Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education
January 2005

ASSESSMENT and QUALIFICATIONS ALLIANCE

APPLIED SCIENCE (DOUBLE AWARD) 3860/2H
HIGHER TIER
Unit 2 Science for the Needs of Society

Tuesday 18 January 2005 9.00 am to 10.30 am

H

In addition to this paper you will require:
a ruler.
You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 90.
- Mark allocations are shown in brackets.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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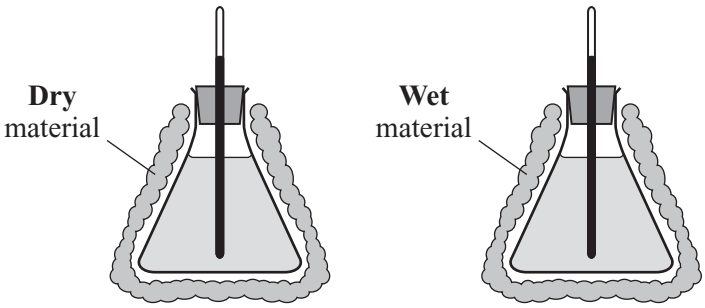
Answer **all** questions in the spaces provided.

1 (a) Hypothermia occurs if the body loses too much heat.

A student was worried about getting hypothermia if he got soaking wet during a field trip. He set up an experiment to test how much heat was lost through wet clothing and how much was lost through dry clothing, as shown in the diagram.



He measured the temperature of the water in the conical flasks every 2 minutes for 10 minutes.

The results for Flask **A** have been plotted on the graph. The table shows his results for Flask **B**.

Time in minutes	**Temperature of water in °C**
	Flask **B**
0	72
2	68
4	65
6	62
8	59
10	57

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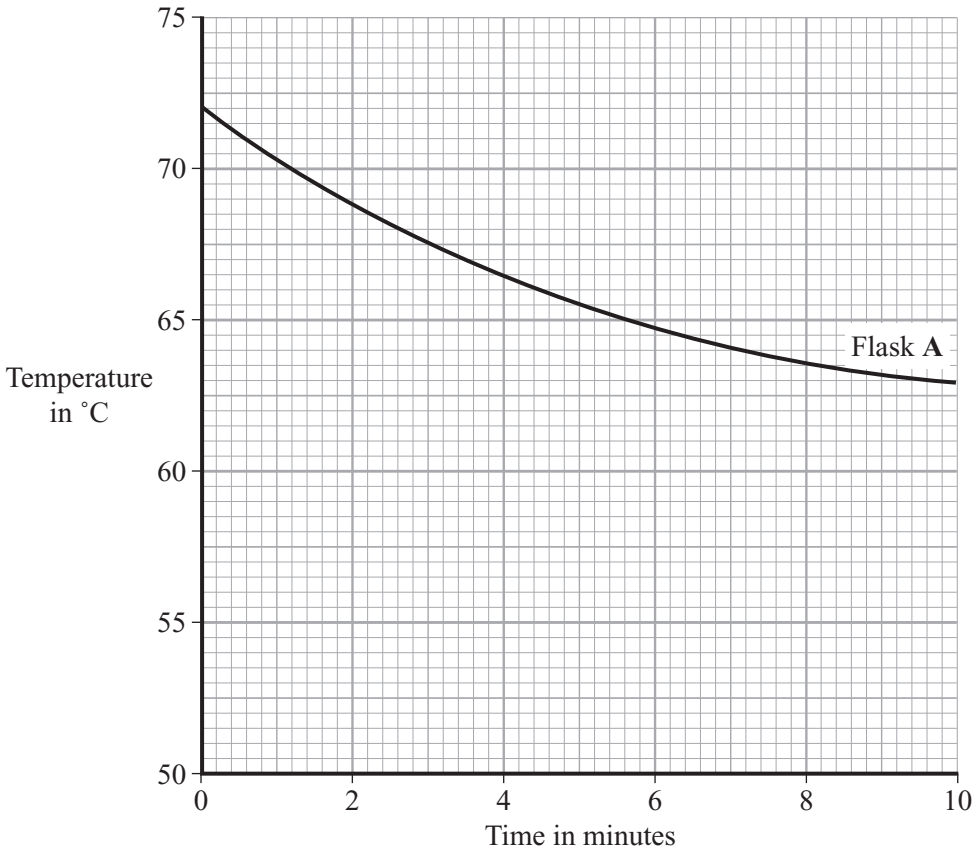
(i) Draw a line graph for Flask **B** on the same axes.



