Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

7586436648

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **October/November 2021**

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

DC (LK/CB) 214255/3

[Turn over

1 A student investigates how germinating bean seeds respond to gravity.

The student has two germinating bean seeds, **A** and **B**. The beans are left to grow for two days.

Fig. 1.1 shows the appearance of beans **A** and **B** after two days.

Fig. 1.1

(a) Measure on Fig. 1.1 the length of the roots **A** and **B** after two days. This is the distance between the dotted lines.

Record in Table 1.1 your value in millimetres to the nearest millimetre.

Table 1.1

bean	root length after two days /mm	root length after four days /mm	increase in root length /mm
A		38	
B			

[2]

(b) Bean **A** is rotated through 90°. Bean **B** is **not** rotated.

Fig. 1.2 shows the appearance of beans **A** and **B** after two more days growth.

A **B**

Fig. 1.2

Describe how Fig. 1.2 shows that the growth of roots is affected by gravity.

.....

.....

..... [1]

(c) The student measures the length of the root of bean **A** and records this in Table 1.1.

On Fig. 1.2 measure the length of the root of bean **B**.

Record in Table 1.1 your value in millimetres to the nearest millimetre. [1]

(d) **(i)** Calculate the increase in root length for bean **A** and bean **B**.

Use the equation shown.

increase in length = length after four days – length after two days

Record your values in Table 1.1.

[1]

(ii) Describe how rotating the bean affects the growth rate of the root.

Explain your answer with reference to the data in Table 1.1.

effect .....

explanation .....

.....

[1]

(e) The student repeats the investigation with more beans. To make it a fair test they use beans of the same species (type).

Explain why the student uses beans of the same species.

.....

..... [1]

(f) The student tests a sample of crushed bean root for the presence of starch.

Name the reagent used to test for starch and state the observation for a positive result.

reagent .....

observation .....
[2]

[Total: 9]

2 A student investigates the heart rate of *Daphnia*.

Daphnia are small animals that live in water.

Procedure

The student:

- measures the heart rate of a *Daphnia* in water
- records in Table 2.1 the number of heartbeats in 1 minute
- repeats this measurement two more times
- adds some cola, coffee or tea to three separate samples of water containing *Daphnia*.

The student repeats the procedure with each water sample.

Table 2.1

solution	heart rate / beats per minute			
	trial 1	trial 2	trial 3	average
water	194	287	299	260
cola	374	389	378	
tea	415	409	402	409
coffee	316	324	313	318

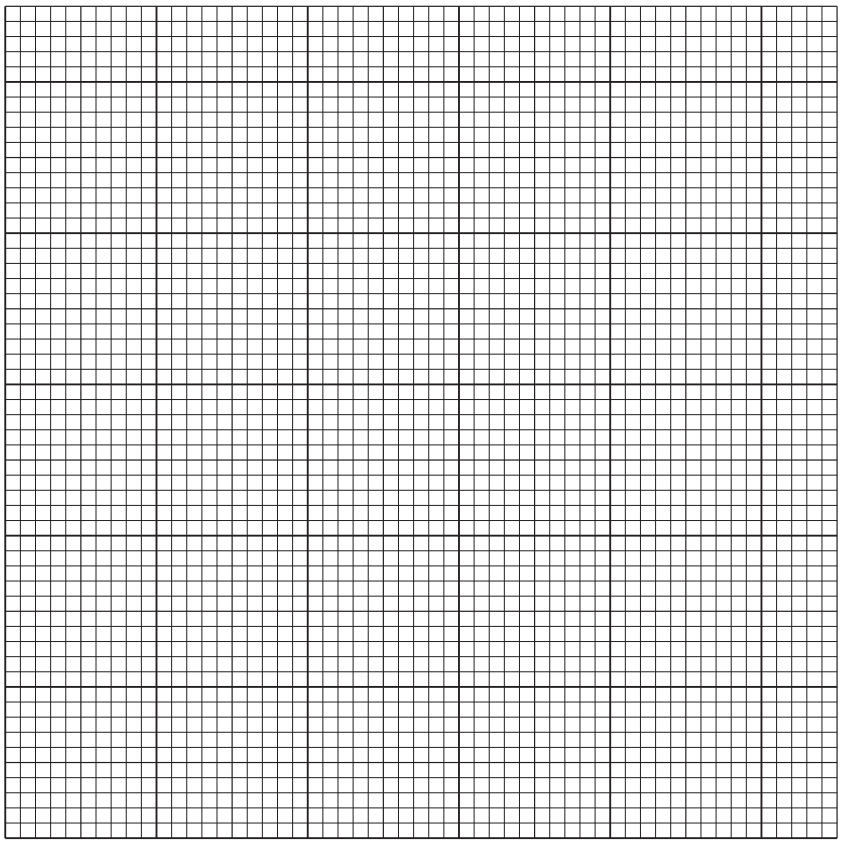
(a) Calculate the average heart rate for *Daphnia* in cola.

