Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2009
Advanced Subsidiary Examination

APPLIED SCIENCE **SC02**
Unit 2 Energy Transfer Systems

Wednesday 14 January 2009 1.30 pm to 3.00 pm

For this paper you must have:
- a pencil and 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. Answers written in margins or on blank pages will not be marked.
- 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 maximum mark for this paper is 80.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.

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

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

1 A man decides to exercise twice a week to prepare to take part in the London marathon. His heart rate (pulse rate) speeds up during exercise and returns to normal sometime after he stops exercising.

1 (a) (i) What is the normal range of pulse rate in an adult?

..... bpm

(1 mark)

1 (a) (ii) Describe how impulses from nerves make the heart rate return to normal after exercising.

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(4 marks)

1 (b) A work colleague decides to compete with him in the London marathon.
The work colleague decides to have his cardiovascular fitness assessed before he starts training.
Using heart rate as an indicator, design an experiment to assess cardiovascular fitness.

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(4 marks)

1 (c) During exercise, the concentration of carbon dioxide in the blood increases.
Describe how this change in carbon dioxide concentration alters the heart rate.

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(3 marks)

Question 1 continues on the next page

1 (d) (i) Why does the contraction of the ventricles of the heart start at the base?

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(2 marks)

1 (d) (ii) How is the flow of blood from the atria to the ventricles prevented?

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(2 marks)

1 (d) (iii) Where else in the heart is the direction of blood flow controlled?

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(1 mark)

17

2 (a) While travelling on a cruise liner, a sailor fell overboard into the sea.
What physical feature of his body would mainly influence his survival time in the cold water?

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(1 mark)

2 (b) (i) After being in the cold water for several minutes, the sailor was rescued and was found to have a core body temperature of 32 °C.
What condition was the sailor suffering from?

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(1 mark)

2 (b) (ii) Below what core body temperature is death normally likely to occur?

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(1 mark)

2 (c) (i) Following the rescue, the sailor's body automatically attempted to return his core body temperature to normal.
What name is given to this process?

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(1 mark)

2 (c) (ii) Name and explain **two** mechanisms the body uses to try to raise the core body temperature to normal.

Mechanism 1 .....

Explanation .....

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Mechanism 2 .....

Explanation .....

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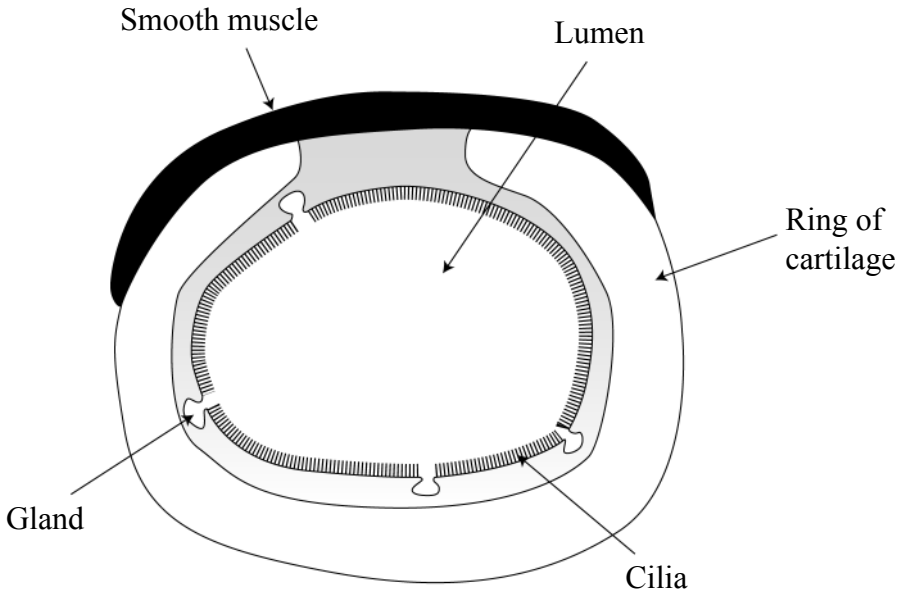
(6 marks)

10

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



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

3 (a) (i) Ring of cartilage

Function .....