(3 marks)

(ii) After 10 minutes, how much cooler was the water in Flask **B** than the water in Flask **A**?

.....

(1 mark)

(iii) Explain why the water in Flask **B** cooled faster.

.....

.....

(2 marks)

QUESTION 1 CONTINUES ON THE NEXT PAGE

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(b) The diagram shows a cross-section through the skin.

The diagram is not reproduced here due to third-party copyright constraints.

Explain how sweating and changes in the diameter of the blood vessels enable humans to maintain a constant body temperature.

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.....

.....

(4 marks)

10

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TURN OVER FOR THE NEXT QUESTION

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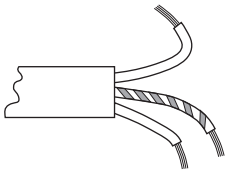
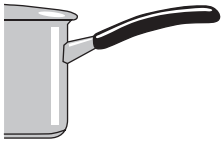
2 In industry, materials are chosen for a particular use because they have the right properties.

(a) Complete the table by naming a material that is suitable for each use.

Use	Suitable material
The frame of a bicycle	
 Electrical wiring	
 The handle of a saucepan	

(3 marks)

(b) The list below gives some words used to describe the properties of materials.

electrical conductivity	**malleability**	**hardness**
flexibility	**melting point**	**tensile strength**
density	**thermal conductivity**	**appearance**

Choose properties from the list to help you answer the following questions.

(i) Give **two** reasons why the material you have chosen is suitable for making the frame of a bicycle.

1 .....

.....

2 .....

.....

(2 marks)

LEAVE MARGIN BLANK

(ii) Give **two** reasons why the material you have chosen is suitable for making electrical wiring.

1 .....

.....

2 .....

.....

(2 marks)

(iii) Give **two** reasons why the material you have chosen is suitable for making the handle of a saucepan.

1 .....

.....

2 .....

.....

(2 marks)

9

TURN OVER FOR THE NEXT QUESTION

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3 When making chips, a chef soaks them in water before cooking them.

The water enters the potato by a process called osmosis.

(a) Complete the following definition of osmosis.

Osmosis is the movement of water

from .....

to .....

through .....