Record in Table 2.1 this value to the nearest whole number.

[2]

(b) On the grid draw a **bar chart** of average heart rate (vertical axis) against solution.

Use the values in Table 2.1.



[3]

(c) Cola and tea contain a chemical called caffeine.

Use your bar chart to describe the effect caffeine has on the average heart rate of *Daphnia*.

..... [1]

(d) **(i)** Explain why the average result for heart rate of *Daphnia* in water is **not** reliable.

.....

..... [1]

(ii) Suggest how the student can make this average result for the heart rate of *Daphnia* in water more reliable.

.....

..... [1]

(iii) Suggest why water with nothing added is used as one of the solutions.

..... [1]

(e) The maker's of the coffee claim that it does **not** contain caffeine.

Use the data in Table 2.1 and your bar chart to state if you agree with the makers claim.

Explain your answer.

statement .....

explanation .....

.....

[1]

(f) The student uses a different *Daphnia* for each solution.

Suggest why a different *Daphnia* must be used.

.....

..... [1]

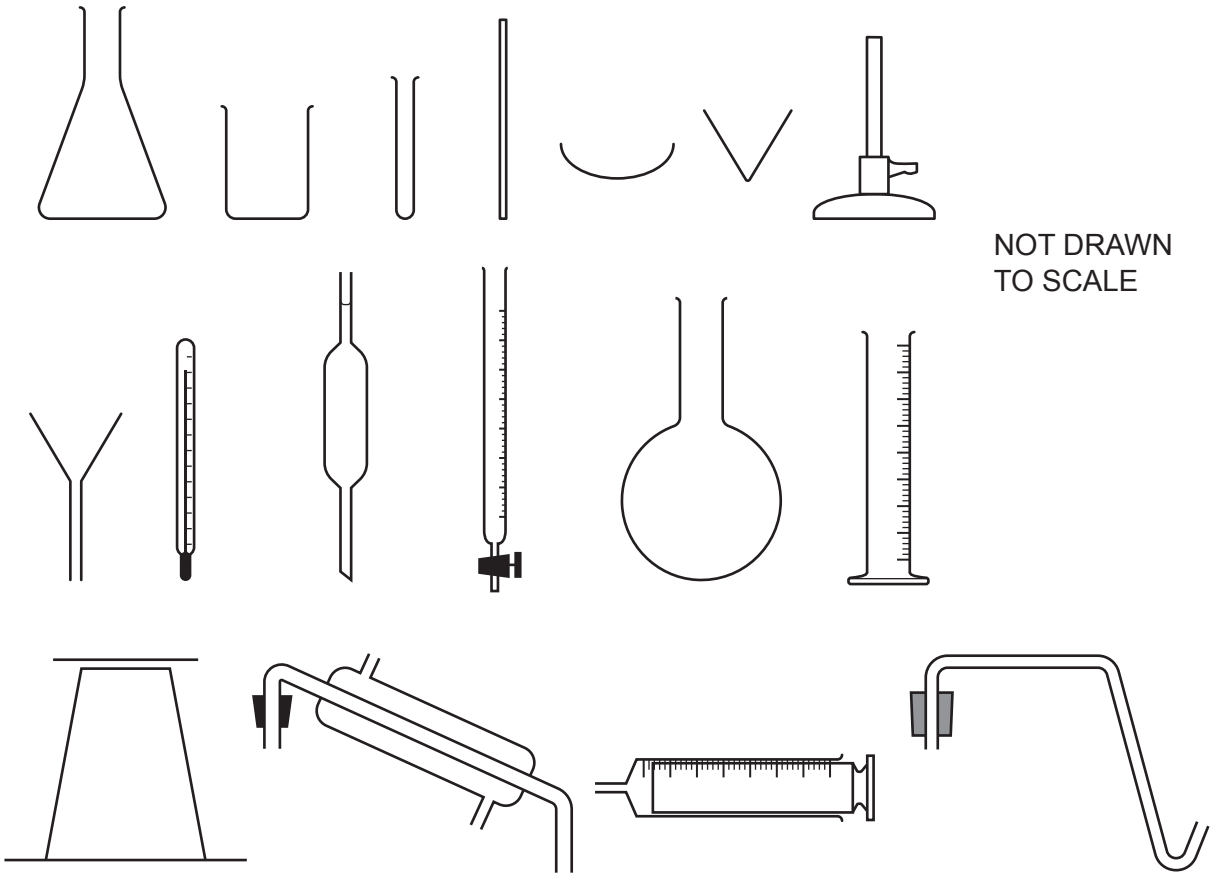
[Total: 11]

