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 2012

Applied Science SC02

Unit 2 Energy Transfer Systems

Friday 18 May 2012 1.30 pm to 3.00 pm

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.

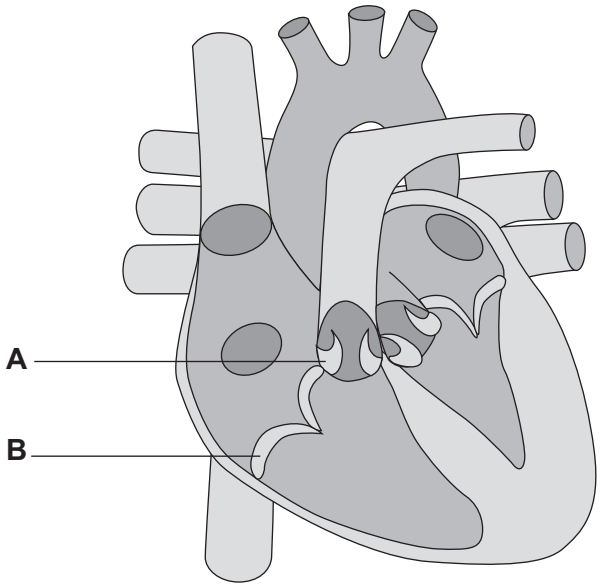
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You are expected to use a calculator where appropriate.

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

1 A 15-year-old boy started to become tired more easily when playing football. A nurse carried out a health assessment on the boy. This showed that one of the valves in his heart was not working properly.

Figure 1 shows a cross section through a human heart.

Figure 1



1 (a) Name the structures labelled **A** and **B** in **Figure 1**.

A .....

B .....

(2 marks)

1 (b) What is the function of the valves in the heart?

.....

.....

(1 mark)

1 (c) When the boy was nine years old he was ill with rheumatic fever. This illness weakened the muscle in the wall of the left ventricle of his heart, making it thinner. Explain why this might affect the flow of blood leaving his heart.

.....

.....

.....

.....

.....

.....

(3 marks)

1 (d) During the health assessment, a nurse used a stethoscope to listen to the boy's heart and was able to hear his heart beating.
Describe and explain what causes the sounds that the nurse hears.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

Question 1 continues on the next page

1 (e) A group of six friends, **A** to **F**, decided to have their health assessed to see if they could cope with a long walk. Their blood pressure was measured and some of the results are shown in **Table 1**.

Table 1

Person	Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)
A	125	80
B	136	82
C	122	92
D		
E	86	56
F	132	84

1 (e) (i) Person **D** is a healthy 40-year-old woman.
Complete **Table 1** by writing the results you might expect for her blood pressure.

(1 mark)

1 (e) (ii) Use the information in **Table 1** to suggest which person, **A** to **F**, is most likely to be asked back for further health assessment.

Person .....

(1 mark)

1 (e) (iii) Explain why you think this person will be asked back for further health assessment.

.....

.....

(1 mark)

1 (f) One of the friends decided to take part in a long and difficult walk over rough and hilly ground. Her heart rate speeded up during the difficult parts of the walk and returned to normal a few minutes after she finished the walk.
Describe how her body returned her heart rate to normal after she finished the walk.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

1 (g) A work colleague of one of the friends decides to have her cardiovascular fitness assessed.
Using heart rate as an indicator, design an experiment to assess cardiovascular fitness.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