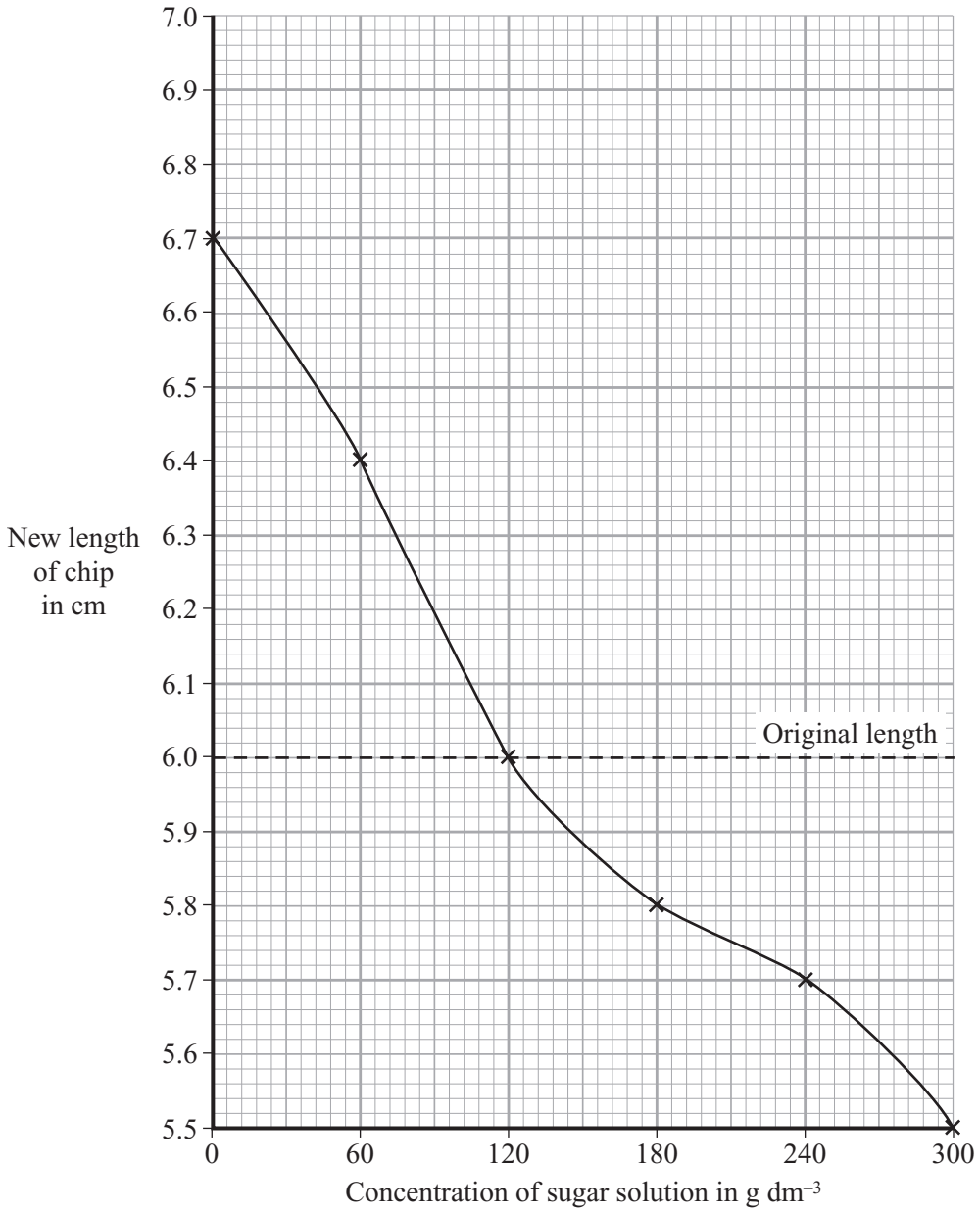
(3 marks)

(b) The chef wondered whether soaking the chips in a sugar solution would give her better chips.

She did an experiment to find out.

The graph shows the results when she soaked some chips in different concentrations of sugar solution.

Each chip was 6 cm long at the start of the experiment.



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(i) Describe the results of the experiment.

.....

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(2 marks)

(ii) Use osmosis to explain the results of the experiment.

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(4 marks)

(iii) The chef used potato, different concentrations of sugar solution, water and ordinary kitchen equipment.

Describe how the chef would carry out this experiment.

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(3 marks)

12

TURN OVER FOR THE NEXT QUESTION

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4 Over one million tonnes of ammonia are made in the UK each year.

(a) Ammonia (NH_3) is an inorganic compound which is made by joining two elements together.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

(i) Why is ammonia described as *inorganic*?

.....

(1 mark)

(ii) Name the elements used to make ammonia.

.....

(2 marks)

(b) One of the elements used to make ammonia is separated from liquid air.

The table shows some gases from the air and their boiling points.

Gas	Boiling point in °C
N_2	–196
O_2	–183
Ar	–186

(i) At which temperature will all three gases have condensed into liquids?

.....

(1 mark)

(ii) Name the process used to separate a mixture of liquids with different boiling points.

