

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use
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General Certificate of Education  
 January 2010  
 Advanced Subsidiary Examination



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

**SC02**

Tuesday 12 January 2010 9.00 am to 10.30 am

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a pencil and a ruler</li> <li>• a calculator.</li> </ul>
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For Examiner's Use			
Question	Mark	Question	Mark
1		5	
2		6	
3			
4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

**Instructions**

- Use black ink or black ball-point pen. Use pencil only for drawing.
- 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 that you do not want to be marked.
- Show the working of your calculations.

**Information**

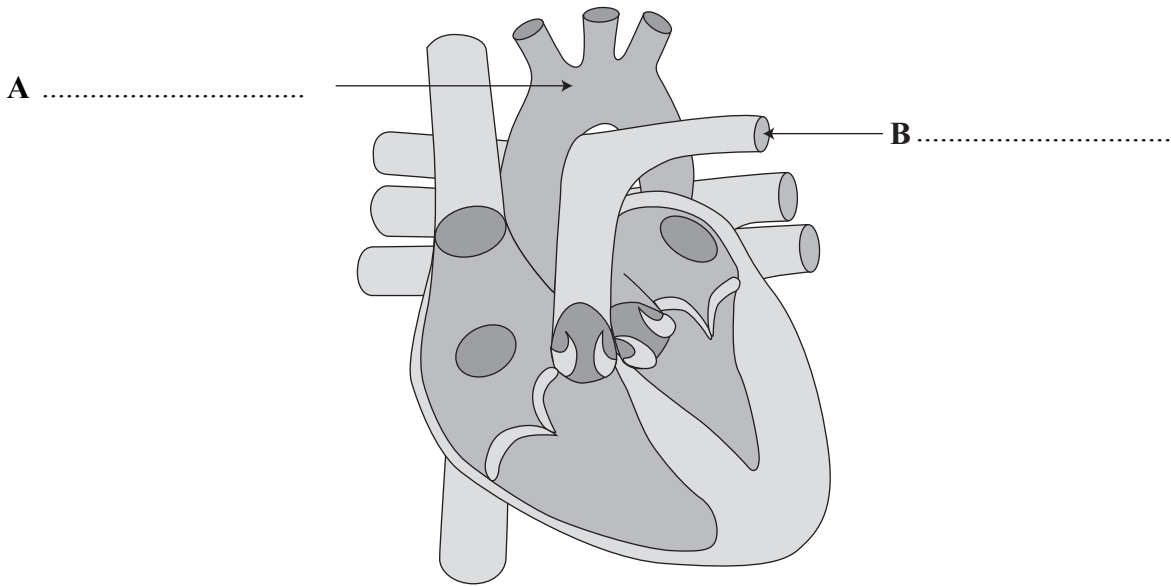
- The maximum mark for this paper is 80.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.



J A N 1 0 S C 0 2 0 1

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

**1** The diagram shows a cross-section through a human heart.



**1** (a) Label the structures **A** and **B** on the diagram. (2 marks)

**1** (b) Explain why the wall of the left ventricle is thicker than the wall of the right ventricle.

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(2 marks)

**1** (c) A 12-year-old girl found that she became tired quickly during sports activities. A health practitioner decided to carry out a health assessment to discover the cause.

**1** (c) (i) The girl's electrocardiogram (ECG) was recorded and compared with a normal ECG trace.  
What does an ECG trace show about the working of the heart?

