| Centre No. | | | | | | Paper Reference | | | | | | | Surname | Initial(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Candidate No. | | | | | | 7 | 5 | 4 | 0 | / | 0 | 2 | Signature | |

Paper Reference(s)

**7540/02**

# London Examinations GCE

## Physics

## Ordinary Level

Paper 2

Tuesday 18 May 2010 – Afternoon

Time: 2 hours

| Examiner's use only | | |
|---|---|---|
| | | |
| **Team Leader's use only** | | |
| | | |

**Materials required for examination**
Nil

**Items included with question papers**
Nil

| Question Number | Leave Blank |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
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| Total | |

### Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (~~☒~~) and then mark your new answer with a cross (☒).

### Information for Candidates

Calculators may be used.
Where necessary, assume the acceleration of free fall, $g = 10\ m/s^2$.
The total mark for this paper is 100. The marks for parts of questions are shown in round brackets: e.g. **(2)**.
This paper has 5 questions. All blank pages are indicated.

### Advice to Candidates

Write your answers neatly and in good English.
In calculations, show **all** the steps in your working.



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***Turn over***

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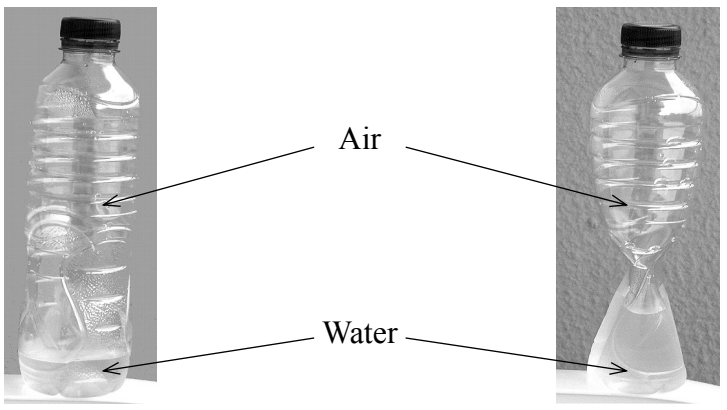
Leave blank

**Answer ALL the questions.**

**1. This question is about the pressure of gases.**

An aeroplane passenger drinks most of the contents of a water bottle while the aeroplane is at cruising altitude and then tightens the cap to seal the bottle. When the aeroplane has landed the passenger notices that the bottle has squashed as shown in the pictures below.




**At cruising altitude** **On ground**

(a) (i) Just after the bottle has been sealed how does the air pressure inside the bottle compare with the air pressure outside the bottle?

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**(1)**

Explain in terms of the pressure of the air inside and outside the bottle why the bottle has been squashed.

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**(2)**

Leave blank

(ii) How do air molecules exert a pressure on the surface of the bottle?

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**(2)**

(iii) Explain in terms of molecules why water is very difficult to compress but takes up the shape of its container.

