SL Paper 3

A potato chip (crisp) was ignited and the flame was used to heat a test tube containing water.

Mass of potato chip / g	0.421
Mass of water / g	20.0
Initial temperature of water / °C	17.8
Final temperature of water / °C	51.3

a. (i) Calculate the heat required, in kJ, to raise the temperature of the water, using data in the table above and from Table 2 of the Data Booklet. [3]

(ii) Determine the enthalpy of combustion of the potato chip, in .

b. This energy comes mainly from the combustion of triglycerides. State the name of **one** other type of lipid found in the body and **one** role, other than energy storage, of this type of lipid. [2]

Name:

Role:

c. Explain why lipids have a higher energy content than carbohydrates. [1]

Foods such as rice, bread and potatoes are rich in carbohydrates. There are three main types of carbohydrate – monosaccharides, disaccharides and polysaccharides.

a. Glucose, , is a monosaccharide. When 0.85 g of glucose was completely combusted in a calorimeter, the temperature of 200.10 g of water increased from 20.20 °C to 27.55 °C. Calculate the energy value of glucose in . [3]

b. (i) Draw the straight chain structure of glucose. [4]

(ii) Draw the structural formula of -glucose.

(iii) Distinguish between the structures of - and -glucose.

(iv) Two -glucose molecules condense to form the disaccharide maltose. Deduce the structure of maltose.

c. One of the major functions of carbohydrates in the human body is as an energy source. State **one** other function of a carbohydrate. [1]

Granola bars are a source of dietary fibre.

When 1.13 g of a granola bar was combusted in a bomb calorimeter, the temperature of of water increased from 18.5 °C to 28.0 °C.

Calculate the energy value, in kJ per 100 g, of the granola bar to the correct number of significant figures.

Glucose, $C_6H_{12}O_6$, is a monosaccharide that our body can use as a source of energy.

a. Deduce the equation for the cellular respiration of glucose. [1]

b. Calculate the energy, in kJ, produced from 15.0g of glucose if its enthalpy of combustion is $-2803 kJmol^{-1}$. [2]

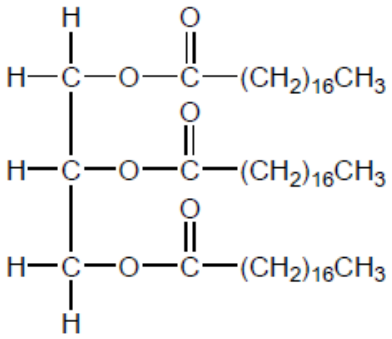
c. Glucose is the basic building block of starch which can be used to make bioplastics. Outline **two** advantages and **two** disadvantages of biodegradable plastics. [4]

Two advantages:

Two disadvantages:

d. Bioplastics are broken down by enzyme catalysed reactions. Sketch a graph illustrating how the rate of this reaction varies with pH. [1]

Vegetable oils, such as that shown, require conversion to biodiesel for use in current internal combustion engines.



a. State **two** reagents required to convert vegetable oil to biodiesel. [2]

b. Deduce the formula of the biodiesel formed when the vegetable oil shown is reacted with the reagents in (a). [1]

c. Explain, in terms of the molecular structure, the critical difference in properties that makes biodiesel a more suitable liquid fuel than vegetable oil. [2]

d. Determine the specific energy, in $kJ\,g^{-1}$, and energy density, in $kJ\,cm^{-3}$, of a particular biodiesel using the following data and section 1 of the data booklet. [2]

Density = $0.850\ g\,cm^{-3}$; Molar mass = $299\ g\,mol^{-1}$;

Enthalpy of combustion = 12.0 MJ mol^{-1}.

Specific energy:

. . . . . .

. . . . . .

Energy density:

. . . . . .

. . . . . .

Polymers are made up of repeating monomer units which can be manipulated in various ways to give structures with desired properties.

