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 2010

Applied Science SC02

Unit 2 Energy Transfer Systems

Thursday 27 May 2010 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. 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) A carpenter is using a saw to cut a piece of wood when the saw slips and she injures her hand. She loses a lot of blood and her blood pressure falls below normal. She is admitted to hospital where she is assessed by a nurse.

1 (a) (i) Name the equipment that the nurse uses to measure the carpenter's blood pressure.

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(1 mark)

1 (a) (ii) What is the normal value of blood pressure for a healthy 20-year-old female?

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(1 mark)

1 (a) (iii) How does the normal value of blood pressure for a healthy 20-year-old female compare with the normal value of blood pressure for a healthy 20-year-old male?

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(1 mark)

1 (b) (i) The nurse could monitor the activity of the carpenter's heart to discover if she has a normal heart rhythm.
What piece of equipment would the nurse use to do this?

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(1 mark)

1 (b) (ii) Ventricular fibrillation is associated with abnormal heart rhythm.
Describe what happens in the heart during ventricular fibrillation.

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(1 mark)

1 (b) (iii) What is likely to happen to a person suffering from untreated ventricular fibrillation?

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(1 mark)

1 (c) The right ventricle in the heart has thinner walls than the left ventricle.
Explain why.

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(1 mark)

1 (d) (i) Arteries and veins differ in structure and function.
Give **two** ways in which the *structure* of arteries differs from that of veins.

1 .....

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2 .....

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(2 marks)

1 (d) (ii) Give **two** ways in which the *function* of arteries differs from that of veins.

1 .....

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2 .....

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(2 marks)

1 (e) (i) A person's blood pressure changes over a 24-hour period.
What might a healthy person be doing when their blood pressure is at its lowest?

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(1 mark)

1 (e) (ii) State **two** things that might cause a healthy person's blood pressure to rise.

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(2 marks)