.....

Importance .....

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(2 marks)

3 (a) (ii) Cilia

Function .....

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Importance .....

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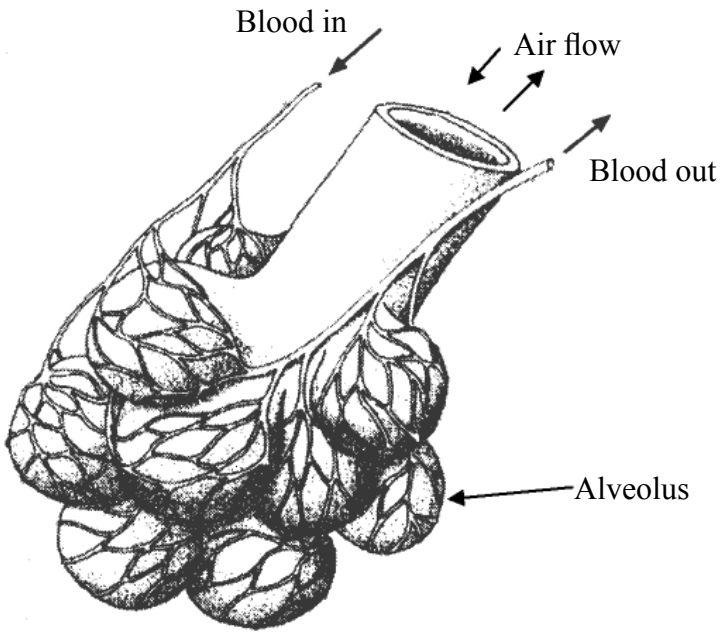
(2 marks)

3 (b) The diagram shows a small part of a human lung.



3 (b) (i) Give **two** features of alveoli that aid the diffusion of gases.

1 .....

2 .....

(2 marks)

3 (b) (ii) Describe how the blood vessels shown in the diagram above help in the exchange of gases between the blood and the air in the lung.

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(3 marks)

Question 3 continues on the next page

3 (c) A woman was rushed to hospital following a serious accident. She could not breathe unaided. She was connected to a life support machine while her injures were assessed. The assessment showed that she would not recover from her injuries and it was decided to turn off the life support machine.
What ethical issues should the doctors discuss with the relatives before this decision is made?

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(2 marks)

3 (d) Before new drugs are made available to the public, pharmaceutical companies conduct clinical trials using human beings as subjects.
Give **two** pieces of information that the subjects need to be told before they agree to take part in the clinical trials.

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2 .....

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(2 marks)

13

4 (a) In some countries, snow is melted from paths by scattering black coal dust on top of the snow. This helps to use heat energy from the Sun to melt the snow.

4 (a) (i) Name the heat transfer mechanism that carries heat from the Sun to the Earth.

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(1 mark)

4 (a) (ii) How does scattering the black coal dust on the snow help the snow to melt faster?

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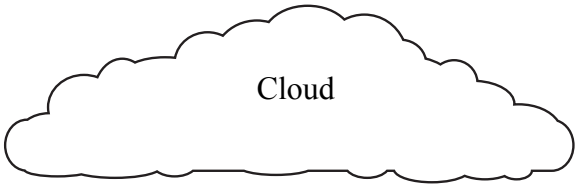
(2 marks)

4 (b) Some clouds are held up in the air by convection currents below them.

4 (b) (i) Complete the diagram by adding arrows to show how the convection currents flow below the cloud to help keep it up in the air.



Ground

(2 marks)

Question 4 continues on the next page

4 (b) (ii) Explain how these convection currents are formed.

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(3 marks)

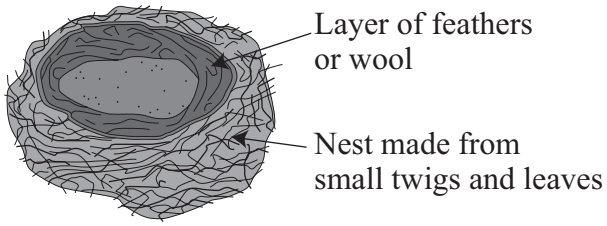
4 (b) (iii) Which of the following allow convection currents to flow through them?

