Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2011

Applied Science SC02

Unit 2 Energy Transfer Systems

Friday 20 May 2011 9.00 am to 10.30 am

For this paper you must have:
- a pencil
- a ruler
- a calculator.

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You are expected to use a calculator where appropriate.

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

1 (a) People with asthma experience difficulties moving enough air in and out of their lungs.
A doctor wanted to find out if a woman had asthma and asked her to have some tests to assess her lung function.
Her test results are shown in the table.

	Test results	**Normal values**
Tidal volume (cm^3)	350	
Vital capacity (dm^3)	2.8	
Expiratory peak flow rate ($dm^3\ min^{-1}$)	300	

1 (a) (i) Insert into the table the normal values for each lung function. *(3 marks)*

1 (a) (ii) Explain whether or not the results in the table would support a diagnosis of asthma.

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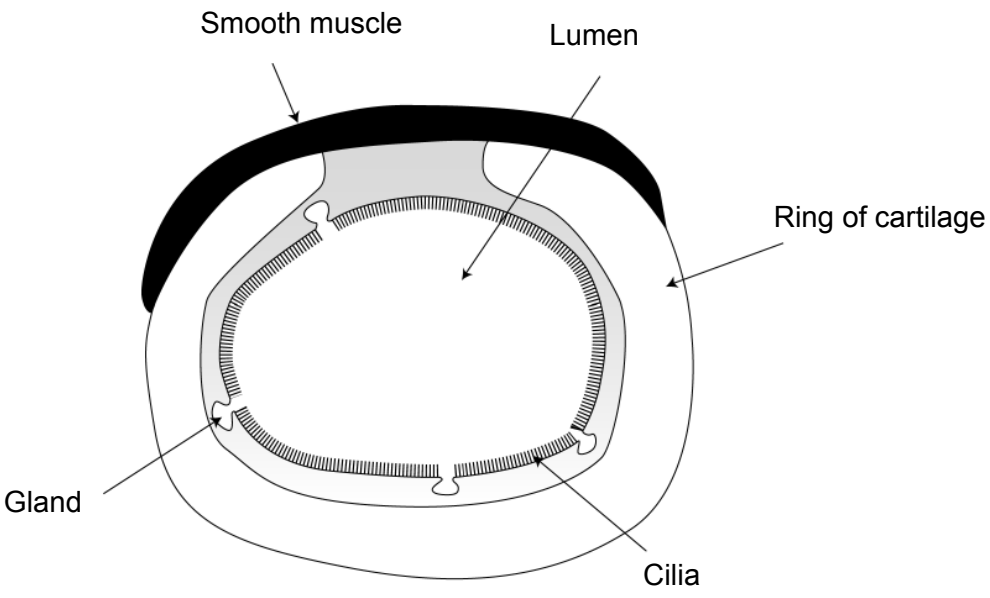
(1 mark)

1 (b) Air travels into and out of the lungs through the trachea.
The diagram shows a cross-section through the trachea.



For each of the structures listed below, state its function and say why it is important.

1 (b) (i) Gland

Function .....

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Importance .....

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(2 marks)

1 (b) (ii) Cilia

Function .....

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Importance .....

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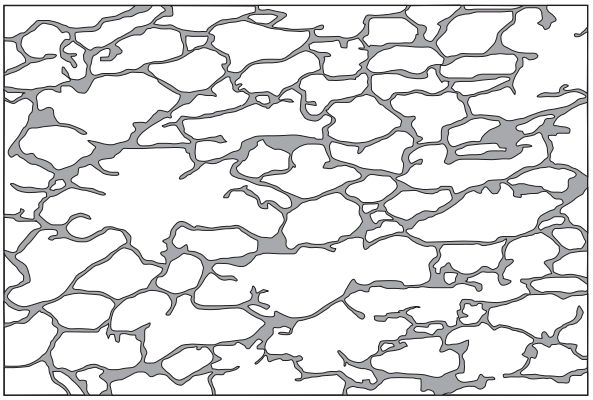
(2 marks)

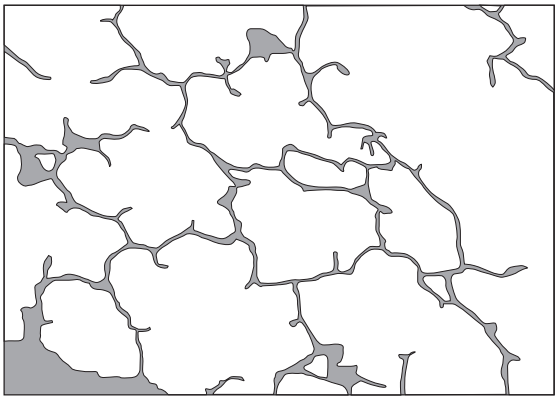
Question 1 continues on the next page

1 (c) Smokers can develop a lung disease called emphysema. The disease causes breathing difficulties and extra oxygen is often needed to help with breathing. Emphysema affects lung tissue as shown in the photomicrographs of alveoli.