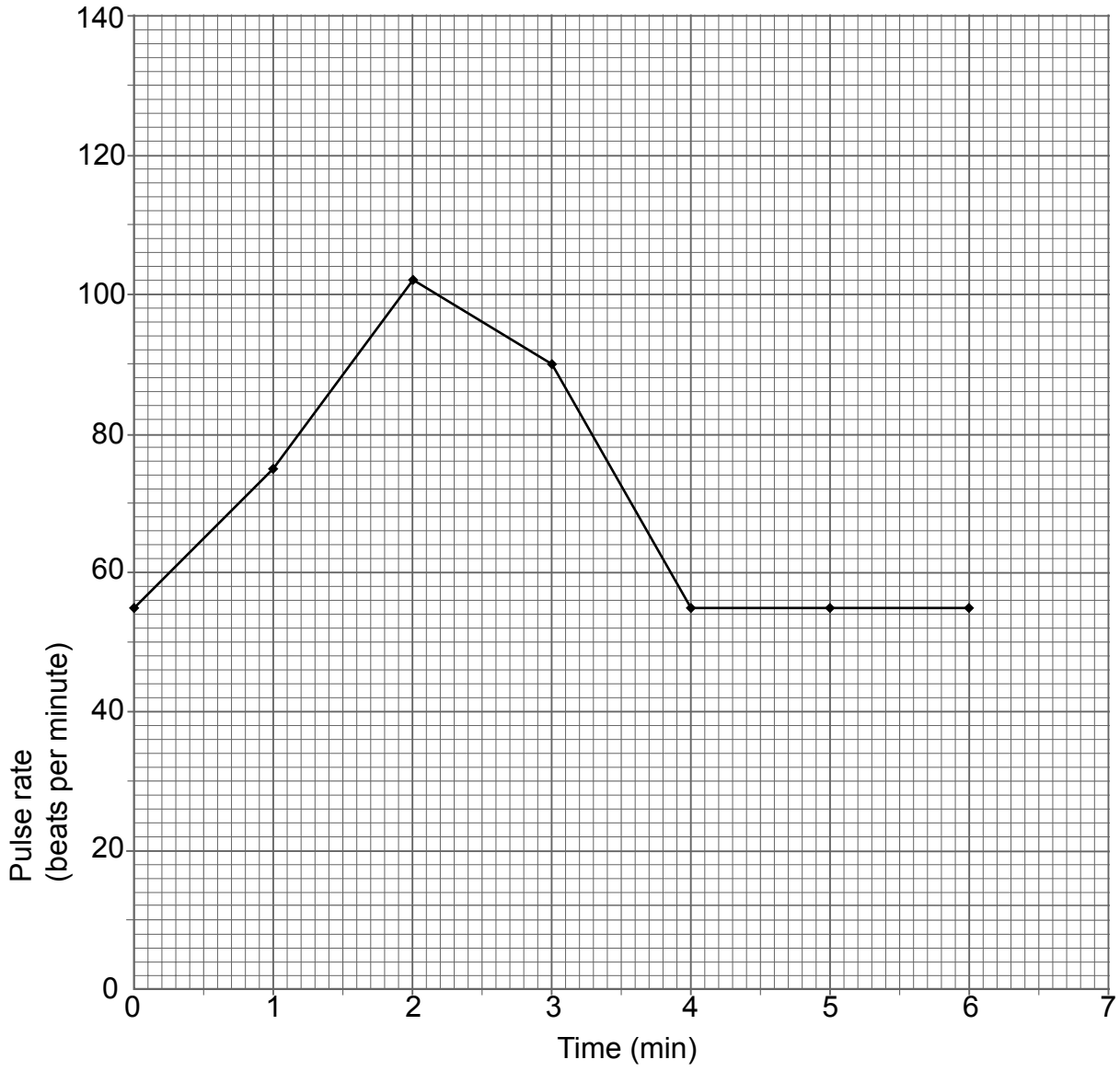
Question 1 continues on the next page

1 (f) A company asks two of their staff to undergo a health assessment. During the assessment, both people had to exercise for two minutes. Their pulse rates were recorded before, during and after exercise. The results for **Person 1** are shown on the graph.

The results for **Person 2** are shown in the table.

Time after exercise started (min)	0	1	2	3	4	5	6
Pulse rate (beats per minute)	85	100	140	135	125	110	85

1 (f) (i) Plot the information for **Person 2** from the table on the graph.



(2 marks)

1 (f) (ii) Explain how the information in the graph indicates that **Person 1** is fitter than **Person 2.**

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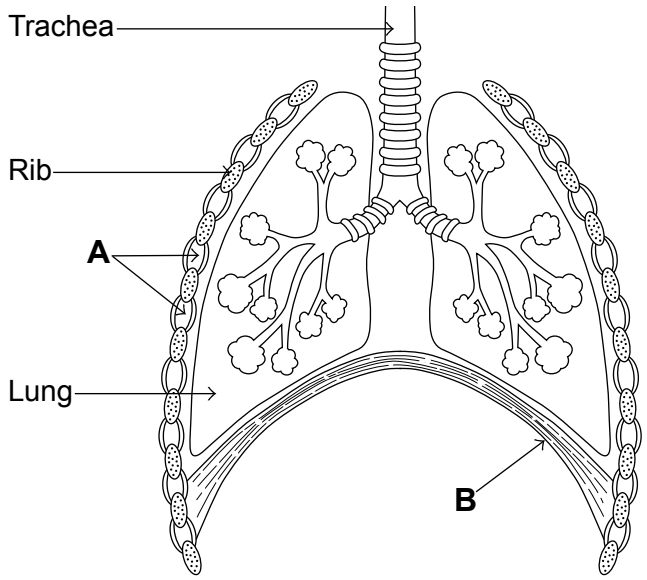
(3 marks)

19

Turn over for the next question

2 The diagram shows the human respiratory system.



2 (a) (i) Complete the table to show the structures that the letters **A** and **B** represent.

	Structure
A	
B	

(2 marks)

2 (a) (ii) Describe how air is drawn into the lungs during breathing.

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(4 marks)

2 (b) People visiting places at very high altitudes sometimes experience altitude sickness. This is because less oxygen is available.

2 (b) (i) What effects might the reduced oxygen level in the blood have on a person's breathing?

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(2 marks)

2 (b) (ii) What effect might the reduced oxygen level in the blood have on a person's heart rate?

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(1 mark)

2 (c) Gases are exchanged between the atmosphere and the blood, across the surfaces of the alveoli.
Describe how carbon dioxide gas passes from the blood into the alveoli.

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(3 marks)

12

Turn over for the next question

3 *Hypothermia* is a serious threat to people who take part in outdoor sports such as mountaineering.

3 (a) What is hypothermia?

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(2 marks)

3 (b) Suggest **one** symptom of hypothermia.

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(1 mark)

3 (c) (i) On a mountaineering expedition, a person develops hypothermia.
Suggest **one** way to treat the person.

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(1 mark)

3 (c) (ii) Explain why your suggestion in part (c)(i) might be effective.

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(1 mark)

3 (d) A person's core body temperature is normally maintained by homeostatic mechanisms.
Explain what is meant by *homeostasis*.

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(2 marks)

3 (e) Give **two** mechanisms that the body uses to raise its core body temperature to normal, when necessary.

