CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER

PHYSICAL SCIENCE 0652/61

Paper 6 Alternative to Practical **October/November 2015**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **17** printed pages and **3** blank pages.

IB15 11_0652_61/3RP
© UCLES 2015

International Examinations

[Turn over

PAPA CAMBRIDGE

1   The teacher shows the science class how to find the boiling point of an organic liquid. She has sets up the apparatus shown in Fig. 1.1.
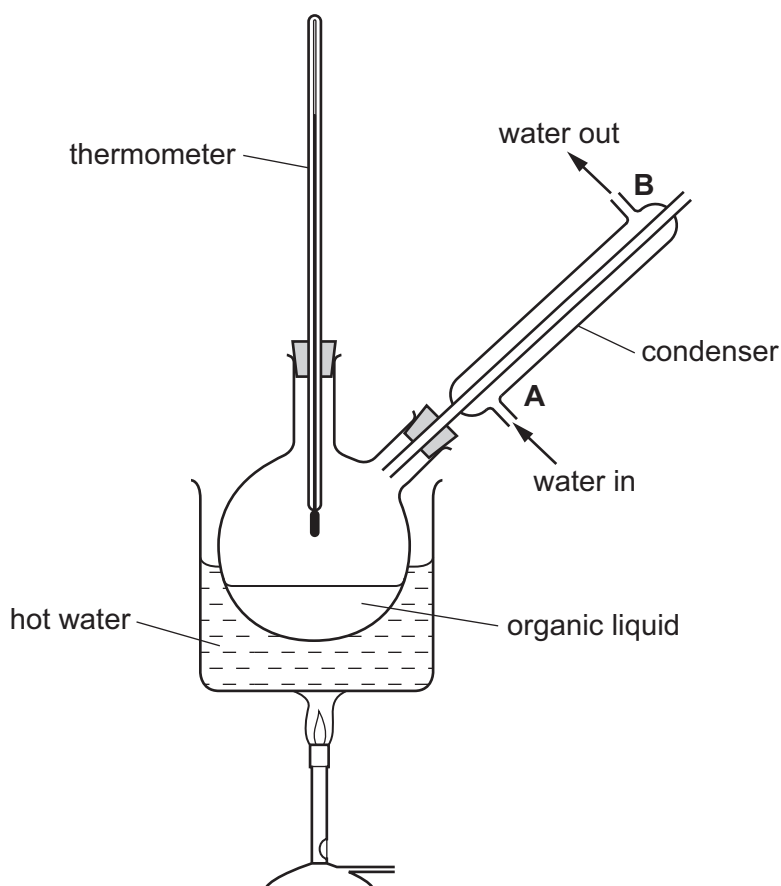

Fig. 1.1

(a) (i) Suggest **two** reasons why the cold water must enter the condenser at point **A** and not at point **B**.

....

....

.... [2]

(ii) Explain why it is unsafe to use this apparatus for boiling organic liquids, such as methanol, unless the cold water is flowing through the condenser.

....

....

.... [2]

(b) The teacher places some ethanol in the flask. She gently heats the flask until the ethanol is boiling. When the reading on the thermometer is steady she records the temperature in Table 1.1. Then she repeats the experiment using the other organic liquids listed in Table 1.1.

Table 1.1

name and formula of organic liquid	methanol CH_3OH	ethanol C_2H_5OH	propanol C_3H_7OH	hexane C_6H_{14}	heptane C_7H_{16}
boiling point / °C	65		98		

Fig. 1.2 shows the thermometer scales for the missing boiling points. Read the scales and record in Table 1.1 the temperatures. [3]

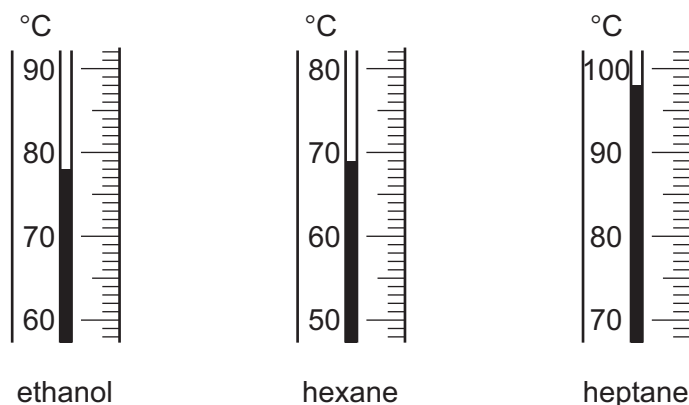ethanol   hexane   heptane

Fig. 1.2

(c) (i) Methanol, ethanol and propanol are members of the homologous series of alcohols. Hexane and heptane are members of the homologous series of alkanes.