Alveoli in healthy lung tissue



Alveoli in lung tissue from a person with emphysema



These diagrams are drawn to the same scale.
Use the evidence in the photomicrographs and your knowledge of the respiratory system to explain why people with emphysema might experience breathing difficulties.

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(4 marks)

12

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

2 (a) A group of students are asked to design an experiment to investigate anaerobic respiration and aerobic respiration.

2 (a) (i) What does *aerobic respiration* mean?

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(1 mark)

2 (a) (ii) Write a balanced chemical equation for aerobic respiration.

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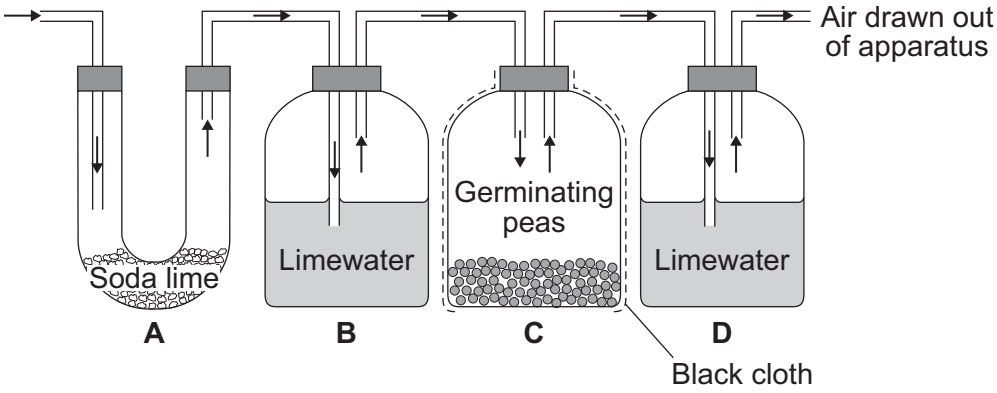
(2 marks)

2 (b) The students set up the experiment as shown in the diagram. They used germinating peas, which respire rapidly.
Carbon dioxide is absorbed by soda lime. Carbon dioxide turns limewater from clear to cloudy.
Flask **C** was covered with a black cloth.



2 (b) (i) Explain any changes you would expect to see in flasks **B** and **D**.

Flask **B**
Explanation .....

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Flask **D**
Explanation .....

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(2 marks)

2 (b) (ii) Suggest why flask **C** was covered with a black cloth.

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(1 mark)

2 (c) The students were also asked to determine the respiratory quotient for the germinating peas.

The respiratory quotient (RQ) is defined as

$$\text{RQ} = \frac{\text{volume of carbon dioxide given off}}{\text{volume of oxygen taken up}}$$

2 (c) (i) The RQ for aerobic respiration = 1.
Anaerobic respiration does not require oxygen.
In this experiment, 9 cm^3 of carbon dioxide was given off and 6 cm^3 of oxygen was used by the germinating peas.
Calculate the RQ.

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(1 mark)

2 (c) (ii) Use your answer to part (c)(i) to explain what is happening, in terms of respiration, in the germinating peas.

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(2 marks)

9

Turn over for the next question

3 (a) In 2007, 10% of NHS health authorities in the UK refused to give people who smoked or were obese a hip replacement. Many of these people had to wait until they had shown a commitment to becoming healthier.
The NHS denied that they were trying to cut costs.

3 (a) (i) Suggest **two** reasons why it might be ethically right to refuse necessary operations for smokers or obese people.

Reason 1 .....

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Reason 2 .....

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(2 marks)

3 (a) (ii) Suggest **two** reasons why it might be ethically wrong to refuse necessary operations for smokers or obese people.

Reason 1 .....

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Reason 2 .....

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(2 marks)

3 (b) A 40-year-old teacher decided to take part in the Great North Run in the UK to raise money for charity. Before he started training he had his cardiovascular fitness assessed.
Describe how this could be done using only standard school equipment.

