

Name:

School Year:

School:

Answer all questions in the spaces provided.

Please write your answers clearly.

The total marks allocated to the paper are 40 marks (Section A 10 marks, Section B 30 marks)

The time allocated to the paper is 30 minutes.

Scoring: Section A / 10

Section B / 30

Total / 40

SECTION A General chemistry knowledge

1. Name the element with the latin name 'plumbum'. (1 mark)

lead.....

2. Name the element with a name that means 'light bearer.' (1 mark)

phosphorus

3. Four new elements were added to the Periodic Table at the start of 2016.

Give the IUPAC name for any **one** of the elements. (1 mark)

ununtrium / ununpentium / ununseptium / ununoctium (any one, must be spelt correctly)

4. Which two elements are the main components of glass? (2 marks)

silicon and oxygen.....

5. Write the chemical formula for indium fluoride. (1 mark)

InF₃.....

6. State the bond angle in a molecule of methane, CH₄. (1 mark)

109 ° / 109.5 ° / 109°28'.....

7. Name the process you would use to separate a liquid from an **insoluble** solid. (1 mark)

filtration / filtering / any variation of these.....

8. Name the process you would use to separate a liquid from a **soluble** solid. (1 mark)

distillation (ignore mention of fractional or simple).....

9. Which disease is the drug cis-platin used to treat? (1 mark)

cancer.....

Total: 10 marks

12. This question is about jelly babies.

The table below gives some nutritional information taken from the back of a packet of jelly babies.

	Per 100 g	Per 4 sweets (26.4 g)	Guideline daily amounts
Fat	< 0.1 g	< 0.1 g	70 g
Of which saturates	< 0.1 g	< 0.1 g	20 g
Carbohydrates	78 g	21 g	260 g
Of which sugars	74 g	20 g	90 g
Protein	3.5 g	0.9 g	50 g
Salt	0.02 g	< 0.01 g	6 g

a. What percentage of the Guideline Daily Amount of sugar is present in 100 g of jelly babies. (1 mark)

$(74 \text{ g} / 90 \text{ g}) \times 100\% = \underline{82\% / 82.2\%}$

b. Assuming that all the sugar present is in the form of sucrose, $C_{12}H_{22}O_{11}$, write an equation for the complete combustion of the sugar in the jelly babies. (2 marks)



c. If 342 g of sucrose releases 5644 kJ of energy, calculate the amount of energy released by 4 jelly babies. (2 marks)

Sugar in 4 jelly babies = 20 g (1 mark).....

Energy released = $(20 / 342) \times 5644 \text{ kJ} = \underline{330.1 \text{ kJ} / 330 \text{ kJ}}$ (1 mark).....

d. A man needs to consume about 2500 dietary calories (kcal) per day. Given that 1 kJ = 0.239 kcal, how many sweets must a man consume in order to meet his daily calorific requirement? (3 marks)

Correct answer scores all 3 marks.....

$2500 \text{ kcal} = (2500 / 0.239) = 10460 \text{ kJ}$ (1 mark)

$10460 \text{ kJ} / 330.1 \text{ kJ per 4 sweets} = 31.69 \text{ lots of 4 sweets}$ (1 mark)

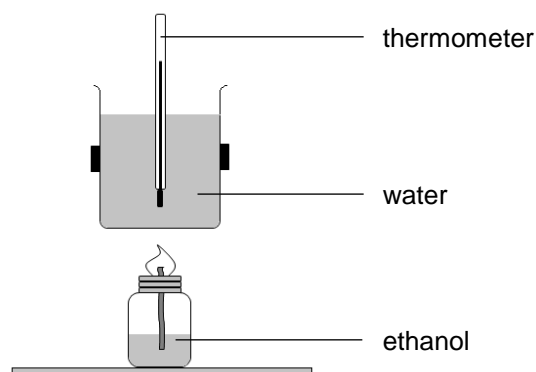
$31.69 \times 4 \text{ sweets} = 126.8 / 127 \text{ sweets}$ (1 mark)

Mark consequentially based on student's answer to part(c)

13. Many conventional petrol engines will run on ethanol, or mixtures of petrol and ethanol. Much of the petrol sold in the UK at present has 5-10% ethanol added.

- a. George uses a simple calorimetry experiment to determine the energy released per gram of ethanol, C_2H_5OH .

He sets up the apparatus as shown in the diagram. He burns some ethanol in a fuel burner and uses the heat energy released to heat up 75 g of water in a copper calorimeter.



He records the temperature of the water before and after heating it with the ethanol.

He records the mass of ethanol burnt by recording the mass of the fuel burner before and after the experiment.

