Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
June 2006
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 6 June 2006 1.30 pm to 3.00 pm

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

Time allowed: 1 hour 30 minutes

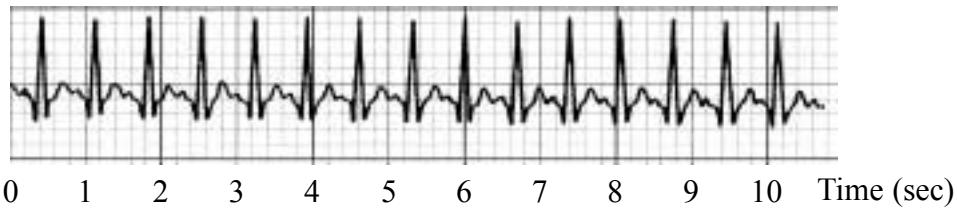
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Show the working of your calculations.

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			
Number	Mark	Number	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 40-year-old woman is required to have a medical examination for insurance purposes. A nurse monitors the activity of her heart using an electrocardiogram (ECG). The trace resulting from her ECG is shown below.



(a) The ECG shows an abnormal heart beat.
What name is given to this type of heart beat irregularity?

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(*1 mark*)

(b) What is the typical range of pulse rate for a healthy person?

..... bpm

(*1 mark*)

(c) During the medical examination, the nurse measured the blood pressure of the 40-year-old woman and recorded it as 145/95 mm Hg.

(i) How does this compare with the normal blood pressure for a woman of this age?
Circle the correct answer.

Higher **Normal** **Lower**

(1 mark)

(ii) The woman's blood pressure is represented as 145/95 mm Hg.
In the table below write the terms which correctly describe the blood pressure.

Blood pressure (mm Hg)	**Term**
145	
95	

(2 marks)

(d) The woman is asked to use a treadmill for 10 minutes. Describe how the nervous system increases her heart rate in order to meet the demand for increased blood supply by the muscles.

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(*3 marks*)

8

Turn over for the next question

2 A professional athlete starts a training session by jogging 100 m.

(a) (i) The athlete exercises on a regular basis and has a higher than normal vital capacity.
What is *vital capacity*?

.....

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.....
(*2 marks*)

(ii) What equipment would be used to measure vital capacity?

.....
(*1 mark*)

(iii) What is the normal value for vital capacity for a healthy adult male at rest?

.....
(1 mark)

(iv) What term is used to describe the volume of air breathed in and out during one ventilation cycle?

.....
(1 mark)

(b) Breathing rate is controlled by the level of carbon dioxide in the blood.

(i) What type of receptor is sensitive to changes in blood carbon dioxide concentration?

.....
(1 mark)

(ii) Where in the body are carbon dioxide-sensitive receptors found?

.....

.....
(*1 mark*)

(c) The athlete's lung function was also assessed using a peak flow meter.
The best of three measurements of his peak expiratory flow rate was 700 $dm^3\ min^{-1}$.

(i) What is meant by the term *peak expiratory flow rate*?

.....

.....

(1 mark)

(ii) How does the athlete's peak expiratory flow rate of 700 $dm^3\ min^{-1}$ compare with the normal rate?

.....

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(*1 mark*)

(iii) What might a fall in a person's peak expiratory flow rate indicate?

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(*1 mark*)

(iv) As the athlete runs, the rate and depth of his breathing also increases.
Explain how this happens.