Use the data in Table 1.1 to state the trend in boiling points for a homologous series.

--, [1]

(ii) Butanol, C_4H_9OH, also belongs to the homologous series of alcohols.

Use the data in Table 1.1 to predict the boiling point of butanol.

--- [1]

(d) Pentanol, $C_5H_{11}OH$, has a boiling point of 139 °C.

Explain why the apparatus in Fig. 1.1 cannot be used to find the boiling point of pentanol.

--, [1]

PAPA CAMBRIDGE

2 A student investigates how the speed of the reaction between potassium iodide and an oxidising agent is changed by the presence of various catalysts.

When potassium iodide solution reacts with the oxidising agent, iodine is formed. If a particular solution **A** is added, a blue-black colour is seen.

The student first carries out the reaction without a catalyst (experiment **1**) using the procedure below.

He repeats the reaction but adds $1\,cm^3$ of a solution containing Fe^{3+} ions before adding the oxidising agent (experiment **2**).

He then repeats the reaction twice more, adding Fe^{2+} ions (for experiment **3**) and X^{2+} ions of an unknown metal, **X** (for experiment **4**).

procedure

- Place $10\,cm^3$ of potassium iodide solution into a conical flask.

- Add 5 drops of the solution **A**.

- Add $1\,cm^3$ of metal ion solution (experiments **2**, **3** and **4** only).

- Add $10\,cm^3$ of the oxidising agent solution. Shake well and start the stopclock.

- When the mixture in the flask turns blue-black, stop the stopclock. Record this time in Table 2.1 to the nearest second.

Table 2.1

experiment	metal ion solution added	time taken for blue-black colour / s
1	none added	
2	Fe^{3+}	
3	Fe^{2+}	
4	X^{2+}	1

(a) Name the solution **A** that produces the blue-black colour when iodine is formed.

.... [1]

(b) (i) Name a piece of apparatus, other than a measuring cylinder, that can be used to measure accurately $10\,cm^3$ of potassium iodide solution and transfer it to the flask.
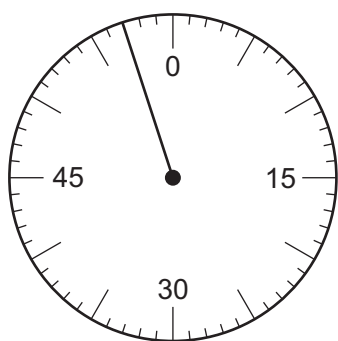
.... [1]

(ii) Name a piece of apparatus, different to your answer in **(b)(i)**, that can be used to place 5 drops of solution **A** into the flask.

.... [1]
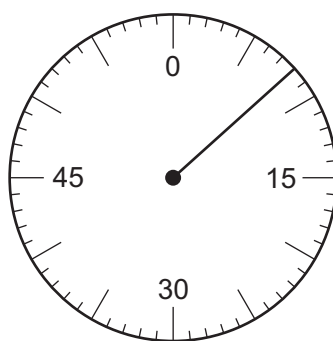
(c) Fig. 2.1 shows the stopclock dials for the three times missing from the last column of Table 2.1.

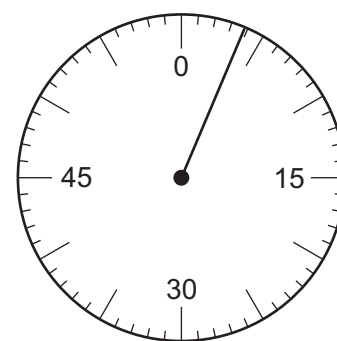Read the dials and record the readings in Table 2.1. [3]

experiment **1**   experiment **2**   experiment **3**

Fig. 2.1

(d) Use the results in Table 2.1 to conclude which ion is the better catalyst, Fe^{3+} or Fe^{2+}. Explain your answer.

....