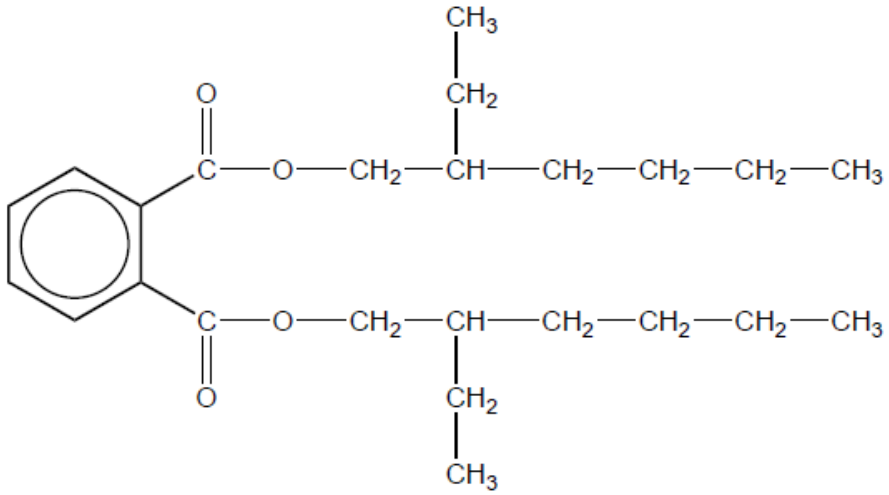
a. (i) Draw the structure of 2-methylpropene. [2]

(ii) Deduce the repeating unit of poly(2-methylpropene).

b. Deduce the percentage atom economy for polymerization of 2-methylpropene. [1]

c. (i) Suggest why incomplete combustion of plastic, such as polyvinyl chloride, is common in industrial and house fires. [2]

(ii) Phthalate plasticizers such as DEHP, shown below, are frequently used in polyvinyl chloride.



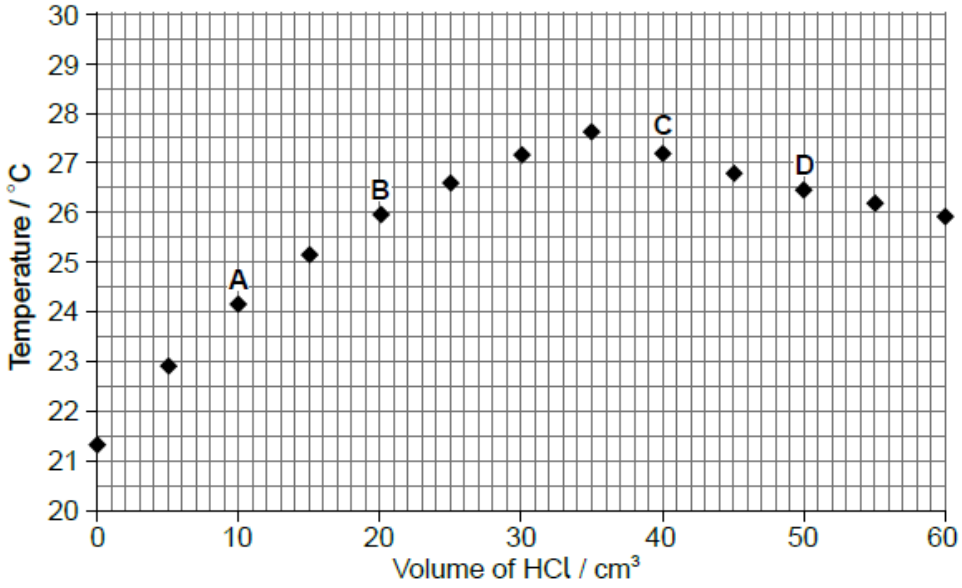
With reference to bonding, suggest a reason why many adults have measurable levels of phthalates in their bodies.

A class was determining the concentration of aqueous sodium hydroxide by titrating it with hydrochloric acid, whilst monitoring the pH of the solution. The sodium hydroxide solution was added into a glass beaker from a measuring cylinder and the hydrochloric acid added using a burette. One group of students accidentally used a temperature probe rather than a pH probe. Their results are given below.

Volume of aqueous NaOH = 25.0 ± 0.5 cm^3

Concentration of HCl = 1.00 ± 0.01 mol dm^{-3}

Volume HCl ± 0.1 / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0
Temperature ± 0.1 / °C	21.3	22.9	24.2	25.1	25.9	26.6	27.2	27.6	27.2	26.8	26.5	26.2	25.9



The graph of temperature against titre can be used to calculate the concentration of alkali without knowing the concentration of the hydrochloric acid, using the enthalpy of neutralization.

a. Explain how the concentration may be calculated in this way. [2]

b. Heat losses would make this method less accurate than the pH probe method. Outline why the thermometric method would always give a lower, not a higher, concentration. [2]

c. Suggest how heat loss could be reduced. [1]

d. State **one** other assumption that is usually made in the calculation of the heat produced. [1]

e. Suggest why scientists often make assumptions that do not correspond to reality. [1]

f. Outline why the thermochemical method would not be appropriate for 0.001 mol dm^{-3} hydrochloric acid and aqueous sodium hydroxide of a similar concentration. [1]