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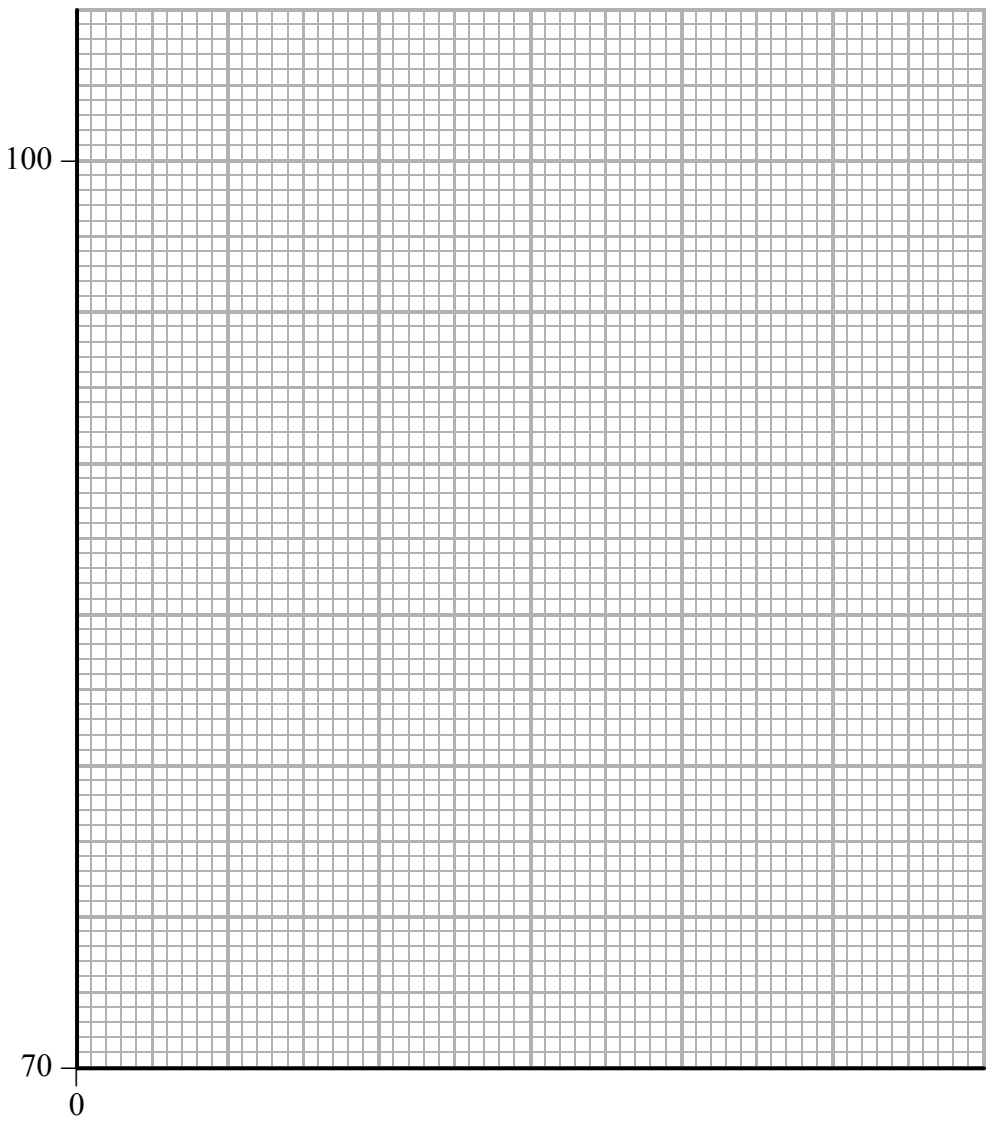
**(2)**

Leave blank

(b) The table below shows how the average atmospheric pressure varies with altitude (height above sea level).

| Atmospheric pressure / kPa | 100 | 95 | 90 | 85 | 80 | 75 | 70 |
|---|---|---|---|---|---|---|---|
| Altitude / m | 0 | 500 | 1000 | 1500 | 2000 | 2500 | 3000 |

(i) On the grid below plot a graph of atmospheric pressure ($y$-axis) against altitude ($x$-axis). You should use a suitable scale for the $x$-axis that makes best use of the graph paper. Draw a best fit line through the points.




**(5)**

(ii) Use your graph to find the altitude at which the atmospheric pressure would be 82 kPa. On the grid show clearly how you used the graph to obtain your answer.

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**(2)**

Leave blank

(c) Gases can be stored in metal cylinders at very high pressures. If a fire occurs in a building containing such a cylinder, the fire-fighters will move people well away from the burning building.

(i) A cylinder containing nitrogen gas has a pressure of 20 MPa (20 000 000 Pa) when the temperature is 27 °C. In such a fire this cylinder is heated to a temperature of 507 °C. Calculate the new pressure of the nitrogen gas assuming the volume of the gas remains constant.

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**(3)**

(ii) Give a reason why the fire-fighters will move people well away from this burning building.

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**(1)**

(iii) Explain in terms of molecules why the pressure of the nitrogen gas in the cylinder increases when the temperature increases.