.... [1]

(e) (i) The student adds ammonia solution to a portion of the solution of X^{2+} ions. He sees a light blue precipitate which dissolves to form a dark blue solution.

Name metal **X**. .... [1]

(ii) Name the light blue precipitate that the student sees when ammonia is added to the solution of X^{2+} ions.

.... [1]

(f) The teacher says that the experiments are not a fair comparison. Suggest **one** change to experiment **1** which would make the comparison fair.

....

....

.... [1]

3 A student has been given a plastic cup, shown in Fig. 3.1. He finds the volume of the cup in cm^3 using two different methods, **method 1** and **method 2.**
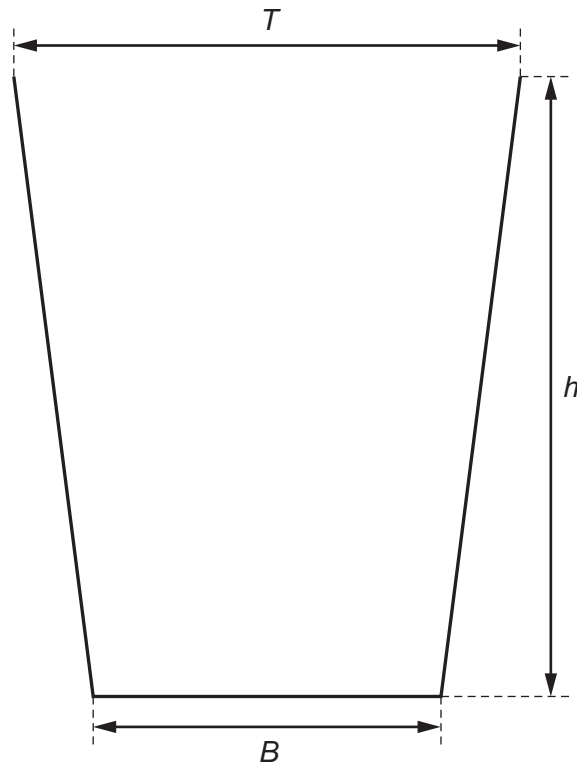

Fig. 3.1

method 1

Fig. 3.1 shows the actual size of the cup. Use a ruler to answer **(a)(i)**, **(ii)** and **(iii)**.

(a) (i) Measure h, the vertical height of the cup, to the nearest 0.1 cm.

$h =$ .... cm   [1]

(ii) Measure B, the diameter of the bottom of the cup, to the nearest 0.1 cm.

$B =$ .... cm   [1]

(iii) Measure T, the diameter of the top of the cup, to the nearest 0.1 cm.

$T =$ .... cm   [1]

(iv) Calculate d, the average diameter of the cup, using your answers to **(a)(ii)** and **(iii)**.

$d =$ .... cm   [1]

PAPA CAMBRIDGE

(v) Calculate V_1, the volume of the cup, to the nearest cm^3, using the equation

$$V_1 = \pi d^2 \frac{h}{4}$$

$V_1 =$ .... cm^3 [1]

method 2

The student places $250\,cm^3$ of water into a measuring cylinder. He fills the plastic cup from the measuring cylinder.

Fig. 3.2 shows the amount of water left in the measuring cylinder.
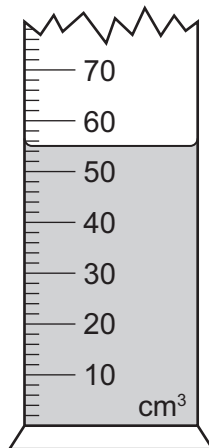
Fig. 3.2

(b) (i) Read the scale to the nearest $1\,cm^3$ to find the volume of water left in the measuring cylinder.

volume of water = ... cm^3 [1]

(ii) Find V_2, the volume of water that was placed in the plastic cup.

$V_2 =$ .... cm^3 [1]

PAPA CAMBRIDGE

(c) The student thinks that **method 2** is less accurate than **method 1**.

Suggest **two** sources of inaccuracy in **method 2.**

1 ....

....

2 ....

....

[2]

(d) Another student finds the mass in grams of the empty plastic cup. Then he finds its mass when it is full of water.

Explain how he can use these two masses to find the volume of water in the cup.

....

....

.... [1]

Please turn over for Question 4.

