

Candidate Name: \_\_\_\_\_

Candidate Signature: \_\_\_\_\_

# Ampleforth College

## Year 9 Scholarship Assessment

### Specimen Paper

Paper 3 – STEM Option

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Time allowed – 1hr

#### Materials

- There are no additional materials required for this paper.
- **YOU MAY USE A CALCULATOR.**

#### Instructions

- Use black ink or ball point pen. Use a pencil only for drawing.
- Answer **ALL** questions.
- You must answer the questions in the spaces provided.
- Do all rough work in this book.
- Cross through any work you do not wish to be marked.
- Answer question 5(c)(i) and 5(c)(ii) on the graph paper provided.

#### Information

- The total number of marks available for this paper is 58.

**SECTION A – Suggested Time 6 minutes**

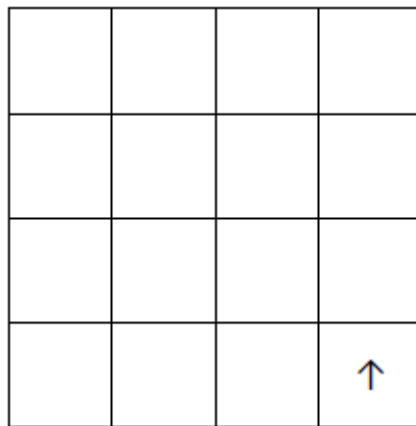
**Q1.**

Four separate subroutines have been written to control a robot.

- `Forward(n)` moves the robot `n` squares forward.
- `TurnLeft()` turns the robot 90 degrees left.
- `TurnRight()` turns the robot 90 degrees right.
- `ObjectAhead()` returns `true` if the robot is facing an object in the next square or returns `false` if this square is empty.

- (a) Draw the path of the robot through the grid below if the following program is executed (the robot starts in the square marked by the ↑ facing in the direction of the arrow).

```
Forward(2)
TurnLeft()
Forward(1)
TurnRight()
Forward(1)
```

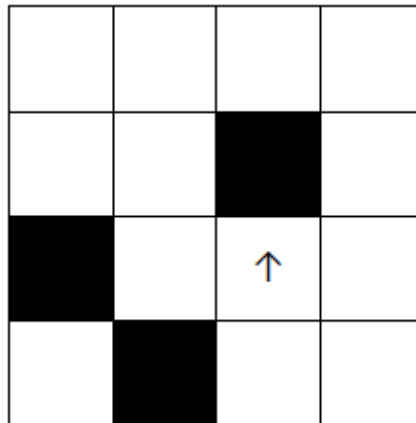


(2)

(b) Draw the path of the robot through the grid below if the following program is executed (the robot starts in the square marked by the ↑ facing in the direction of the arrow). If a square is black then it contains an object.

- The code between `WHILE` and `ENDWHILE` will loop while `ObjectAhead()` remains true.

```
WHILE ObjectAhead() = true
  TurnLeft()
  IF ObjectAhead() = true THEN
    TurnRight()
    TurnRight()
  ENDIF
  Forward(1)
ENDWHILE
Forward(1)
```



(4)  
(Total 6 marks)

**SECTION B – Suggested Time 12 minutes**

**Q2.**

Read the passage below.

Use the information in the passage and your own knowledge to answer the questions that follow.

**Toystory**

Toystory is a bull who was born in 2001. The photograph shows Toystory.



In the world of dairy farming Toystory is a famous bull. He fathered 500 000 offspring but did not mate with any cows. He was able to father so many offspring because his semen was collected and then used to fertilise cows using artificial insemination.

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Toystory's mother was a high milk producer and his father was a popular bull. He was sold for \$4000 by his owner to a specialist breeding company called Genex.

Genex started to collect semen from Toystory when he was four years old. The semen is carefully collected, using a teaser animal and an artificial rubber vagina.

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The semen is divided into many separate samples. These samples are put in small straws and frozen in liquid nitrogen. The straws can then be sold and sent to dairy farmers around the world to inseminate their cows. A total of 2.4 million samples of semen from Toystory was sold in more than 50 countries around the world.

Toystory's reputation grew as the offspring he fathered went on to be high milk producers. His semen straws sold for over \$60 each. Bull semen can now be sold as sexed or unsexed samples, with sexed samples being more expensive to purchase.

Toystory was highly valued because his offspring produced large quantities of milk of a desired composition. His semen was effective at getting cows pregnant, his daughters gave birth easily and were strong. He had a rare mix of fertility, genetics and appearance.