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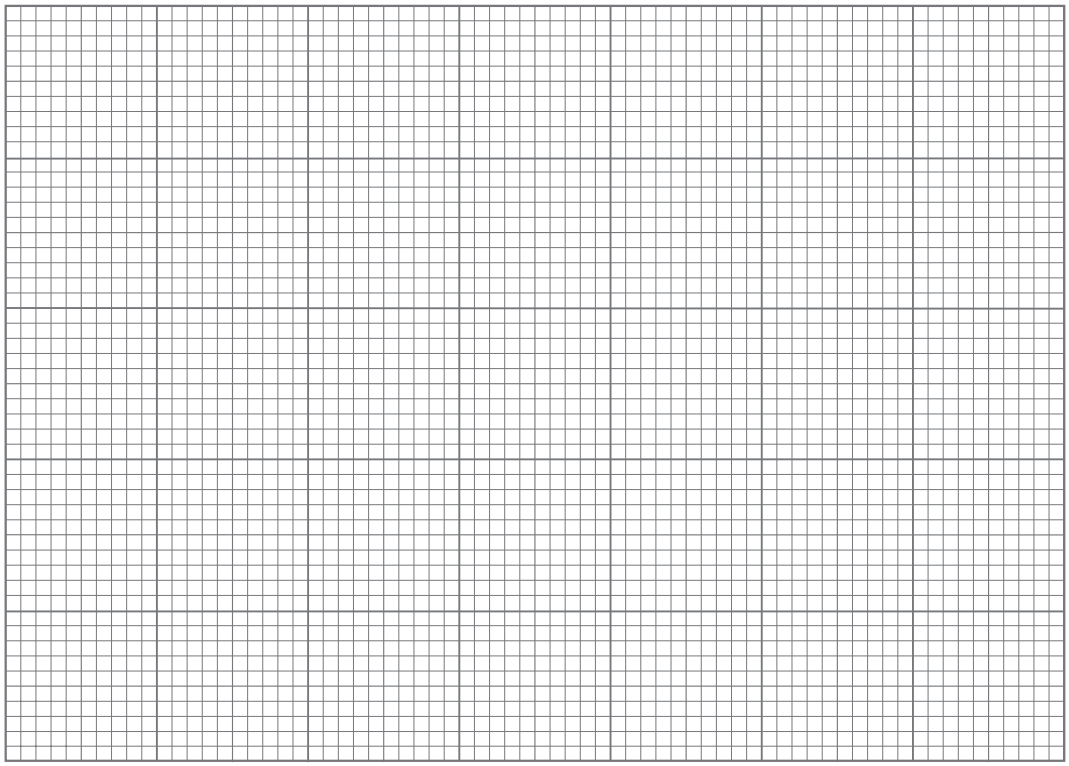
(4 marks)

Question 2 continues on the next page

(d) A woman with asthma was asked by her doctor to monitor her peak expiratory flow rate (PEFR) for one week, by taking measurements every morning and evening. These measurements are shown below.

Day	**1**		**2**		**3**		**4**		**5**		**6**		**7**	
PEFR (ml l^{-1})	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
	300	340	280	320	290	330	275	315	285	325	315	355	310	350

(i) Plot the data on the graph using suitable scales. *(4 marks)*



(ii) Describe **two** trends seen on the graph.

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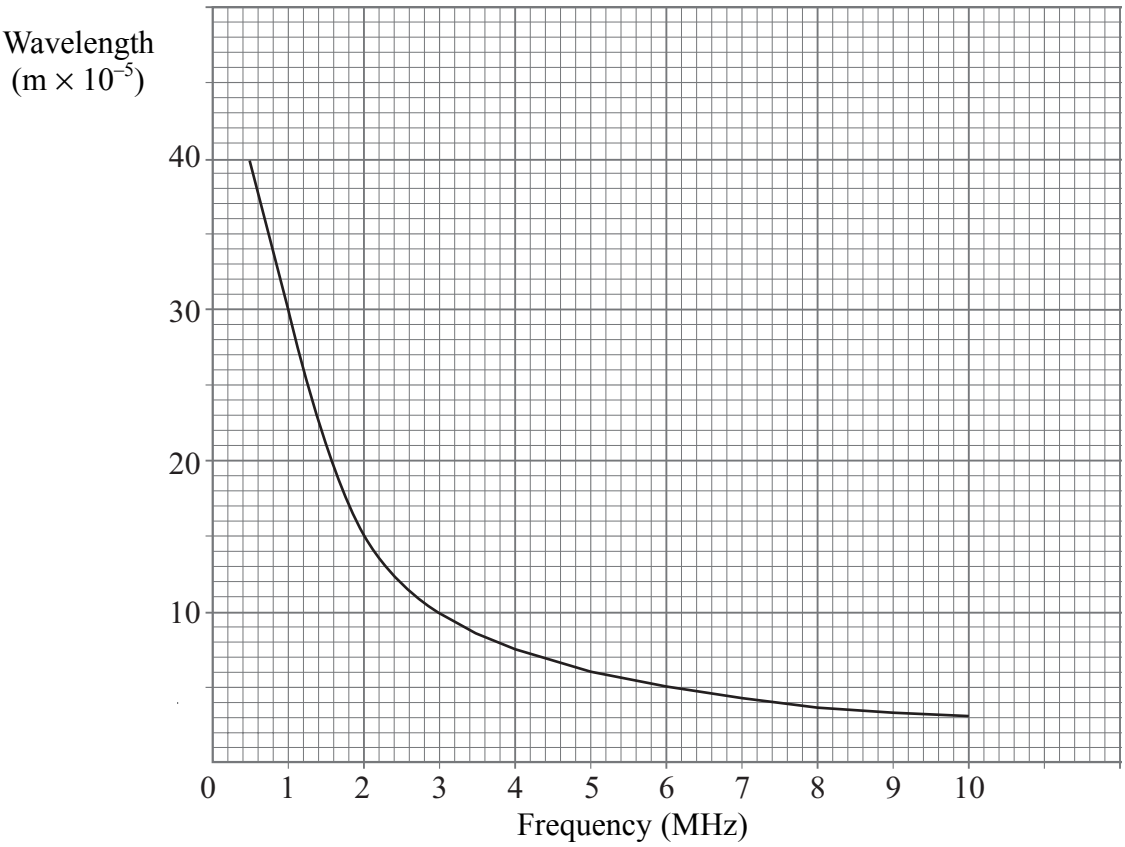
(2 marks)