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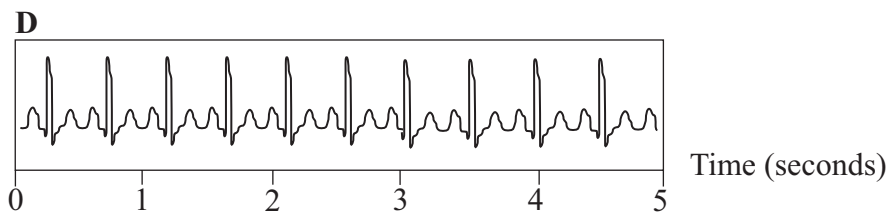
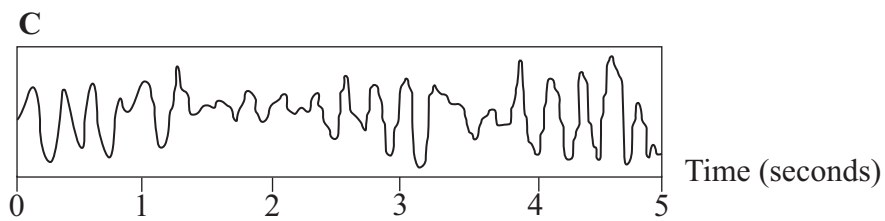
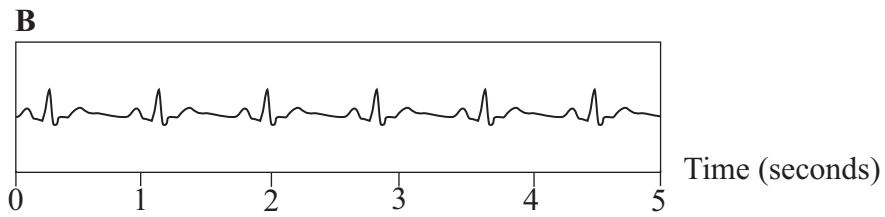
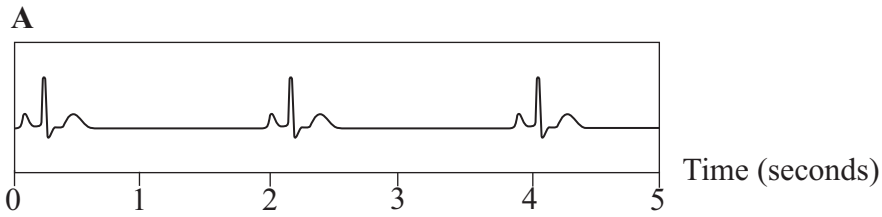
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(2 marks)



1 (c) (ii) The girl was found to have tachycardia.

Which ECG trace, **A**, **B**, **C** or **D**, shows tachycardia? .....



(1 mark)

Turn over ▶



- 1 (d) The health practitioner listened to the girl's heart using a stethoscope and was able to hear her heart beating.

Describe what the health practitioner heard and explain what causes these sounds.

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(4 marks)

- 1 (e) The girl's breathing was also monitored and her peak expiratory flow rate was found to be  $280 \text{ dm}^3 \text{ min}^{-1}$ .  
How does this value compare with a normal value for peak expiratory flow rate?

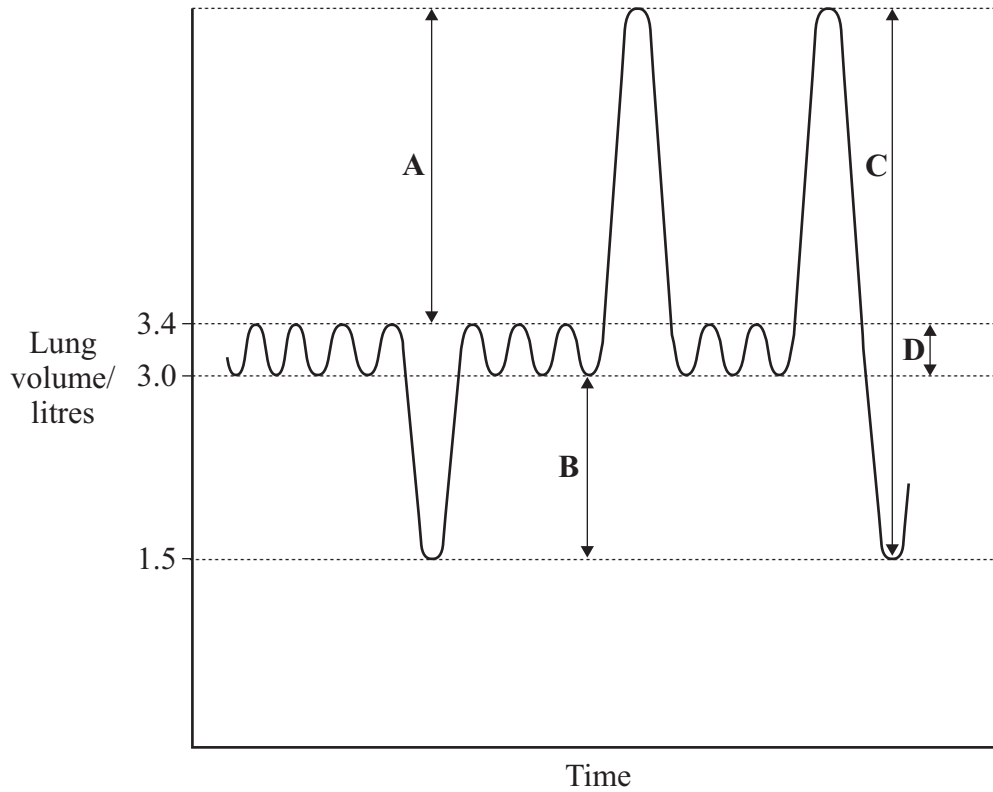
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(1 mark)



- 1 (f) The girl's lung function could have been measured using a spirometer. A spirometer trace is used to identify different lung volumes. The following spirometer trace was produced when a person with normal lung function was tested.