PAPA CAMBRIDGE

4 The teacher gives a student three different resistors, labelled **X**, **Y** and **Z**. He has made the resistors by winding pieces of resistance wire into coils. The pieces of wire are made from the same alloy but they have different lengths and thicknesses.

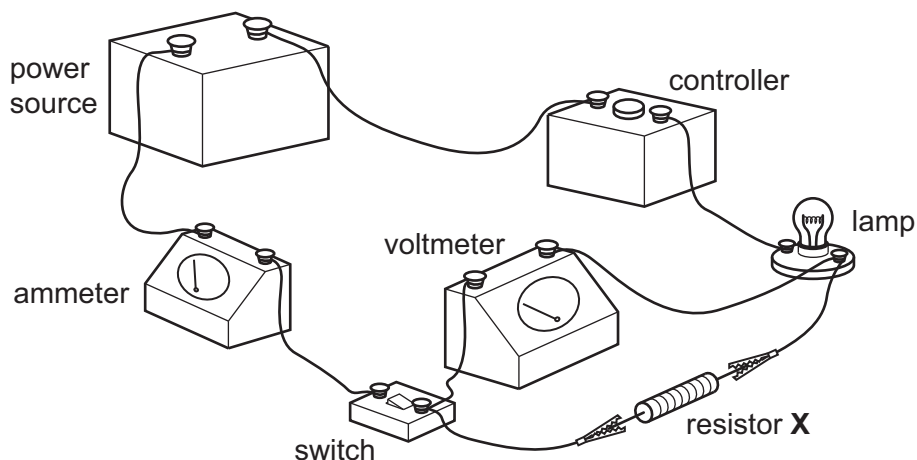The student uses the apparatus shown in Fig. 4.1 to compare the resistances of **X**, **Y** and **Z**.

Fig. 4.1

Method

- He joins resistor **X** into the circuit as shown in Fig. 4.1.

- He sets the controller so that the minimum current will flow.

- He turns the switch on and uses the controller to gradually increase the current until the lamp is lit.

- He records in Table 4.1 the current and the reading on the voltmeter.

- He switches off the current and returns the controller to the first setting.

- He carries out the same experiment using resistors **Y** and **Z**, setting the controller so that the same current flows each time.

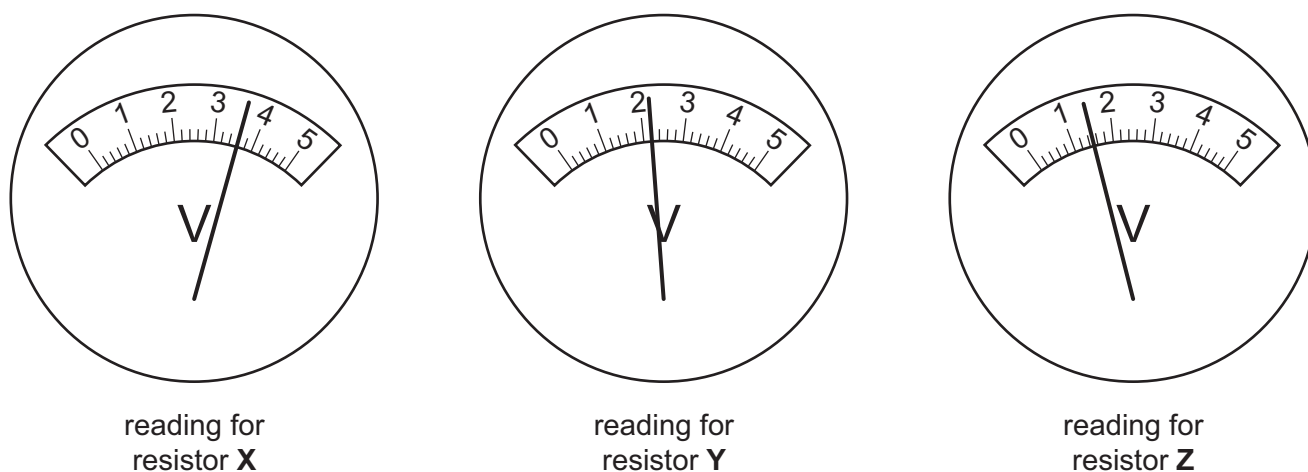Fig. 4.2 shows the voltmeter readings for the three experiments.

reading for
resistor **X**

reading for
resistor **Y**

reading for
resistor **Z**

Fig. 4.2

Table 4.1

current for resistors X, Y and Z / A	voltage for resistor X / V	voltage for resistor Y / V	voltage for resistor Z / V
0.5			

(a) Read the voltmeters shown in Fig. 4.2.