20

Turn over for the next question

3 A medical physicist wants to check the output of her ultrasound machine.
To do this, she sets the machine at five different frequency settings and measures the wavelength of each ultrasound wave produced.
The results she obtained are shown on the graph below.



(a) Use the graph above to find the following.

The wavelength of the wave when the frequency is 1.5 MHz.

.....

The frequency of the wave when the wavelength is 8×10^{-5} m.

.....

(*2 marks*)

(b) Health professionals use ultrasound to diagnose some types of medical problems.

(i) Give **one** example where ultrasound is used for diagnosis.

.....

(1 mark)

(ii) Explain why ultrasound is suitable for the use you have chosen in part (b)(i).

.....

.....

(*1 mark*)

(c) Ultrasound is not suitable for diagnosing some types of medical problems.

(i) Give **one** example where ultrasound is **not** suitable for diagnosis.

.....

(1 mark)

(ii) Explain why ultrasound is **not** suitable for the use you have chosen in part (c)(i).

.....

(*1 mark*)

(d) A new method of using radioactive tracers to diagnose brain damage is suggested by medical researchers. The researchers want to trial this method using human patients rather than animals.

Briefly discuss the ethical issues involved.

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(3 marks)

9

Turn over for the next question

4 A fireworks manufacturer is designing a new rocket. The rocket rises to a height of 30 m above the ground and its mass is 0.2 kg after its fuel has been burned.

(a) Calculate how much gravitational potential energy the rocket will have when it reaches this height.
(g = 10 m s^{-2})

.....

.....

.....

gravitational potential energy = ... J
(2 marks)

(b) The rocket then falls to earth.

(i) What is the maximum kinetic energy it could have as it returns to the ground?

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(1 mark)

(ii) Calculate the maximum velocity it could have as it returns to the ground.

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(*4 marks*)

(c) Give **one** reason why the rocket is likely to return to the ground with a slower maximum velocity than you have calculated in part (b)(ii).

.....
(*1 mark*)

(d) The diagram below shows the rocket which contains a radio-controlled camera. The camera is protected from the heat of the rocket, but the designer is concerned that the camera may be damaged as the rocket hits the ground.

The designer adds a crumple zone to the front of the rocket, to protect the camera as the rocket falls to the Earth.

Explain in detail how the crumple zone could protect the camera as the rocket hits the ground.

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(*4 marks*)

(e) Suggest an alternative way of protecting the camera from the effects of landing at high speed.
Explain briefly how your idea works.

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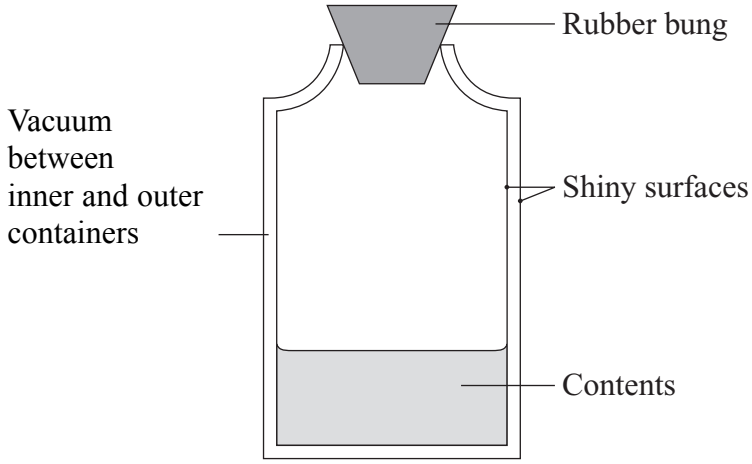
(*2 marks*)