.....

(1 mark)

(c) One of the elements used to make ammonia is obtained from methane and steam in an endothermic reaction.

(i) Balance the equation by writing the correct number in the space provided.

$$CH_4 + H_2O \rightarrow CO + \text{.....} H_2$$

(1 mark)

LEAVE MARGIN BLANK

(ii) What is an *endothermic reaction*?

.....

.....

(1 mark)

(iii) Explain, in terms of bond breaking and bond forming, why the reaction is endothermic.

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(3 marks)

(d) Ammonium sulphate, $(NH_4)_2SO_4$, is used as an artificial fertiliser.

It is made by reacting ammonia with an acid.

$$2NH_3 \quad + \quad H_2SO_4 \quad \rightarrow \quad (NH_4)_2SO_4$$

(i) Name the acid used to make ammonium sulphate.

.....

(1 mark)

(ii) Describe how to make crystals of ammonium sulphate from a solution of ammonium sulphate.

.....

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.....

(2 marks)

(iii) Why are artificial fertilisers used in intensive farming?

.....

.....

(1 mark)

14

Turn over ▶

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5 Domestic users of electricity are charged for the number of kilowatt-hours (units) of electrical energy that they use.

(a) Information from a domestic electricity bill is given below.

The Power Company

Your electricity statement

Present reading: 92005 units taken on 30 January 2004

Previous reading: 89383 units taken on 30 October 2003

1 unit is 1 kilowatt-hour (kWh)

(i) Calculate the number of units of electricity used between the two dates.

.....

(1 mark)

(ii) One unit costs 7p.

Calculate the cost of the electrical energy used between the two dates.

.....

.....

(2 marks)

(b) (i) An electrical appliance transferred 18 kilowatt-hours of electrical energy when it was switched on for six hours.

Use the equation to calculate the power of the electrical appliance.

$$\text{power (kilowatts)} = \frac{\text{energy transferred (kilowatt-hours)}}{\text{time (hours)}}$$

.....

.....

..... kilowatts

(2 marks)

LEAVE MARGIN BLANK

(ii) Use the equation to calculate the current used by the electrical appliance when it is operated with a potential difference (voltage) of 240 volts.

$$\text{current (amps)} = \frac{\text{power (watts)}}{\text{voltage (volts)}}$$

.....

.....

.....

..... amps

(3 marks)

8

TURN OVER FOR THE NEXT QUESTION

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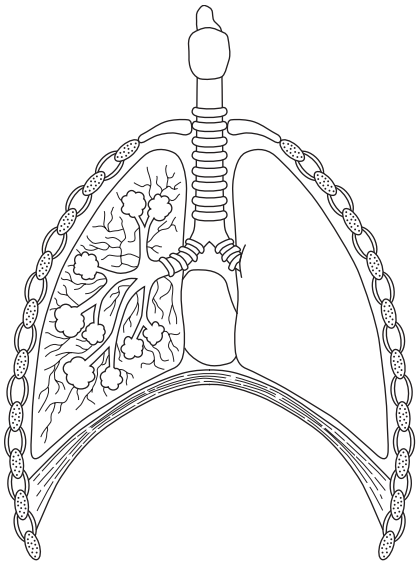
6 The diagram shows the structure of the thorax.



(a) (i) Label the diagram with an **X** and a **Y** to show the position of the muscles concerned with increasing and decreasing the volume of the thorax.

(2 marks)

(ii) Describe how air is breathed **out**.

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(4 marks)

LEAVE MARGIN BLANK

(b) During vigorous exercise, it may be difficult to take oxygen into the lungs quickly enough. When this happens, glucose is broken down into lactic acid to release energy.

An athlete ran for 10 minutes and then rested for 60 minutes.

The table shows how much lactic acid was present in his blood over the 70 minute period.

The data also show how the exercise affected his breathing rate.