21

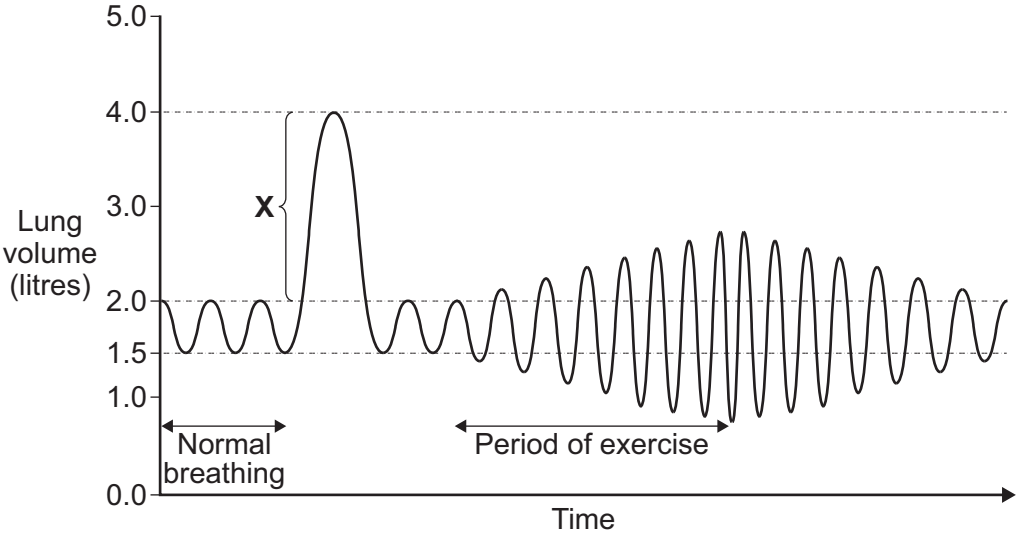
Turn over for the next question

2 (a) A woman had a tooth removed by her dentist. A general anaesthetic was used and the breathing rate of the woman was carefully monitored to check that it did not fall below normal.
What is the normal range for the breathing rate of an adult female at rest?

breaths per minute .....
(1 mark)

2 (b) The woman exercised in a gym regularly and agreed to have her breathing rate monitored while she ran on the running machine.
The trace obtained is shown in **Figure 2**.

Figure 2



2 (b) (i) Before she started to exercise, the woman was asked to breathe in normally. She was then asked to breathe in again as much as she could, and then breathe normally.
What is the lung volume, labelled **X** on the spirometer trace, called?

.....
(1 mark)

2 (b) (ii) Use the spirometer trace to determine the volume labelled **X**.

X = ... litres
(1 mark)

2 (b) (iii) Describe what **Figure 2** shows is happening to the woman's breathing during the time she is exercising, compared with her normal breathing.

.....

.....

.....

.....

(2 marks)

2 (c) When the woman started to exercise, she needed energy for her muscles to contract. This energy was initially produced by aerobic respiration in the cells.

2 (c) (i) Explain how this happens.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

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

.....

.....

(2 marks)

11

3 A ferry was involved in a collision and several people fell into the sea.

3 (a) When the people were rescued from the cold water their core body temperature was found to be a few degrees below normal.
Name the condition they might be suffering from.

.....

(1 mark)

3 (b) Some of the people rescued from the sea were less affected by the cold than were others.
Suggest a physical feature of the body that helped protect them from the cold.

.....

.....

(1 mark)

3 (c) Some of the people rescued did not need urgent medical treatment because their core body temperature started to return to normal very quickly.
Name and explain **two** mechanisms used to raise the core body temperature to normal.

Mechanism 1 .....

Explanation .....

.....

.....

.....

Mechanism 2 .....

Explanation .....

.....

.....

.....

(6 marks)

8

4 A farmer is hammering a fence post into the ground as shown in **Figure 3**. He uses a hammer of mass 3 kg. Just before hitting the post, the hammer is moving at 6 m s^{-1}.

Figure 3

4 (a) What is the kinetic energy of the hammer just before it hits the post?

.....

.....

.....

.....

.....

Kinetic energy =.....J

(3 marks)

4 (b) Just after hitting the post, the kinetic energy of the hammer is zero.
What has happened to this energy?

.....

.....

.....

.....

(2 marks)

Question 4 continues on the next page

4 (c) The farmer has too many fence posts to hammer in by himself.
He decides to buy a diesel-driven machine to do the job.
The machine uses chemical energy at a rate of 1200 W.
How long will it take the machine to use some fuel containing 36 000 J of chemical energy?

.....

.....

.....

.....

.....

..... seconds
(3 marks)

4 (d) The input power to the machine is 1200 W and its efficiency is 40%.
What is the output power of the machine?

.....

.....

.....

Output power = ... W
(2 marks)

4 (e) Suggest **two** disadvantages for the local environment if the farmer uses the machine, rather than hammering in the posts himself.

Disadvantage 1 .....

.....

Disadvantage 2 .....

.....
(2 marks)

4 (f) The farmer is using the fence posts to support a thick hedge as shown in **Figure 4a** and **Figure 4b**.
This hedge is about 0.7 m thick and is loosely held in place by the fence posts.
He has found that his cattle are not able to kick this thick hedge down.

