONSHEET 17

The temperatures of reactions of zinc, magnesium and nickel with hydrochloric acid were measured. The results are shown in the table.

metal	Temp at start ^{o}C	Highest temp reached ^{o}C	Temp change ^{o}C
nickel	19	24	5
magnesium	19	57	
zinc	19	30	11

(a)(i) What piece of equipment would you use to measure the temperature?

..... [1]

(ii) Calculate the temperature change for the magnesium reaction.

..... [1]

(iii) Calcium is more reactive than zinc.

Predict the temperature change for a reaction between calcium and hydrochloric acid.

..... [1]

(b) What name is given to reactions which give out heat?

..... [1]

(c) (i) Suggest another reaction which would give out heat.

..... [1]

(ii) Why are reactions which give out heat useful?

..... [1]

(iii) Why are reactions which take in heat useful?

..... [1]

TOTAL / 7

Low Demand Questions QUESTIONSHEET 18

A person's daily energy requirements depend on a number of things.
These include the person's sex and size.

(a) Name two more things which could affect your energy requirements.

.....

..... [2]

(b) For breakfast a man eats the following

bowl of cereal	325 J
bacon	1430 J
egg	660 J
tea (with sugar)	200 J

How much energy in total does he get from his breakfast?

.....

..... [2]

(c) An Indian farmer consumes 7200 J per day. The man described above consumes 20 000 J per day.

(i) How would you expect the man and the farmer to differ in appearance?

.....

..... [2]

(ii) Why is the farmer often very tired?

..... [1]

(iii) Suggest two things that the man could do to lose weight.

.....

..... [2]

TOTAL / 9

Low Demand Questions QUESTIONSHEET 19

A modern power station uses powdered coal.
A blast of air is passed up through the burning coal.
This is more efficient and produces less harmful gases than large pieces of coal.

(a) Why does powdered coal burn more efficiently?

.....

..... [2]

(b) Sometimes the powdered coal is blown into a flame.
Why is this better?

.....

..... [2]

(c) Using oxygen instead of air speeds up the burning process.
Explain the reason for this.

.....

..... [2]

(d) Name **two** gases which may form when coal is burned.

.....

..... [2]

TOTAL / 8

Low Demand Questions QUESTIONSHEET 20

(a) List **three** characteristics of an ideal fuel.

.....

.....

..... [3]

(b)(i) Describe an experiment to compare paraffin and alcohol as fuels.
Mention all the measurements you would make.

.....

.....

.....

..... [4]

(ii) Why would it be difficult to compare coal using the same method?

..... [1]

(iii) Why is it difficult to compare methane gas using the same method?

..... [1]

(c) George compared two fuels and came up with the following results.

Fuel A produces 1500 kJ
Fuel B produces 790 kJ

Why are these results of very little use?

..... [1]

TOTAL / 10