Time in minutes	0	10	20	30	40	50	60	70
Relative amount of lactic acid in blood	2	12	8	6	4	3	2	2
Number of breaths per minute	18	41	32	28	25	20	18	18

(i) After exercise, how long did it take to reduce the lactic acid to a normal level?

.....

(1 mark)

(ii) What does the information in the table tell you about the effect of exercise on the breathing rate?

.....

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(2 marks)

(iii) Explain why the breathing rate changes during exercise.

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.....

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(3 marks)

12

Turn over ▶

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7 Nuclear fuels are used to generate approximately 25% of the United Kingdom's electricity supply.

An understanding of atomic structure allows us to predict the behaviour of the radioactive elements that are used as nuclear fuels.

(a) Information about the atomic structure of three elements is given in the table.

Element	Atomic number	Mass number	Number of protons	Number of neutrons
carbon	6	12	6	
iron	26	56		30
lead	82	207	82	

(i) Complete the table to show the number of protons and neutrons in the atoms.

(3 marks)

(ii) Draw a labelled diagram to show the structure of an atom of carbon.

(4 marks)

(b) Uranium is a radioactive element used as a nuclear fuel.

(i) Explain how heat energy, released from nuclear fuels, is used to generate electricity.

.....

.....

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(4 marks)

LEAVE MARGIN BLANK

(ii) Give **one** advantage of using nuclear fuels to replace fossil fuels to generate electricity.

.....

.....

(1 mark)

(iii) Outline **two** problems caused by the use of nuclear fuels.

1 .....

.....

2 .....

.....

(2 marks)

(iv) Describe **two** steps that can be taken to reduce the hazards of radioactive substances.

1 .....

.....

2 .....

.....

(2 marks)

16

TURN OVER FOR THE NEXT QUESTION

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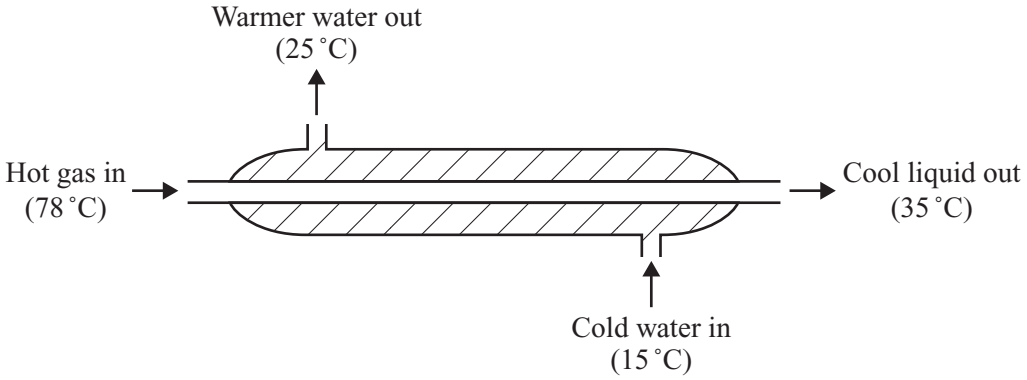
8 The diagram shows the cross-section of a glass heat exchanger used in the laboratory to condense hot gases into liquids.



(a) Explain how the efficiency of the heat exchanger would be affected by each of the following changes.

(i) The heat exchanger is made from metal instead of glass.

.....

.....

(1 mark)

(ii) The coolant is replaced by a liquid with a lower heat capacity.

.....

.....

(1 mark)

(iii) The heat exchanger is replaced by one with a larger surface area.

.....

.....

(1 mark)

(b) Why is the use of heat exchangers important in industry?

.....

.....

(2 marks)

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(c) The coolant in a heat exchanger gained 450 kilojoules of energy when the hot gases lost a total of 1,500 kilojoules of energy.

(i) Calculate the percentage efficiency of the heat exchanger.

.....

.....

.....

(3 marks)

(ii) Explain why the percentage efficiency of a heat exchanger is often quite low.

.....

.....

(1 mark)

9

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE

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