Record the readings in Table 4.1.   [3]

(b) The controller shown in Fig. 4.1 is used to vary the current passing through the circuit. Suggest the correct name for the controller and draw its symbol in the space below.

.... [2]

(c) (i) Place **X**, **Y** and **Z** in the order of their resistance to a current passing through them.

most resistance to the current   ....

                                                       ....

least resistance to the current   ....   [1]

(ii) Explain in words how you can decide on your answer to **(c)(i)** without calculating the resistances of **X**, **Y** and **Z**.

....

.... [1]

(d) Use data from Table 4.1 to calculate the resistance of **X**.

resistance of **X** = ... Ω   [1]

PAPA CAMBRIDGE

(e) The student unwinds each of the three resistance wires from the coils and measures the length and thickness of each wire. His results are shown in Table 4.2.

Table 4.2

	wire 1	wire 2	wire 3
length / m	1.0	1.5	2.0
thickness / mm	1.0	1.5	2.0

Which wire is **X**, **Y** or **Z**?

wire 1 is ---

wire 2 is ---

wire 3 is ---   [2]

5 A student carries out an investigation on carbon dioxide.

He dissolves carbon dioxide in water. Then he finds the concentration of the carbon dioxide solution by reacting it with limewater.

Fig. 5.1 shows the apparatus for making the carbon dioxide using marble chips and dilute hydrochloric acid.

marble chips
and dilute
hydrochloric acid
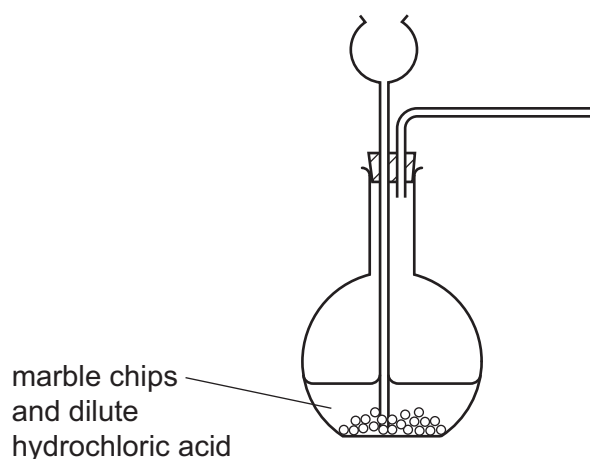
Fig. 5.1

(a) Complete Fig. 5.1 to show how the carbon dioxide is dissolved in water. [1]

(b) The student slowly adds limewater to $25\,cm^3$ of the carbon dioxide solution.

When enough limewater has been added, a precipitate forms in the mixture. He records the volume of limewater used at the point where the precipitate has just formed. He repeats the experiment another two times.

(i) Suggest the best way for the student to detect the precipitate as soon as it begins to form.

....

.... [1]

PAPA CAMBRIDGE

(ii) Fig. 5.2 shows the measuring instruments used to add limewater to the carbon dioxide solution in each of the three experiments. Each instrument is shown after the limewater has been added.

The measuring instruments are filled with limewater to the zero point of the scale and the limewater slowly released from a tap at the bottom of the instrument. The level of limewater in each tube shows how much has been used.