3 Carbon dioxide gas can be made from marble chips and dilute hydrochloric acid.

The marble chips are placed in a conical flask and dilute hydrochloric acid is added.

The carbon dioxide gas is collected over water in a test-tube.

Fig 3.1 shows some pieces of apparatus.



NOT DRAWN
TO SCALE

Fig. 3.1

(a) (i) Name a piece of apparatus that can be used to collect and measure the **volume** of gas produced.

..... [1]

(ii) Draw a labelled diagram of the assembled apparatus used for making and collecting the carbon dioxide gas made in this reaction.

In your diagram include the following apparatus from Fig. 3.1:

- a conical flask
- a beaker
- a test-tube
- a delivery tube
- any other apparatus necessary.

Also include the marble chips, dilute hydrochloric acid and water and label them.

[4]

(iii) Ammonia is a gas which is very soluble in water.

Suggest why ammonia gas **cannot** be collected using the apparatus in the diagram in **(a)(ii)**.

..... [1]

(b) A substance freezes and melts at the same temperature.

A pure substance has a fixed melting point temperature.

When an impurity is added to a substance its melting point temperature decreases.

(i) **P**, **Q** and **R** are solutions of different concentrations of the same substance.

Procedure

The student:

step **1** half fills a beaker with crushed ice

step **2** stirs the ice

step **3** measures and records in Table 3.1 the melting point temperature of ice, 0.0 °C.

step **4** adds 10 cm^3 of solution **P** to the ice

step **5** stirs the mixture and records in Table 3.1 the lowest temperature reached

step **6** pours the mixture into the waste container.

The student repeats steps **1**, **4** and **5** with solution **Q** and then solution **R** instead of solution **P**.

Table 3.1

solution added to ice	melting point temperature / °C
none added	0.0
P	–5.5
Q	
R	

Fig. 3.2 shows thermometer readings for solution **Q** and solution **R**.

Record these negative temperatures in Table 3.1.

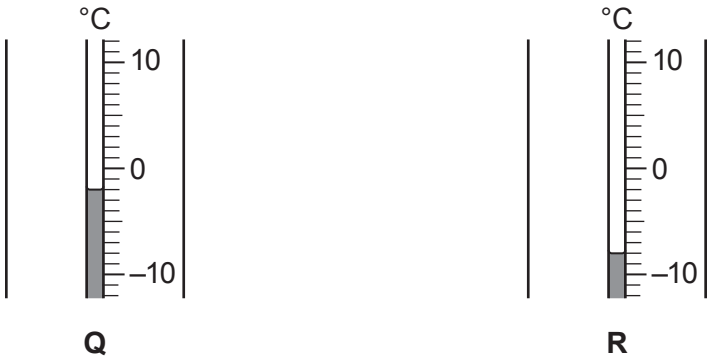


Fig. 3.2

[2]

(ii) The more impurity that is added to a substance, the lower its melting point temperature becomes.