Figure 4a

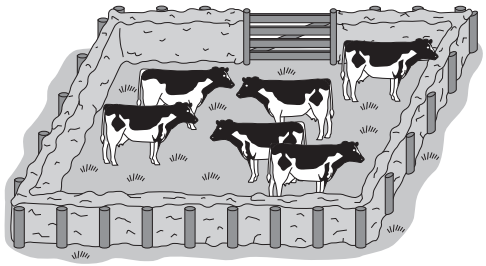
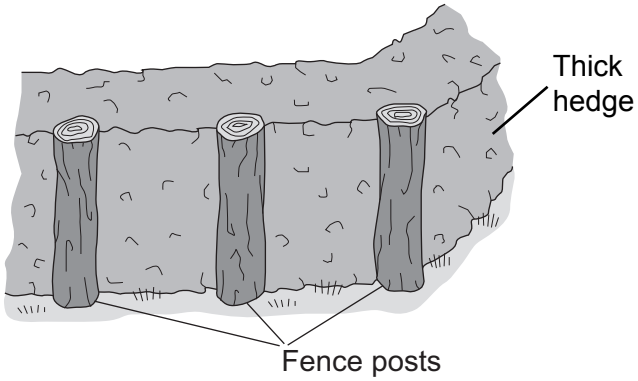
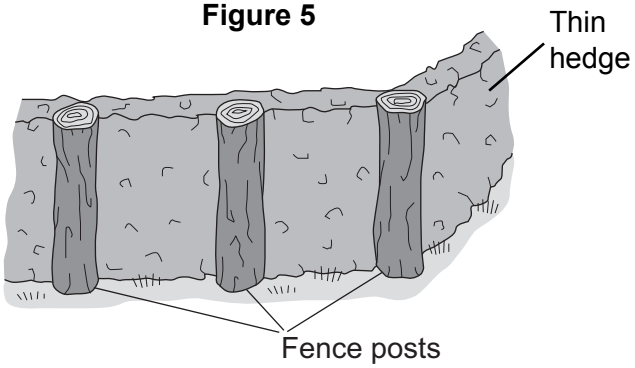


Figure 4b



A neighbour has used similar fence posts, at the same spacing, to support a thin hedge as shown in **Figure 5**.
The cattle found it easy to kick this thin hedge down.

Figure 5



Use your knowledge of momentum to explain why the thick hedge can withstand kicks from cattle, while the thin hedge cannot.

.....

.....

.....

.....

.....

.....

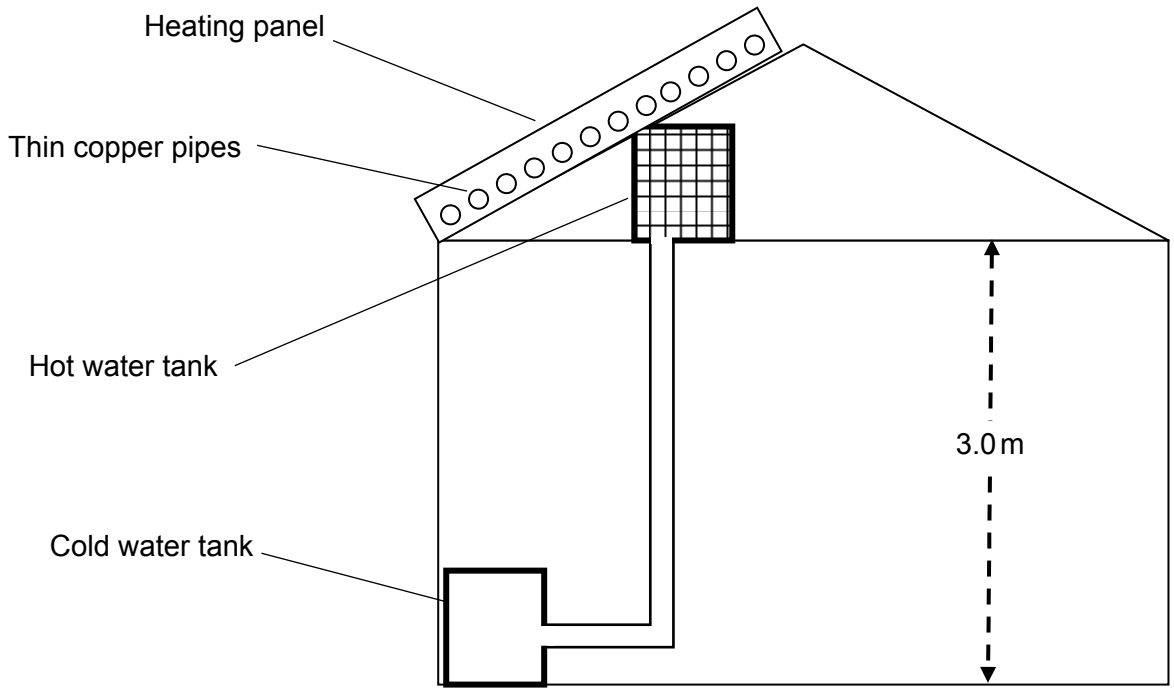
(3 marks)