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**(2)**

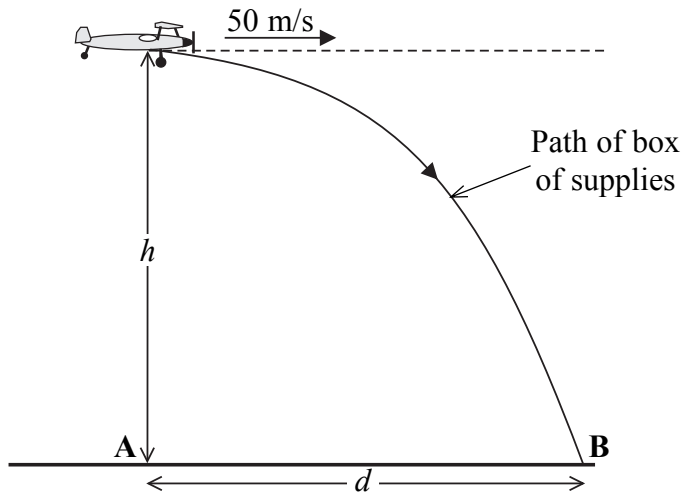
**Q1**

**(Total 20 marks)**

Leave blank

**2. This question is about forces and energy.**

Following a natural disaster, aeroplanes are used to drop emergency supplies to survivors. The aeroplane flies low at a constant speed of 50 m/s. A box of supplies is dropped when the aeroplane is above point **A** and falls following the path shown in the diagram and lands at point **B**. Assume that the effect of air friction is negligible.




(a) (i) The vertical velocity of the box when it is dropped is zero and the box takes 4.0 seconds to fall freely until it reaches the ground. Calculate the height *h* of the aeroplane above the ground.

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**(2)**

(ii) Calculate the vertical velocity of the box as it hits the ground.

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**(2)**

(iii) The resultant velocity of the box can be calculated using the relationship:
$(\text{resultant velocity})^2 = (\text{horizontal velocity})^2 + (\text{vertical velocity})^2$
Calculate the magnitude of the resultant velocity of the box as it hits the ground. (Assume the horizontal velocity remains 50 m/s)

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**(3)**

Leave blank

(iv) The mass of the box is 40 kg. Calculate the kinetic energy of the box as it hits the ground.

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**(2)**

(v) What will be the horizontal distance *d* that the box travels before hitting the ground?

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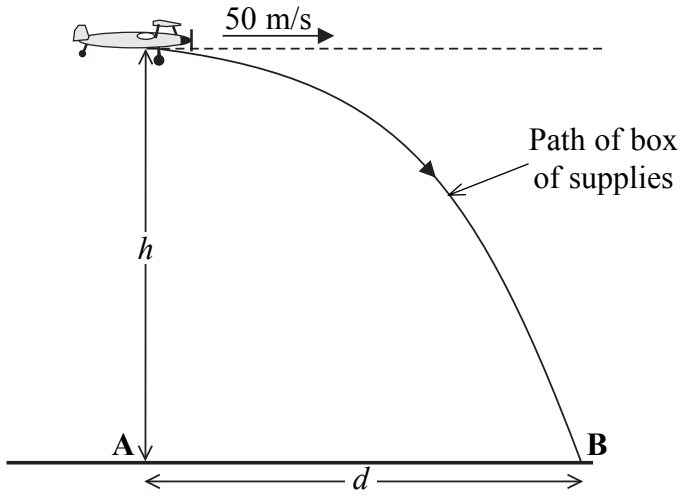
**(2)**

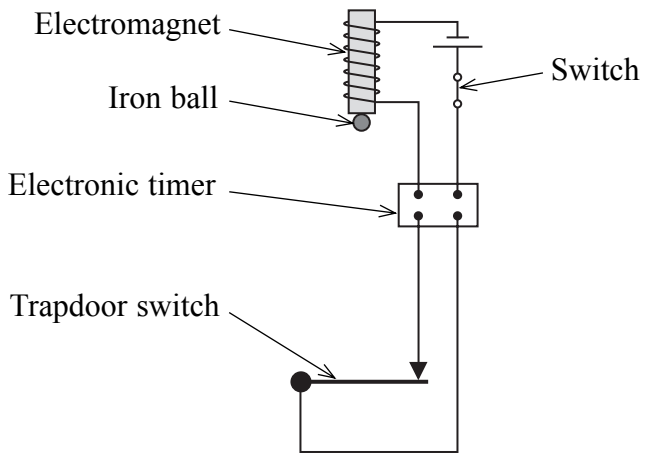
(vi) On the copy of the diagram below add a line to show the path the box might take if air resistance was not negligible.