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(4 marks)

3 (c) The teacher also had his blood pressure measured and it was found to be normal. What is the normal blood pressure for a healthy 40-year-old man?

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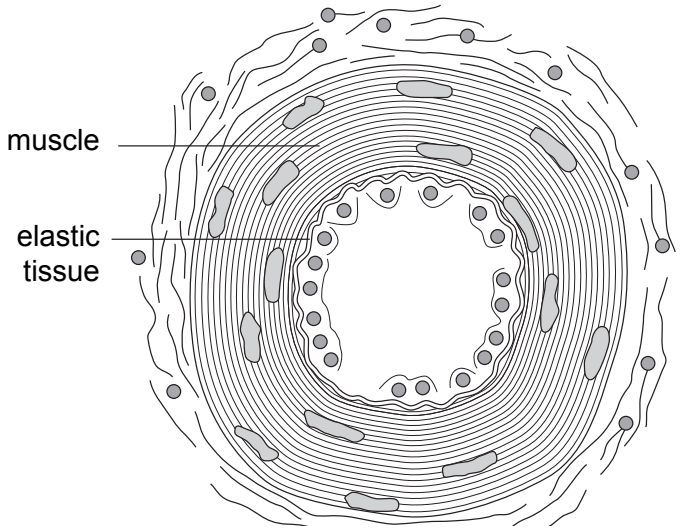
(1 mark)

3 (d) The diagram shows a cross-section through the wall of an artery.



3 (d) (i) Explain how the tissues of the artery wall help to maintain blood pressure within the normal range during systole.

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(2 marks)

3 (d) (ii) Explain how the tissues of the artery wall help to maintain blood pressure within the normal range during diastole.

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(2 marks)

Question 3 continues on the next page

3 (d) (iii) Explain how the muscle of the artery wall helps to maintain blood pressure within the normal range as the blood pressure goes up and down.

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(2 marks)

3 (e) The Great North Run took place when the weather was hot.
How did the teacher's body maintain its temperature within the normal range?

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(4 marks)

19

Turn over for the next question

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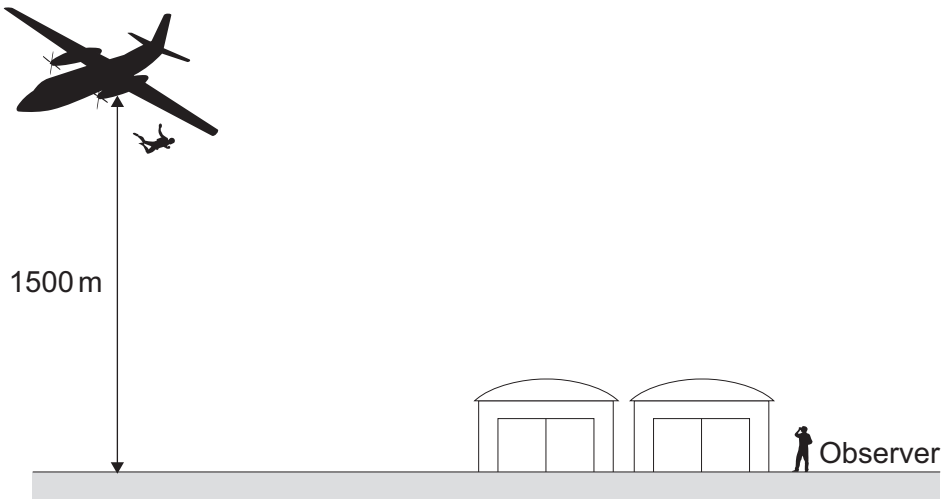
4 A doctor is investigating ways of reducing the extent of injury skydivers may suffer if they land incorrectly. She is observing a skydiver with a mass of 90 kg (including the parachute) as he jumps from an aircraft 1500 m above ground level.



4 (a) How much gravitational potential energy (GPE) does the skydiver have as he leaves the aircraft?
Assume that the acceleration due to gravity, $g = 10\,m\,s^{-2}$.

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(2 marks)

4 (b) Explain why the aeroplane needs to use much more energy than calculated in part (a) to lift the skydiver to this height.

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(2 marks)

4 (c) The skydiver is moving vertically at a speed of $8\,m\,s^{-1}$ just before he lands. Calculate his kinetic energy at this point.

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(2 marks)

4 (d) Why is the skydiver's kinetic energy at the point of landing **not** equal to the (GPE) he has lost?