One of his daughters sold for \$300 000 in 2009. His record number of offspring is unlikely to be beaten. This is because bulls are often retired earlier as new genetic advances are discovered.

(a) Suggest why Genex waited until Toystory was four years old before beginning to collect his semen (line 9).

**(1)**

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.....

(b) Explain how the semen from the bull is used to fertilise cows using artificial insemination.

**(2)**

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.....

(c) (i) Suggest why the semen is stored in liquid nitrogen (line 13).

**(1)**

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.....

(ii) Sexed semen is guaranteed to produce offspring of one sex.  
Suggest why dairy farmers would prefer to use sexed semen (line 19).

**(1)**

.....  
.....

(d) Determine the percentage success of Toystory's semen samples in producing offspring (line 2 and line 15).

**(2)**

percentage success = ..... %

(e) Describe how scientists could investigate which of two bulls is the best to use as a father in dairy farming.

**(3)**

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(f) Explain why the composition of milk is important to consumers (line 22).

**(2)**

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**(Total 12 marks)**

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QUESTIONS CONTINUE ON NEXT PAGE**

**SECTION C – Suggested Time 11 minutes**

**Q3.**

(a) A speed camera is positioned at the side of a road.



© Darryl Sleath/Shutterstock

The camera measures the speed of a vehicle on the road to determine whether the vehicle is travelling too fast.  
The camera takes two photographs of the vehicle 0.25 s apart.  
The photographs are used to measure the distance travelled by the vehicle during this time.

(i) State the formula linking average speed, distance moved and time taken. **(1)**

(ii) In the time between the two photographs, the car travels a distance of 6.5 m.  
Calculate the average speed of the car. **(2)**

average speed = ..... m/s

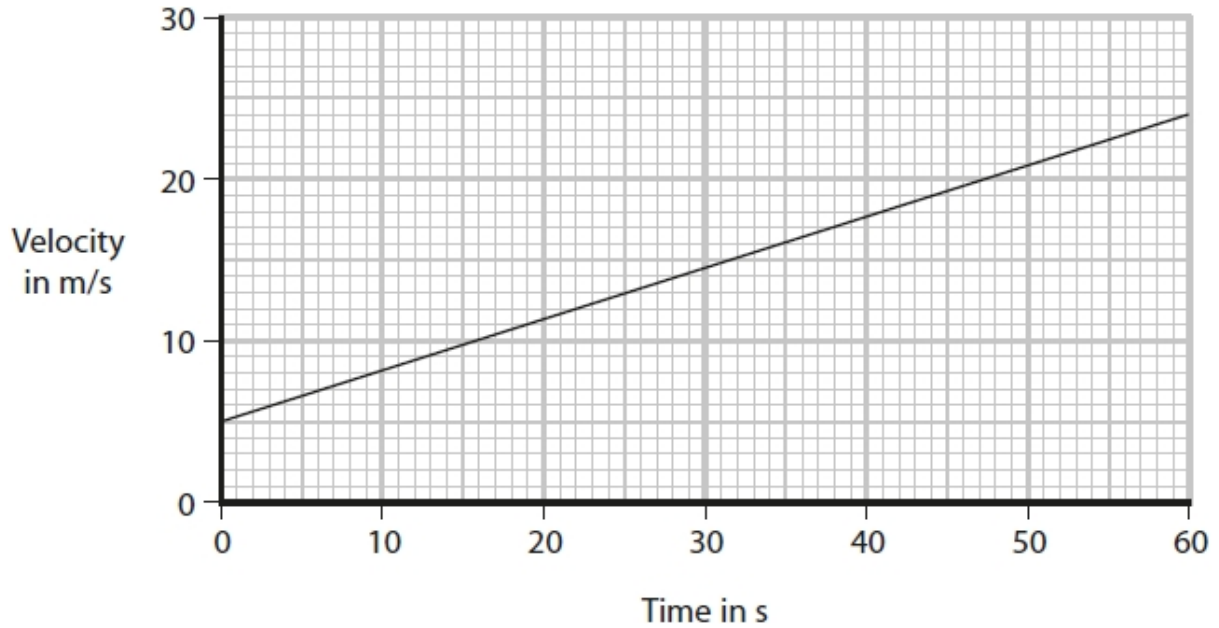


(iii) The speed limit of the road is 80 kilometres per hour.  
Determine whether the car is exceeding the speed limit.

**(2)**

.....  
.....