**(1)**

Leave blank

(b) The diagram shows apparatus for determining the acceleration of free fall *g*.




(i) What other piece of apparatus is needed?

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**(1)**

(ii) Describe how you would use the apparatus to determine *g*.

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**(5)**

Leave blank

(iii) Explain why an iron ball is used rather than a steel one.

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**(1)**

(iv) The reading given by the electronic timer is usually too large. What effect, if any, will this have on the calculated value of *g*?

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**(1)**

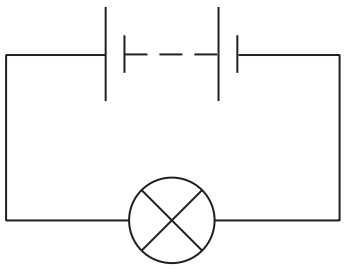
**Q2**

**(Total 20 marks)**

Leave blank

**3. This question is about electricity.**

The diagram shows a 24 V 3 A lamp connected to a 24 V battery.



(a) Calculate

(i) the resistance of the lamp,

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**(2)**

(ii) the power rating of the lamp.

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**(2)**

(b) To emit light of the correct brightness, the lamp requires a 24 V battery. The connecting wires have negligible resistance.

The circuit above is now connected with connecting wires of resistance 2 Ω. Show that a 30 V battery is required for the lamp to emit light of the correct brightness.

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**(2)**

Leave blank

(c) The connecting wires are replaced by connecting wires with double the length and half the area.

(i) Calculate the resistance of these connecting wires.

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**(1)**

(ii) Calculate the voltage across the lamp if a 24 V battery is still used.

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**(1)**

(iii) State two reasons why lighting the lamp with a 24 V battery using these connecting wires is undesirable.

1 .....

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2 .....

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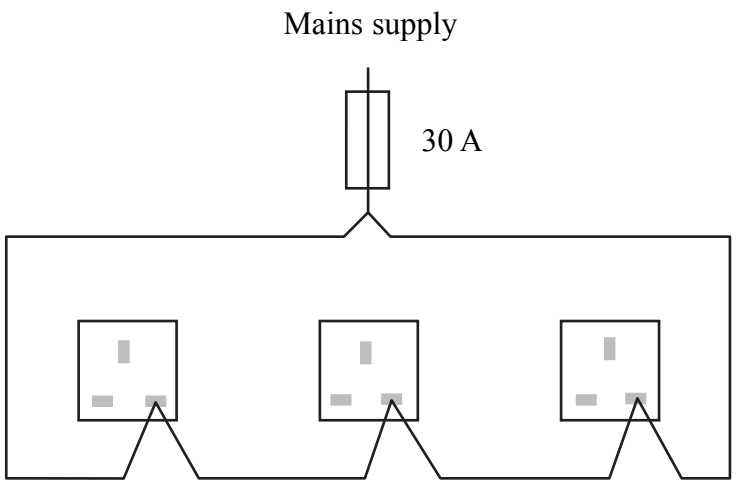
**(2)**

Leave blank

(d) The diagram below shows the live wire of a house wiring circuit with three sockets. The circuit is fitted with a 30 A fuse.




(i) Describe the action of a fuse.

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**(3)**

(ii) The plugs that go into the individual sockets are each fitted with a 13 A fuse. Explain why a 30 A fuse is considered to be sufficient for the circuit.

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**(2)**

Leave blank

(iii) Lamps plugged into the sockets are in parallel.

Give two reasons why the lamps must be connected in parallel.

1 .....