1 .....

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2 .....

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(2 marks)

9

Turn over for the next question

4 A motorist is concerned that the passenger compartment of her car gets overheated by the Sun's rays in summer. It is not safe to leave the windows open to allow the hot air to escape.

4 (a) Name the thermal transfer method that carries heat from the Sun to the car.

.....

(1 mark)

4 (b) The motorist puts sunshades inside the windows of the car. What type of surface should the sunshades have in order to minimise the amount of heat reaching the inside of the car: white, grey, black, shiny, red, green, blue or camouflage colours?

.....

(1 mark)

4 (c) The motorist decides to fit a small electric heater inside the car to keep the car warm overnight during the winter. The heater is operated from the mains, and radiates heat with a power of 250 W.

What colour should the outside of the heater be if it is to radiate heat most effectively?

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(1 mark)

4 (d) How much heat energy will the heater give out in 5 minutes? Include the correct unit in your answer.

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(3 marks)

4 (e) The total surface area of the car's passenger compartment is $4\,m^2$.
The outside temperature is $3\,^{\circ}C$.
The heater keeps the inside temperature at $8\,^{\circ}C$.

Use the following equation to calculate the *U*-value of the car's passenger compartment when the car is losing heat at a rate of $250\,J\,s^{-1}$.

heat transfer rate = surface area × *U*-value × temperature difference

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..... $W\,m^{-2}\,K^{-1}$

(2 marks)

4 (f) Comment on any economic and environmental consequences of motorists using this type of mains powered heater through the winter.

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(2 marks)

4 (g) The motorist goes on holiday for two weeks (336 hours). A pre-payment meter controls the power to the freezer in her kitchen, which draws an average power of 200 watts. The meter has £10 paid into it before she leaves home, and will switch off the freezer when the money runs out.
Electricity costs 16 p per unit. Calculate whether or not the freezer will still be working when the motorist returns from her holiday.

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(2 marks)

12

5 A professional tennis player hits a stationary tennis ball. After contact with the racquet the ball moves at 25 m s^{-1}. The mass of the tennis ball is 60 grams.

5 (a) Calculate the change of momentum of the tennis ball.

momentum = mass × velocity

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..... kg m s^{-1}

(3 marks)

5 (b) The tennis ball is in contact with the racquet for 0.2 seconds. Calculate the force on the tennis ball from the racquet.

change of momentum = force × time

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..... N

(2 marks)

5 (c) Calculate the kinetic energy of the tennis ball when it is travelling at 25 m s^{-1}.

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..... J

(3 marks)

5 (d) (i) Another professional tennis player hits the ball vertically upwards giving it 20 J of kinetic energy. What is the maximum height the ball would reach if it was already 1 m above the ground when it was hit?

$g = 9.81\,m\,s^{-2}$

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..... $m\,s^{-2}$

(3 marks)

5 (d) (ii) Why is your answer to part (d)(i) probably an overestimate?

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(1 mark)

12

Turn over for the next question

6 A farmer on a remote Scottish island decides to install electric power to his house. The cost of installing a mains power line is very high. He has considered solar photo-voltaic cells but he is concerned that they have an efficiency of only 8%.

6 (a) Explain what is meant by *an efficiency of 8%*.

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(2 marks)

6 (b) Other than efficiency, give **one** advantage and **one** disadvantage of generating electricity from solar photo-voltaic cells.

Advantage.....

.....

Disadvantage.....

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(2 marks)

6 (c) Suggest **three** other ways the farmer might generate electricity using renewable sources of energy.

1 .....

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2 .....

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3 .....

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(3 marks)

6 (d) Why are we being encouraged to use renewable sources, rather than fossil fuels, to generate electricity?

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(2 marks)

6 (e) Give **two** reasons why we still produce most of our electricity from fossil fuels.

1 .....

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2 .....

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(2 marks)

6 (f) Give **one** disadvantage of using nuclear fuel as a source of energy.

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(1 mark)

6 (g) On a sunny day, a salesman of photo-voltaic cells measures the maximum potential difference from the cells to be 17 volts, and the maximum current to be 3 amps. This gives a maximum power of 51 watts.

There are 86 400 seconds in a 24-hour day. The salesman uses the equation energy = power $\times$ time and calculates that the photo-voltaic cells will provide electrical energy equal to (51 $\times$ 86 400) = 4 406 400 joules every day.

Explain whether or not the farmer should be satisfied with this claim.

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(2 marks)

Question 6 continues on the next page

6 (h) What measurements would you take, and when would you take them, to estimate the average electrical energy provided by the cells in a day?

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(2 marks)

16

END OF QUESTIONS