15

Turn over ▶

5 An engineer is considering fitting solar heating panels to the roof of her house. These will absorb radiation from the Sun and heat water for use in her house.
Figure 6 shows a side view of the house, one heating panel and water tanks.

Figure 6



The engineer has decided to use many thin copper pipes in each panel, rather than one thick one. She asked for the outside of the pipes to be painted.

5 (a) What colour should the outside of the pipes be painted?

.....

(1 mark)

5 (b) Why should the engineer use copper pipes rather than plastic ones?

.....

.....

.....

.....

(2 marks)

5 (c) The engineer initially finds that all the hot water stays in the panel, and the cold water stays in the lower tank.
Explain why this happens.

.....

.....

.....

.....

(2 marks)

5 (d) The engineer decides to fit a small pump to circulate the water. The pump is designed to lift 20 litres of water (20 kg) by 3 metres, in a fixed time period.

Assume that $g = 10\,m\,s^{-2}$

How much gravitational potential energy is gained when 20 kg is lifted by 3 m?
State the correct unit in your answer.

.....

.....

.....

.....

.....

Gravitational potential energy.....

(3 marks)

5 (e) The engineer wants to power the pump from a small solar cell placed next to the panel. A friend suggests that she should use the mains electricity supply to power the pump.

Suggest **two** advantages of using a solar cell, rather than the mains, to power the pump.

Advantage 1 .....

.....

Advantage 2 .....

.....

(2 marks)

Question 5 continues on the next page

5 (f) The engineer wants to compare her panel (the Aqa-panel) with a rival company's panel (the Heatalot). She plans to install an Aqa-panel on every second house in the street, and a Heatalot panel on the others. She will then measure the heat delivered to the hot water system of each house.

Suggest **two** precautions she should take to make her comparison of the heating systems a fair test.

Precaution 1 .....

.....

Precaution 2 .....

.....

(2 marks)

5 (g) The company accountant suggests that the engineer should cut the costs of the comparison by using one Aqa-panel and one Heatalot panel. The output from each of the panels, for one day, could then be compared. The engineer intends to make this a reliable scientific comparison.
How could she explain to the accountant why she needs to use several panels?

.....

.....

.....

.....

(2 marks)

14

6 A caravan manufacturer was concerned that in caravans that he built, the water might freeze in icy conditions. The caravans were parked outside on a caravan park. He installed a small electric heater inside each caravan to make sure that the water would not freeze.
The heaters were switched on continuously throughout the winter (3600 hours).
The power of each heater was 600 W.

The manufacturer received a bill for £324.00 for the electricity used over this period.

6 (a) How much was the manufacturer charged for each unit (kWh) of electricity used?

.....

.....

.....

.....

.....

Cost per unit (kWh) of electricity = ...

(3 marks)

6 (b) On a cold day the manufacturer noted that the temperature inside a caravan was 7 °C, when the outside temperature was –3 °C.
The area of the walls, floor and ceiling of the caravan totalled 50 m^2.
The 600 W produced by the heater was all being lost to the outside.

U-values can be calculated using the equation:

Power transmitted = area × *U*-value × temperature difference

Calculate the average *U*-value of the 'walls, floor and ceiling' of this caravan.

.....

.....

.....

.....

.....

Average *U*-value = ...

(2 marks)

Question 6 continues on the next page

6 (c) The manufacturer decided to install a layer of foam thermal insulation, 5 cm thick, in the walls of the caravans.
Explain how foam insulation reduces heat loss through the walls of the caravan.

.....

.....

.....

.....

.....

.....

(3 marks)

6 (d) The manufacturer was unhappy about how much it cost to use the heaters. He decided to fit a thermostat to each heater. This meant that the heater only used electricity if the temperature in the caravan was lower than 3 °C.
Explain how the thermostat would stop the temperature in the caravan falling too low.

.....

.....

.....

.....

.....

.....

(3 marks)

11

END OF QUESTIONS