(b) The velocity-time graph shows how the velocity of a lorry changes with time.



(i) Explain how the graph shows that the lorry has a constant acceleration.

**(2)**

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.....

(ii) State the formula linking acceleration, change in velocity and time taken.

**(1)**

(iii) Calculate the acceleration of the lorry.

**(3)**

acceleration = ..... m/s<sup>2</sup>

**(Total 11 marks)**

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QUESTIONS CONTINUE ON NEXT PAGE**

## SECTION D – Suggested Time 12 minutes

**Q4.**

In the figure below an untidy desk is shown.



*Figure 2*

Using **sketches** and **notes**, develop a design to help the user organise their equipment.

- Your designs must help make space to work effectively on the desk.
- Your designs could replace any of the existing equipment apart from the monitor and PC.
- Your designs could have multiple functions.
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Your notes should include reference to materials and manufacturing processes.

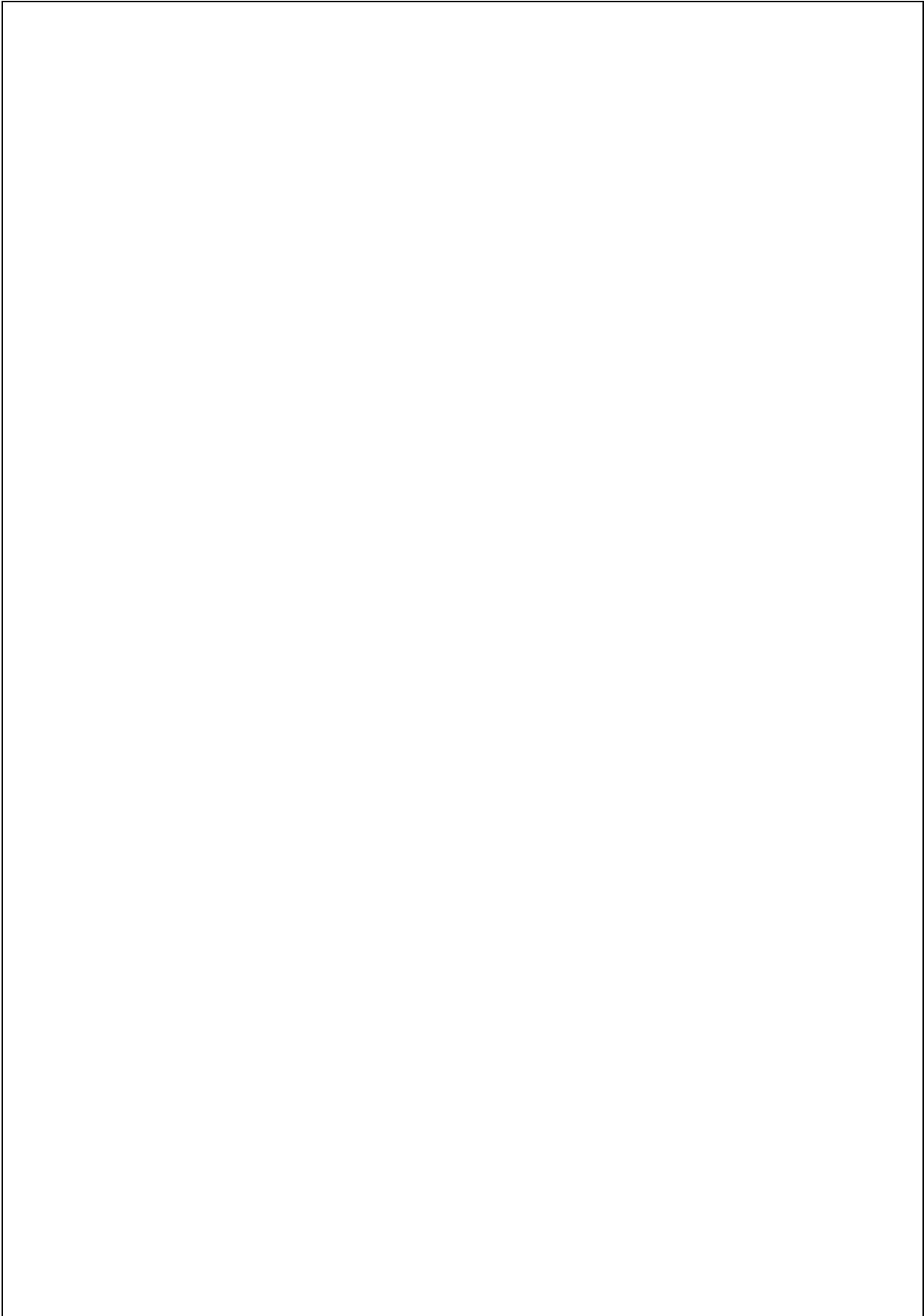
### **Marking guide**

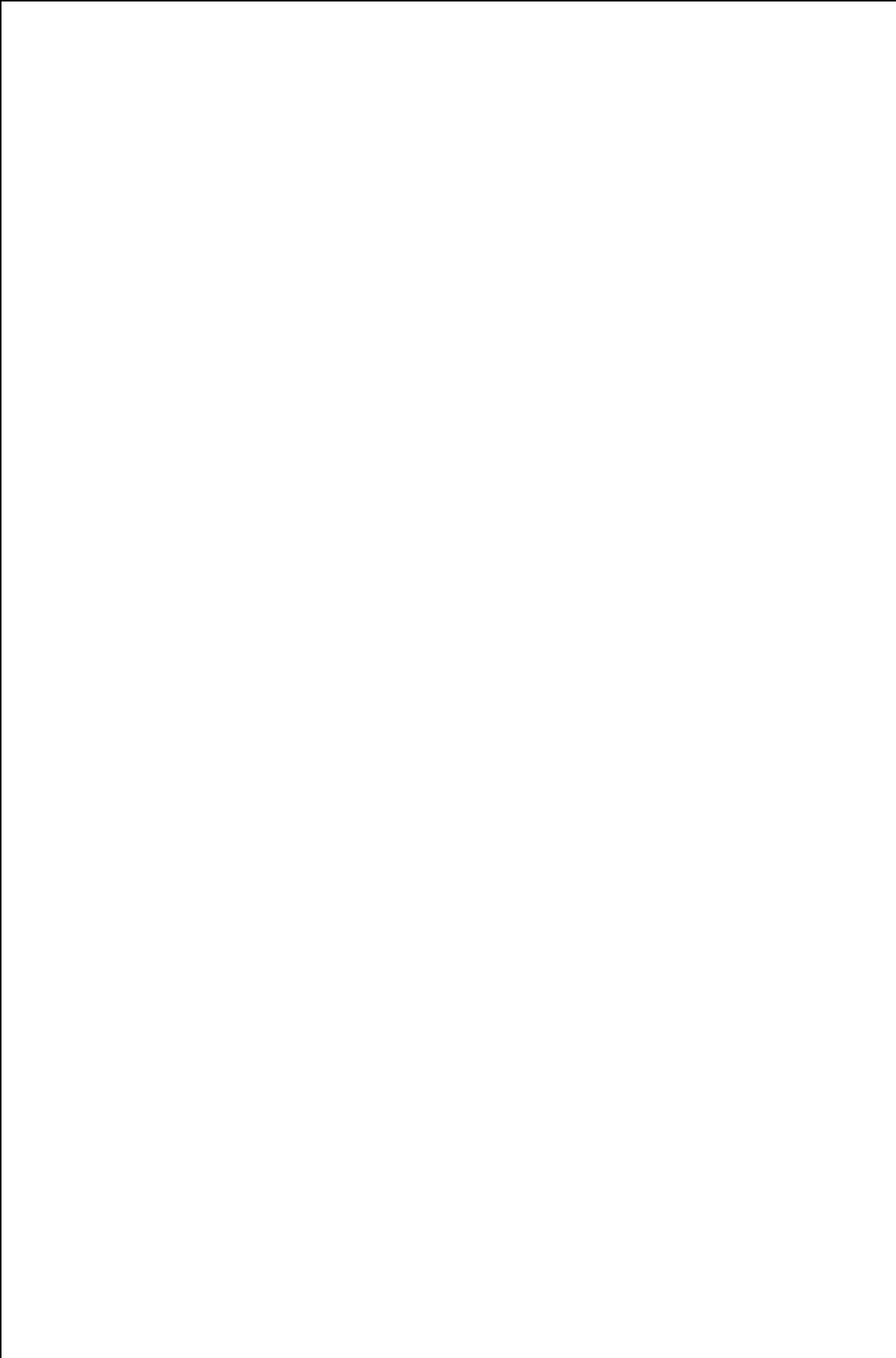
Sketching quality 0-3

Technical details 0-3

Innovative design 0-4

**Answer question 4 in the space below**





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QUESTIONS CONTINUE ON NEXT PAGE**

**SECTION E – Suggested Time 19 minutes**

**Q5.**

This question is about the results of heating a white solid.