experiment 1   experiment 2   experiment 3
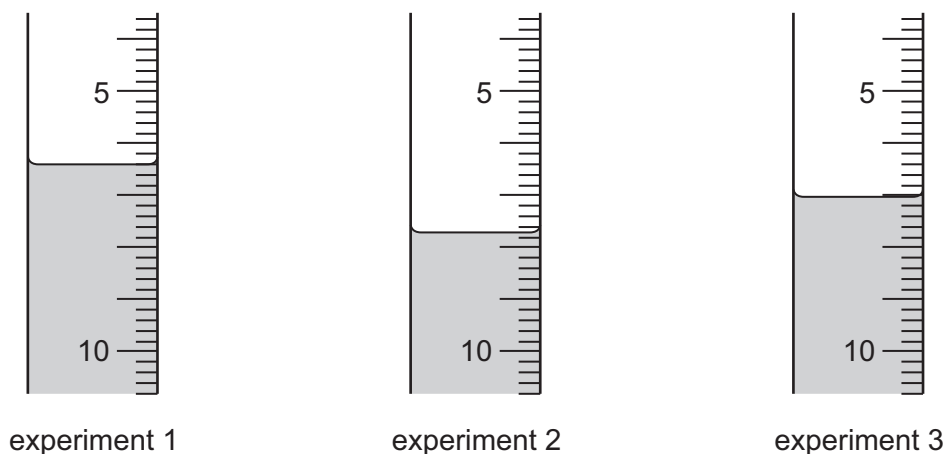
Fig. 5.2

Read the scales and record in Table 5.1 the volume of limewater used to the nearest $0.1\,cm^3$.

Table 5.1

experiment	1	2	3
volume of limewater used / cm^3			

[3]

(iii) Find the average volume of limewater used.

average volume = ... cm^3 [1]

(c) Calculate the concentration of the carbon dioxide solution. Use the formula shown below.

concentration of carbon dioxide solution = $\dfrac{\text{average volume of limewater} \times 0.015\,\text{mol}/\text{dm}^3}{\text{volume of carbon dioxide solution}}$

concentration of carbon dioxide solution = ... mol/dm^3 [2]

(d) A solution of carbon dioxide in water is slightly acidic.

Limewater is alkaline.

An indicator may be used in this experiment instead of looking for the precipitate.

Suggest a suitable indicator to add to the carbon dioxide solution. State the colour change when enough limewater has been added to react with all of the carbon dioxide solution.

indicator ....

colour change .... to ....,   [2]

6 Two students investigate the speed of a trolley running down a smooth slope. The trolley has a mass of 1 kg. The angle of the smooth slope can be adjusted by raising one end. The arrangement of apparatus is shown in Fig. 6.1.
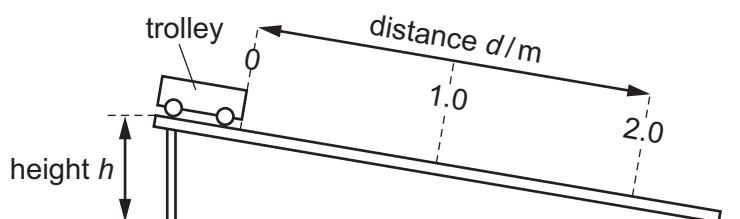

Fig. 6.1

method

- the height *h* is initially set at 2 cm.

- The trolley is placed at the top end of the slope as shown in Fig. 6.1.

- The trolley is released and a timer is started.

- When the trolley passes the 1 m mark, the time t_1 is noted and recorded in Table 6.1.

- When the trolley reaches the 2 m mark, the time t_2 is noted and recorded in Table 6.1.

- The experiment is repeated using different heights of 4 cm and 5 cm.

(a) Explain the best way for the students to work together to obtain the data recorded in Table 6.1 for each experiment.

--. [1]

(b) The timer displays for the missing values of t_1 and t_2 are shown in Fig. 6.2. Read the displays and record the times in the correct places in Table 6.1.

You will have to decide which reading goes in which column. [1]

Fig. 6.2

PAPA CAMBRIDGE

Table 6.1

height h / cm	time t_1 / s for 1 m	time t_2 / s for 2 m
2	3.5	4.9
4		
5	2.0	3.1

(c) (i) Use data for $h = 2$ cm from Table 6.1, to show that the trolley accelerates as it runs down the slope. Show your working.

[2]

(ii) Use data from Table 6.1 to show that the trolley reaches a greater speed over 2 m when the height of the slope is greater. Show your working.

[2]

(d) The students repeat the experiments using a trolley of mass 2 kg. Predict how the results of this set of experiments will compare with the results in Table 6.1. Justify your answer.

--- [2]

(e) One of the students suggests that the height h is increased to 30 cm. Suggest why the results may be inaccurate for this experiment.

--- [1]

(f) State the energy transformation that occurs as the trolley runs down the slope.

--- [1]

PAPA CAMBRIDGE

18

BLANK PAGE

BLANK PAGE

20

BLANK PAGE

PAPA CAMBRIDGE