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2 .....

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**(2)**

(e) The table shows the power used by a computer monitor, both on standby and when left on.

| Power / W | |
|---|---|
| Standby | On |
| 10 | 60 |

Find the amount of energy in **kW h** saved by leaving the computer monitor on standby for 10 hours every day for one week rather than left on for the 70 hours.

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**(3)**

**Q3**

**(Total 20 marks)**

Leave blank

**4. This question is about waves.**

(a) (i) Explain what is meant by resonance.

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**(3)**

(ii) State two factors affecting the natural frequency of a vibrating stretched wire.

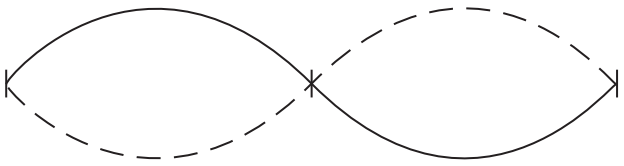
1 .....

2 .....

**(2)**

(b) The diagrams show a wire vibrating under the same tension in two different ways, **A** and **B**.

**A**



**B**

(i) Which wire is emitting the louder sound? Put a cross (☒) in the correct box.

**A** ☒ **B** ☒

**(1)**

(ii) Which wire is emitting the sound with the higher pitch? Put a cross (☒) in the correct box.

**A** ☒ **B** ☒

**(1)**

(iii) Explain your answers to (i) and (ii)

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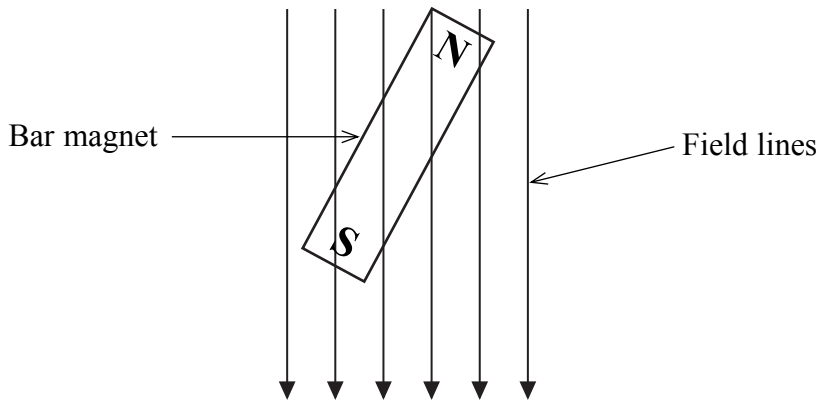
**(2)**

Leave blank

(c) In the process of nuclear magnetic resonance (NMR) certain nuclei behave like tiny bar magnets. In a magnetic field the nuclei can line up with the field.

The diagram shows a bar magnet in a magnetic field.




Describe the movement of the bar magnet in lining up with the magnetic field shown.

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**(2)**

(d) Radio waves of a certain frequency are applied to a group of nuclei. Some nuclei line up. Calculate the wavelength of radio waves of frequency 600 MHz and speed of 300 000 000 m/s.

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**(2)**

Leave blank

(e) The process of NMR involves nuclei with an odd number of protons or an odd number of neutrons. Isotopes $^{14}_{7}N$ and $^{15}_{7}N$ can both be used.

(i) Explain the term isotope.

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**(2)**

(ii) Explain why both isotopes $^{14}_{7}N$ and $^{15}_{7}N$ are suitable for NMR.

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**(1)**

(f) NMR is used in medical diagnosis and has several advantages over X-rays.

(i) State two similarities and one difference between radio waves and X-rays.

Similarities

1 .....

2 .....

Difference

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**(3)**

(ii) State one hazard associated with X-rays.

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**(1)**

**Q4**

**(Total 20 marks)**

Leave blank

**5. This question is about refraction and the design of an experiment.**

(a) (i) State what happens to the direction of a light wave when it goes from air to water.

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**(1)**

(ii) In an experiment using water, a student records the following measurements:

| | |
|---|---|
| Angle of incidence | 50° |
| Angle of refraction | 35° |

Using this data, the calculated value of refractive index for water is 1.34.