Place the solutions **P**, **Q** and **R** in order of increasing concentration.

least concentrated .....

.....

most concentrated .....

[1]

(iii) In cold countries salt is added to icy roads so that the ice melts.

Suggest why adding salt helps the ice to melt.

.....

.....

..... [1]

[Total: 10]

4 Solutions of the cations $X^{2+}(aq)$, $Y^{2+}(aq)$, and $Z^{2+}(aq)$, are each tested with aqueous ammonia and with aqueous sodium hydroxide.

The results are shown in Table 4.1.

Table 4.1

	observations		
test	**X^{2+}**	**Y^{2+}**	**Z^{2+}**
a few drops of aqueous ammonia	white precipitate	white precipitate	white precipitate
excess aqueous ammonia	white precipitate	white precipitate	colourless solution
a few drops of aqueous sodium hydroxide	white precipitate	white precipitate	white precipitate
excess aqueous sodium hydroxide	white precipitate	colourless solution	white precipitate

(a) Use the results in Table 4.1 to describe the test used to confirm the presence of Y^{2+}.

test .....

observation for a positive result .....

.....

[2]

(b) The ions can also be identified using flame tests.

Describe how to do a flame test.

.....

.....

..... [2]

[Total: 4]

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5 A hard candy (sweet) contains soluble colourings.

Colourings **S**, **T** and **U** must **not** be used in candy.

Colourings **S**, **T** and **U** are all soluble in water.

Plan an experiment to find out if any of the colourings, **S**, **T** or **U**, are present in the candy.

You may use samples of the three colourings, **S**, **T** and **U**, samples of candy, chromatography paper and any other common laboratory apparatus.

Include in your plan:

- the apparatus you will use
- a brief description of the method, including any safety precautions AND explain why these are needed
- a labelled diagram of your experiment
- what you will measure
- how you will use your results to draw a conclusion.

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..... [7]

6 A student investigates the rate of cooling of hot water in a beaker.

Procedure

The student:

- pours 200 cm^3 of hot water into a beaker
- places a thermometer into the hot water
- waits for 30 seconds
- stirs the water
- records the temperature *T* of the hot water.

Fig. 6.1 shows the reading on the thermometer.

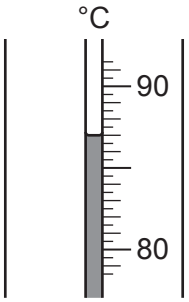

Fig. 6.1

(a) Record in Table 6.1 for time $t = 0$, this value of *T* shown in Fig. 6.1 to the nearest 0.5 °C. [1]

Table 6.1

time t /	**temperature T / .....**
0	
60	83.5
120	80.5
180	77.5
240	75.0
300	73.0

The student records in Table 6.1 the temperature of the water every 60 s for 300 s.

(b) (i) Insert the units in the column headings in Table 6.1. [1]

(ii) Suggest why the student waits for 30 s before recording the initial temperature of the hot water.

.....

..... [1]

(iii) Suggest why stirring the water before taking the reading gives a more accurate value for the initial temperature of the hot water.

.....

..... [1]

(c) Use the temperature values in Table 6.1 to calculate

(i) the rate of decrease in temperature of the water during the **first** 60 s of cooling. Use the equation shown.

$$\text{rate of decrease in temperature during first 60 s} = \frac{\text{temperature decrease in first 60 s}}{60\text{ s}}$$

Give your answer to two significant figures.

rate of decrease in temperature during **first** 60 s = ... °C / s [2]

(ii) the rate of decrease in temperature of the water during the **final** 60 s of cooling.

rate of decrease in temperature during **final** 60 s = ... °C / s [1]

(iii) Use your answers in **(c)(i)** and **(c)(ii)** to write a conclusion about the rate at which hot water in a beaker cools.