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(2 marks)

4 (e) Use the idea of momentum to explain why it is much safer for the skydiver to land allowing his knees to bend, rather than keeping his legs straight.

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(3 marks)

Turn over ▶

4 (f) A second skydiver has jumped from a tall building. She used a lift to take her to the roof. An electric motor raised her and the lift cage to the roof of the building. The electric motor did 300 000 J of useful work in 2 minutes.
What was the power of the motor?

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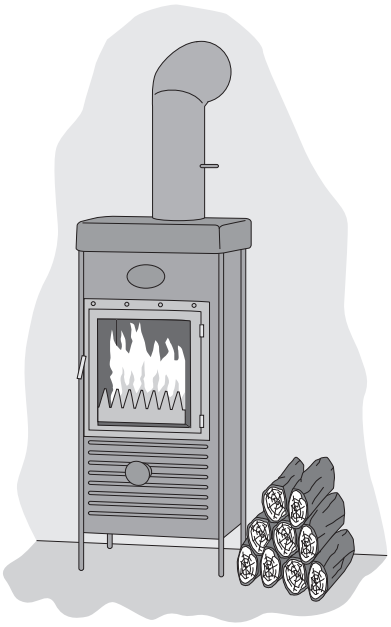
.....W

(2 marks)

13

5 A family installed a wood-burning stove in their house.
The stove burns about 1 kg of wood each hour, and produces heat at a rate of 3 kW.
The family get their wood as fallen branches from a nearby forest.



5 (a) Suggest **two** advantages of using a wood-burning stove to heat the house, compared to using a gas-powered central heating boiler.

Advantage 1 .....

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Advantage 2 .....

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(2 marks)

5 (b) Suggest **one** disadvantage of using wood instead of gas as a fuel.

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(1 mark)

5 (c) What colour should the stove be to give the most radiation from its surface to the room?

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(1 mark)

Question 5 continues on the next page

5 (d) Use your knowledge of heat transfer mechanisms to suggest why the wood-burning stove is made of metal.

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(1 mark)

5 (e) Explain why the hot gases from the burning wood rise up the chimney.

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(3 marks)

5 (f) How much would it have cost the family to use a 3 kW electric heater for 600 hours? Their electricity costs 12p per unit.

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(3 marks)

5 (g) The power station that generated this electricity was 60% efficient.
What rate of energy input would it need to produce an output of 3 kW?

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(2 marks)

5 (h) State **one** advantage and **one** disadvantage of using hydroelectric energy to generate electricity.

Advantage .....

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Disadvantage .....

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(2 marks)

5 (i) Suggest a different device that could be fitted in the house to provide the energy to heat it without producing any carbon dioxide.
Explain the energy flow involved.

Device .....

Explanation .....

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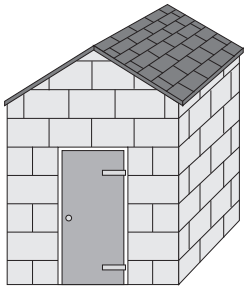
(2 marks)

17

Turn over for the next question

6 A heating engineer is evaluating thermalite blocks to see if they are better than normal building bricks.
She has decided to measure the *U*-value of a garden shed built using thermalite blocks.



The engineer switches on a heater inside the thermalite-built shed. She records the temperature in the shed before turning on the heater, and then every hour until the temperature remained constant.
She then repeats the whole experiment in a brick-built shed.

6 (a) Suggest **two** things she should keep the same, to make this a fair test.

1 .....

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2 .....

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(2 marks)

6 (b) (i) Suggest **one** improvement that could be made to this experiment.

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(1 mark)

6 (b) (ii) State **one** precaution you would take to avoid losing heat by other methods.

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(1 mark)

6 (c) (i) In another experiment, the thermalite shed reached a steady internal temperature of 25 °C, when the outside temperature was 5 °C.
The total surface area (wall, floor and ceiling combined) was 16 m^2.
The power from the heaters was 400 W.

Use the equation:

rate of heat loss = temperature difference × *U*-value × total surface area

Calculate the *U*-value of the shed.

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..... $W/m^2/K$
(2 marks)

6 (c) (ii) Explain why the rate of heat loss is not the same everywhere in the shed.

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(2 marks)

6 (d) Thermalite blocks are made using powdered ash from coal-fired power stations. They contain millions of tiny separate air cells.
This gives them a low density and makes them good insulators.
Explain how the presence of many tiny air cells in the thermalite blocks makes them good thermal insulators.

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(2 marks)

10

END OF QUESTIONS

There are no questions printed on this page

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