However, the student is only able to measure either angle to the nearest degree. For example, the angle of incidence could have been 51°, 50° or 49°. Calculate the **largest** calculated value of refractive index resulting from this data.

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**(3)**

(iii) State the formula used for determining refractive index using a method that does not involve the measurement of angles.

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**(1)**

Leave blank

(b) A student reads that the refractive index of water changes with the addition of salt. She decides to investigate how the refractive index of water changes with different amounts of salt added to the water.

Describe how she would investigate the relationship between refractive index and the percentage, by mass, of salt added.

Your account should include the following:

(i) a way of keeping the water temperature constant throughout,

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**(1)**

(ii) a list of four items of equipment needed to carry out the investigation,

1 .....

2 .....

3 .....

4 .....

**(4)**

Leave blank

(iii) a description of the method she would use. You may wish to draw a diagram of your arrangement.

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**(6)**

(iv) a table for recording results, showing the column headings.

**(2)**

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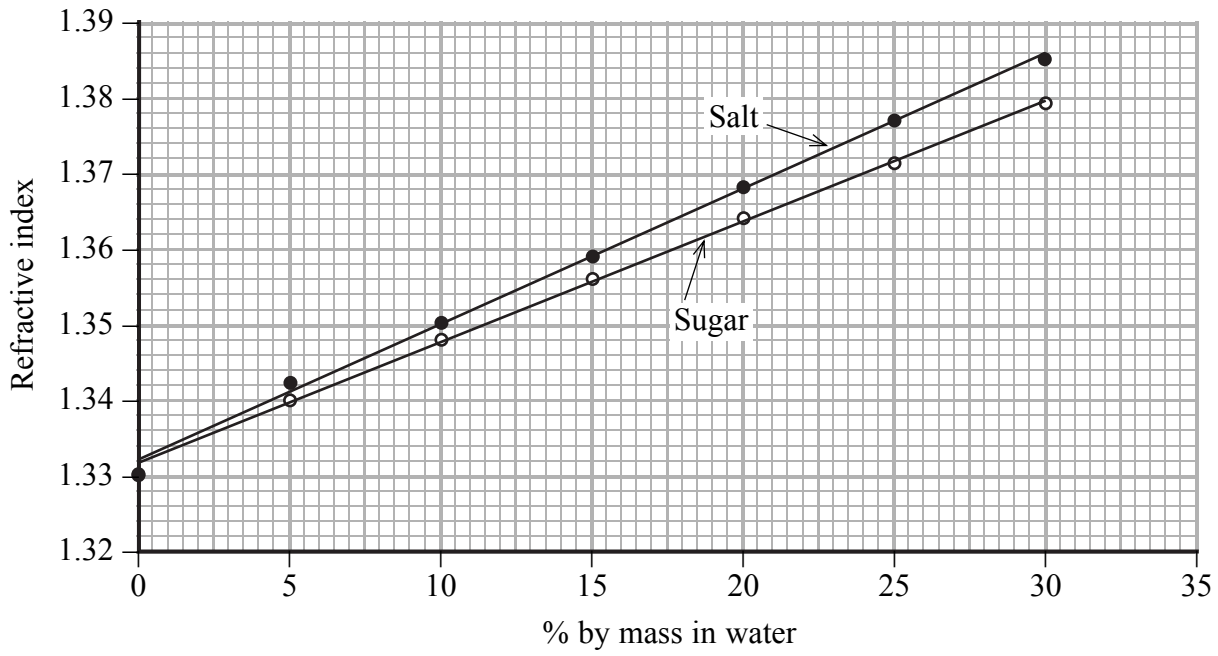
(c) The student repeated the investigation to compare the effects of sugar and salt. She failed to come to a clear conclusion.

She looked up a set of correct results. These are shown below.




Give two reasons why **her** results were inconclusive.

1 .....

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2 .....

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**(2)**

**Q5**

**(Total 20 marks)**

**TOTAL FOR PAPER: 100 MARKS**

**END**