.....

..... [1]

(d) Suggest **two** factors which change the rate of cooling in this experiment.

factor 1 .....

factor 2 .....
[2]

[Total: 10]

7 A student investigates the total resistance of two different combinations of identical resistors.

The student sets up the circuit shown in Fig. 7.1. It contains 2 identical resistors connected in parallel.

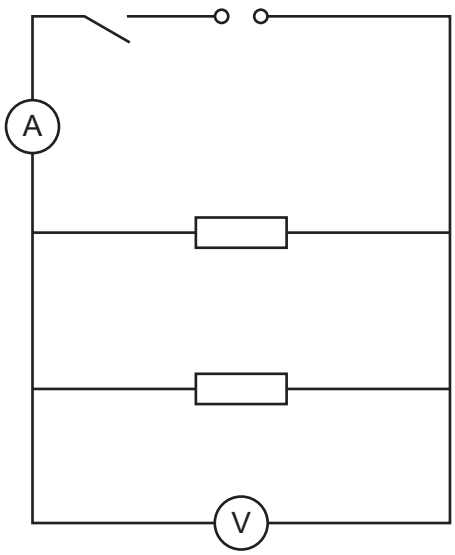

Fig. 7.1

(a) Procedure

The student:

- closes the switch
- measures and records the potential difference V_1 across the resistors
- measures and records the current I_1 in the circuit
- opens the switch.

(i) The readings on the meters are shown in Fig. 7.2 and 7.3.

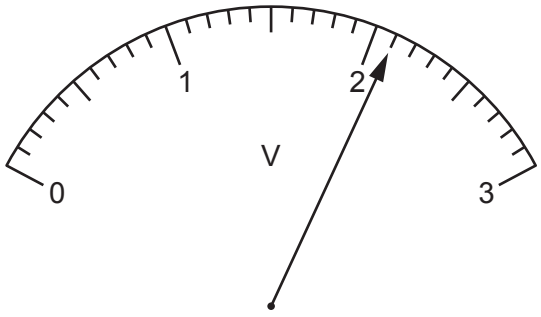

Fig. 7.2

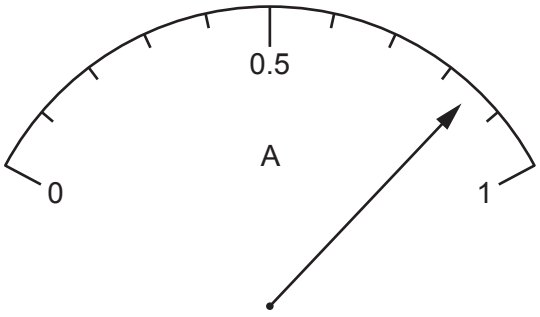

Fig. 7.3

Record the potential difference V_1 and the current I_1.

V_1 = ... V

I_1 = ... A [2]

(ii) Calculate the total resistance R_1 of the combination of resistors.
Use the equation shown.

$$R_1 = \frac{V_1}{I_1}$$

Give the unit of resistance in your answer.

R_1 = ... unit ..... [2]

(b) (i) The student rearranges the circuit so that the two resistors are connected in series.

Draw the rearranged circuit. You do **not** need to include the ammeter and the voltmeter.

[1]

(ii) Suggest why the student opens the switch whilst rearranging the circuit.

.....

..... [1]

(iii) Procedure

The student:

- closes the switch
- connects the voltmeter across both resistors
- measures and records the potential difference V_2 across the resistors
- connects the ammeter
- measures and records the current I_2 in the circuit
- opens the switch.

V_2 = 2.0 V

I_2 = 0.21 A

Calculate the total resistance R_2 of the combination of resistors.
Use the equation shown.

$$R_2 = \frac{V_2}{I_2}$$

R_2 = ... [1]

(c) The teacher states that $R_2 = 4R_1$.

Use your results from **(a)(ii)** and **(b)(iii)** to state if, allowing for experimental error, the teacher's statement is correct.
Justify your answer, showing any working.

statement .....

justification .....

.....
[2]

[Total: 9]