Solids **Liquids** **Gases** **Vacuum**

Circle all your choices.

(1 mark)

4 (c) A bird's nest is made of many small twigs and leaves, with a layer of feathers or with wool from sheep where available.



4 (c) (i) Explain why feathers and wool are both poor conductors of heat.

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(2 marks)

4 (c) (ii) Explain how this layer of feathers or wool reduces the rate of heat loss by convection.

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(2 marks)

4 (c) (iii) What effect would a thicker layer of feathers or wool have on the U-value for the nest?
Give a scientific reason for your answer.

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(2 marks)

15

Turn over for the next question

5 A high-speed railway engine has electrically operated motors with a power output of 5.1 MW (5.1×10^6 watts).
The electric power input from the National Grid to the motors is 6 MW (6×10^6 watts).

5 (a) (i) Calculate the efficiency of the engine.

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(2 marks)

5 (a) (ii) Give **two** reasons why this efficiency is not 100%.

Reason 1 .....

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Reason 2 .....

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(2 marks)

5 (a) (iii) Suggest **one** advantage and **one** disadvantage of using electrical power compared to using diesel power in railway engines.

Advantage .....

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Disadvantage .....

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(2 marks)

5 (a) (iv) The railway engine uses 6 MW (6000 kW) of electricity for 3 hours.
How much does this cost the railway company?
The cost of electricity is 12 p per unit (kilowatt-hour).

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(3 marks)

5 (b) Railway trains are designed to be a safe means of rapid travel. One of the design features of railway carriages is a crumple zone built into both ends of the carriages.

5 (b) (i) Suggest an effective material to use for building a crumple zone.

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(1 mark)

5 (b) (ii) Explain how a crumple zone minimises the force acting on passengers in the event of a collision.

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(3 marks)

5 (b) (iii) The train's crumple zones can absorb 144 MJ of energy.
At what speed must the train be moving if the kinetic energy of the train is 144 MJ? The total mass of the train is 500 tonnes (5×10^5 kg).

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(4 marks)

17

6 A technician is testing new designs of racing skis for a sports equipment manufacturer. She designs a scientific test to find out which type of ski allows a skier to ski fastest down a mountain slope. The technician must carry out a fair test.

6 (a) (i) What is meant by a *fair test*?

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(1 mark)

6 (a) (ii) Why might the technician want to repeat her readings several times?

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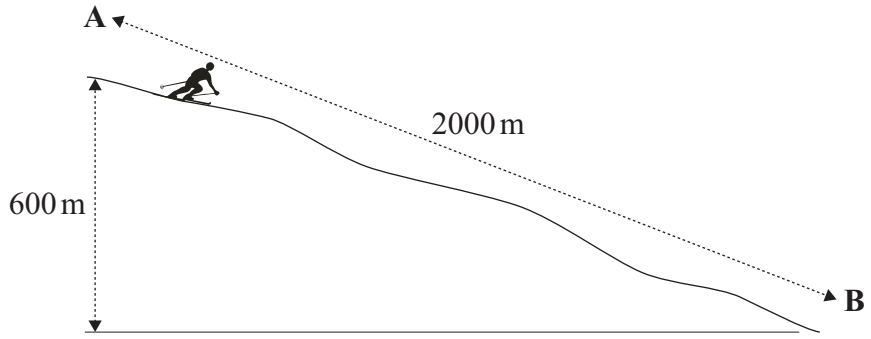
(1 mark)

6 (a) (iii)



The technician needs to measure the time of travel from **A** to **B** very accurately to detect slight changes in the skier's speed. Suggest a way that she could obtain a precise measurement.

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(1 mark)

6 (b) (i) The skier has a mass of 50 kg. If she skis down a mountain slope from **A** to **B**, what is the change in her potential energy?
Assume the acceleration due to gravity is $10\,m\,s^{-2}$.

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(3 marks)

6 (b) (ii) Explain how the skier might gain heat as she skis down the mountain slope.

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(1 mark)

6 (b) (iii) Explain how the skier might lose heat as she skis down the mountain slope.

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(1 mark)

8

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
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