His results are shown in the table below;

Temperature of water at start / °C	18.5
Temperature of water at end / °C	46.2
Mass of fuel burner at start / g	2.36
Mass of fuel burner at end / g	1.84

If 4.2 J of energy is needed to raise the temperature of 1 g of water by 1 °C, calculate;

- i. The amount of energy released per gram of ethanol burnt in joules, J. (4 marks)

Temperature change = 27.7 °C (1 mark).....

Energy released = 27.7 °C x 75 g of water x 4.2 J = 8725.5 J (1 mark).....

Mass of fuel burnt = 0.52 g (1 mark).....

Energy released per gram of fuel burnt = 8725.5 J / 0.52 g = 16779.8 J / 16780 J (1 mark)

- ii. The amount of energy released per mole of ethanol burnt (one mole of a substance has a mass in grams equal to the relative molecular mass for that substance). (2 marks)

Relative molecular mass of ethanol, C_2H_5OH = 46 (1 mark).....

Energy released per mole = 16779.8 J/g x 46 = 771871 / 771870 J (1 mark).....

[Mark consequentially on student's answer to part(i)]

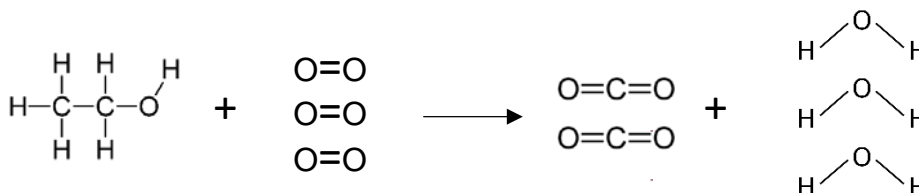
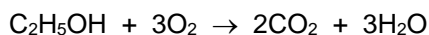
- b. A theoretical value for the energy released during the combustion of ethanol can be calculated by looking at the bonds made and broken during the reaction.

Energy must be supplied to break bonds – so bond breaking is an endothermic process.

Energy is released when new bonds are formed – so bond formation is an exothermic process.

By comparing the energy required to break bonds in the reactants with the energy released when the bonds in the products are formed it is possible to calculate the overall energy change in a reaction.

The equation for the complete combustion of ethanol is shown below;



- i. Complete the table by showing the number of each type of bond broken when the reactants are turned into individual atoms during the reaction. (1 mark)

Bonds broken	Number	Bonds made	Number
C–H	.....5.....	C=O	4
C–C	.....1.....	H-O	6
C–O	.....1.....		
O–H	.....1.....		
O=O	.....3.....	<i>(all correct for 1 mark)</i>	

- ii. The energy required to make or break a bond is given by the bond enthalpy of that bond.

The bond enthalpies of the bonds involved in this reaction are shown in the table.

Bond	Bond enthalpy / kJ per mole
C–H	413
C–C	347
C–O	335
O–H	464
O=O	498
C=O	804
H–O	464

Use the table of bond enthalpies given to calculate;

- The energy needed to break all the bonds in the reactants (2 marks)

$$(5 \times 413) + (1 \times 347) + (1 \times 335) + (1 \times 464) + (3 \times 498) = \underline{4705 \text{ kJ/mol}} \dots\dots\dots$$

(1 mark for working; 1 mark for answer)

(correct final answer on own scores both marks).....

- The energy needed to break all the bonds in the products. (1 mark)
 $(4 \times 804) + (6 \times 464) = \underline{6000 \text{ kJ/mol}}$

- The overall energy change for the reaction.
 Indicate if the reaction is endothermic or exothermic. (2 marks)
Overall energy change = 4705 – 6000 = -1295 or 1295 kJ/mol (1 mark)
Reaction is exothermic (1 mark).....

- c. How does the theoretical value you calculated in part (b) compare to the experimental value obtained from the results in part (a). Explain any differences. (2 marks)

Experimental value is smaller / Theoretical value is larger (1 mark).....

Some discussion of heat loss / inaccuracy of the practical experiment (1 mark)

- d. An alternative way to calculate a theoretical value for the energy change for the combustion of ethanol is to look at the energy required to form each of the reactants and products from their elements.

Use the energy changes for forming each of the reactants and products from their elements, given below, to calculate the energy change for the complete combustion of ethanol. (2 marks)



Energy to make reactants = -147 kJ/mol.....

Energy to make products = (2 × -394) + (3 × -242) = -1514 kJ/mol (1 mark for this number).....

Overall energy change = -1514 - -147 = -1367 kJ/mol (1 mark).....

(Correct final answer with no working scores only 1 mark).....

Total: 30 marks