Potassium chlorate is a white solid which contains the elements potassium, chlorine and oxygen.

When potassium chlorate is heated strongly, it decomposes to form another white solid (the residue) and oxygen gas is given off.

In an experiment, known masses of potassium chlorate were heated and the volume of oxygen produced was measured.

The mass of the white residue was also measured.

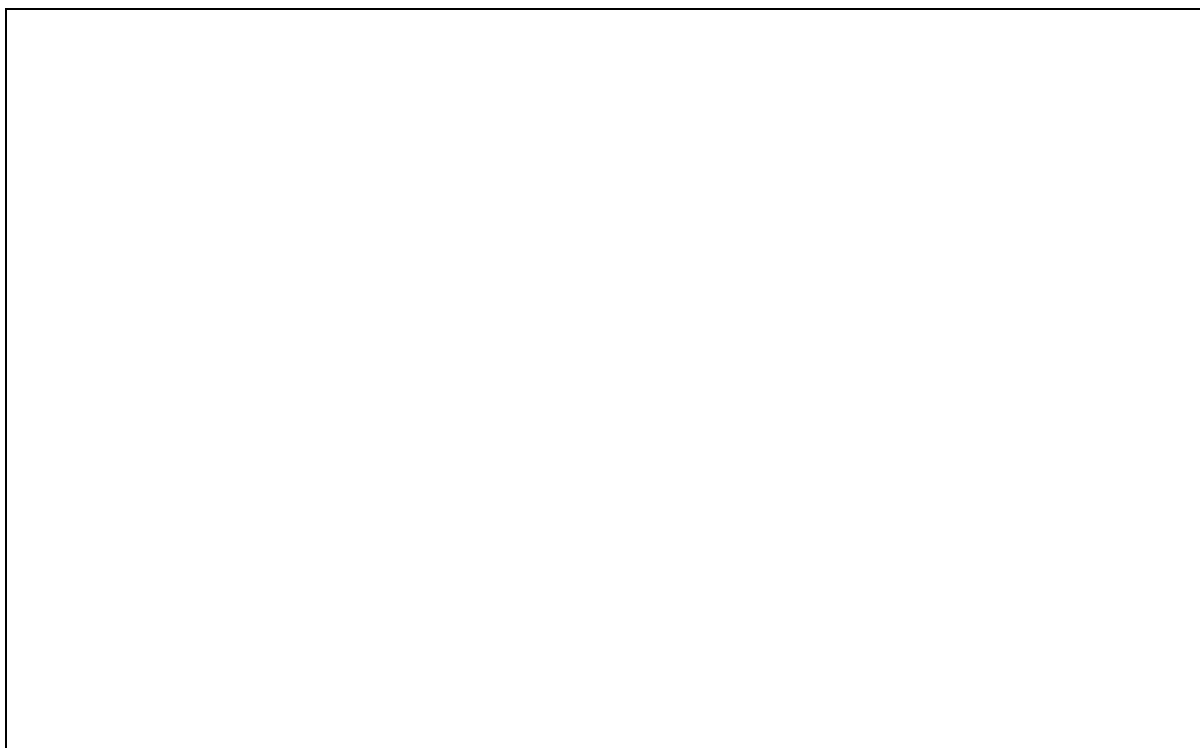
The results are given below.

Mass of potassium chlorate in g	Volume of oxygen produced in cm <sup>3</sup>	Mass of residue in g
0.08	21	0.04
0.15	39	0.08
0.23	60	0.12
0.31	81	0.17
0.38	99	0.20



(a) Draw a diagram of the apparatus you could use to heat the potassium chlorate and measure the volume of oxygen produced.

**(4)**



(b) (i) Describe a test you could do to show that the gas collected was oxygen.

**(2)**

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(ii) Would the oxygen collected be pure? Explain your answer.

**(2)**

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.....

(c) (i) Using the values in the table (on the graph paper provided), plot a graph of mass of residue against mass of potassium chlorate.

**(4)**

(ii) Draw a line of best fit.

**(1)**

(iii) Use this graph to work out the mass of residue left when 0.20g of potassium chlorate is heated.

**(1)**

(iv) Hence, calculate the mass of oxygen gas produced when 0.20g of potassium chlorate is heated.

**(1)**

(v) Hence, calculate the density of the oxygen gas.

**(4)**

**(Total 19 marks)**

**END OF QUESTIONS**