14

5 The diagram below shows a vacuum flask designed to minimise the rate at which heat is transferred between its contents and the environment. The flask is built with an inner and an outer container. The space between them contains a vacuum. An explorer decides to test the flask.



(a) Name the **three** thermal transfer mechanisms. For each mechanism state **one** feature of the flask that reduces the rate of heat transfer.

1 Mechanism .....

Feature .....

2 Mechanism .....

Feature .....

3 Mechanism .....

Feature .....

(6 marks)

(b) The explorer is looking for warm clothing to wear on his next visit to the Arctic. He notices that the animals and birds that live there have thick layers of hair (or feathers) that seem to help them stay warm, despite the freezing temperatures. Explain how these layers help the animals and birds to stay warm.

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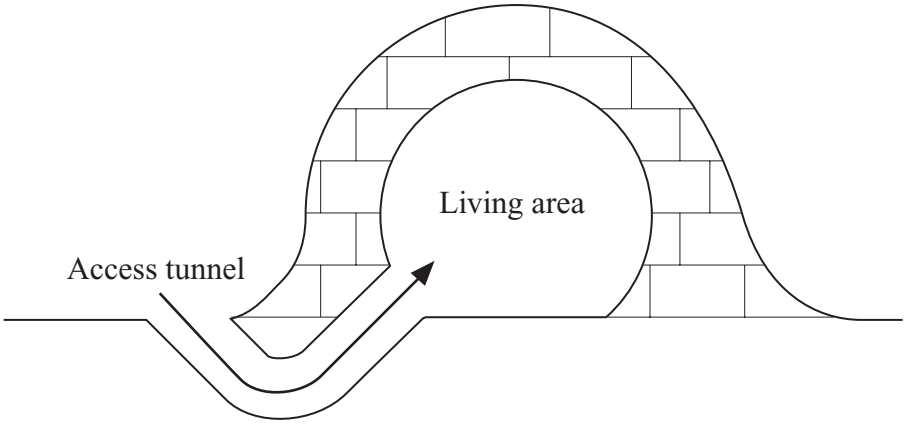
(*3 marks*)

(c) In emergency conditions it may be necessary for the explorer to make an igloo to shelter in. An igloo is made from thick blocks of snow, as shown below.



(i) Why does an igloo made from thick blocks of snow lose heat less rapidly than an igloo made from thin blocks of snow?

.....

.....

.....

(*2 marks*)

(ii) How does the design of the access tunnel help to keep warm air in?

.....

.....

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(*2 marks*)

Question 5 continues on the next page

(d) The human body reacts to high and low temperatures in different ways. Explain how the explorer's body reacts to extremes of temperature when:

(i) the surroundings are cold.

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(*3 marks*)

(ii) the surroundings are hot.

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(3 marks)

(e) A person with hypothermia can be wrapped in a silver coloured blanket as an emergency first aid measure.

Why is a silver coloured blanket used?

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(2 marks)

21

6 The Scottish Parliament is considering methods of generating electrical energy over the next 50 years.
At present, most power stations in Scotland burn coal or use nuclear reactors.
There are also some small hydroelectric schemes.

(a) Suggest **one** advantage for each of these energy sources.
You must give a different advantage for each source.

Source	Advantage
Coal	
Nuclear	
Hydroelectric	

(3 marks)

(b) Suggest **one** other way of generating electrical energy and explain why it is not used on a large scale.

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(2 marks)

(c) A typical coal-burning power station has the efficiencies shown in the table below.

Burning fuel & boiler	85%
Turbines	55%
Generator & transformer	90%

Explain what is meant by the term *efficiency*.

.....

.....

(1 mark)

Question 6 continues on the next page

(d) A power station generates 1800 MW of electrical energy. The overall efficiency of the power station is 45%.

Calculate the rate at which energy from fuel is being used in the power station.

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(2 marks)

8

END OF QUESTIONS