With reference to the spirometer trace, complete the table by inserting the correct letters, **A – D**, to show which lung volumes are represented.

Lung volume	Letter
Vital capacity	
Tidal volume	

(2 marks)

Turn over ►





2 (b) Give **three** routes, other than through the skin, by which the body loses heat.

1 .....

2 .....

3 .....

*(3 marks)*

2 (c) Give **three** factors that affect the rate at which heat is lost from the body.

1 .....

2 .....

3 .....

*(3 marks)*

13

**Turn over for the next question**

**Turn over ▶**



3 (a) A group of students carried out an experiment to monitor the rate of respiration of a yeast solution.

3 (a) (i) Yeast can respire using aerobic respiration.  
Write a balanced chemical equation for aerobic respiration.

.....  
(3 marks)

3 (a) (ii) Ten grams of glucose were dissolved in 100 cm<sup>3</sup> of water. One gram of yeast was added to the solution and carbon dioxide was produced slowly as the yeast respired.  
The carbon dioxide was collected and measured at 20 minute intervals. This was repeated with three other sugars, fructose, maltose and lactose, of equal concentration and also with deionised water.

The results are shown in the table. They show the volume of carbon dioxide that is produced by the yeast during respiration with each sugar, and with deionised water.

The volume of carbon dioxide produced when yeast respire gives an indication of the rate of respiration.

Time min	Volume of carbon dioxide produced (cm <sup>3</sup> )				
	With glucose	With fructose	With maltose	With lactose	With deionised water
0	0.0	0.0	0.0	0.0	0.0
20	0.5	0.0	2.0	0.0	0.0
40	4.6	0.0	7.4	0.5	0.0
60	16.1	0.0	19.2	1.3	0.0
80	32.5	5.6	37.3	2.0	0.0
100	47.4	11.9	57.2	2.6	0.0

Suggest what the data show about the respiration of yeast using the different sugars.

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(4 marks)





3 (a) (iii) Why was the experiment repeated using deionised water?

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(1 mark)

3 (b) (i) Some people are intolerant of lactose, a sugar found in milk. This is because their body does not have an enzyme called lactase which is necessary to break down lactose to glucose.

Some students were asked to design and perform an experiment to show the effect of adding lactase to a lactose solution before adding the yeast and monitoring the rate of respiration.

Use this information and the data in the table on **page 8** to explain what you would expect the results to show.

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(3 marks)

3 (b) (ii) Suggest **two** other factors that the students could alter that would affect the rate of respiration of the yeast.

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(2 marks)



4 Some buses have a feature that allows the front of the bus to be lowered to allow wheelchair users to get on without having to be lifted up.

Each time the bus stops, the front is lowered by 12 cm, bringing the floor of the bus level with the pavement.

Before the bus moves off, the front is raised to its normal height. The force needed to raise the front of the bus is 40 000 N.

4 (a) How much energy is needed to raise the front of the bus to its normal height?

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.....  
.....  
.....

Energy .....  
(2 marks)

4 (b) (i) An electric motor takes 4 seconds to raise the front of the bus to its normal height. What is the minimum output power of this motor?

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.....  
.....

Power .....W  
(2 marks)

4 (b) (ii) A different bus has a similar motor with an output power of 1.5 kW and an input power of 2.0 kW. What is the efficiency of this motor?

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.....  
.....  
.....

(2 marks)



4 (b) (iii) State **two** useful forms of energy that are produced by this motor.

1 .....

2 .....

(2 marks)

4 (c) It has been suggested that the diesel-powered buses should be replaced by electrically powered trams. The trams take electricity from overhead power lines and run on rails.

4 (c) (i) Suggest **two** advantages of this change.

1 .....

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2 .....

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(2 marks)

4 (c) (ii) Suggest **two** disadvantages of this change.

1 .....

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2 .....

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(2 marks)

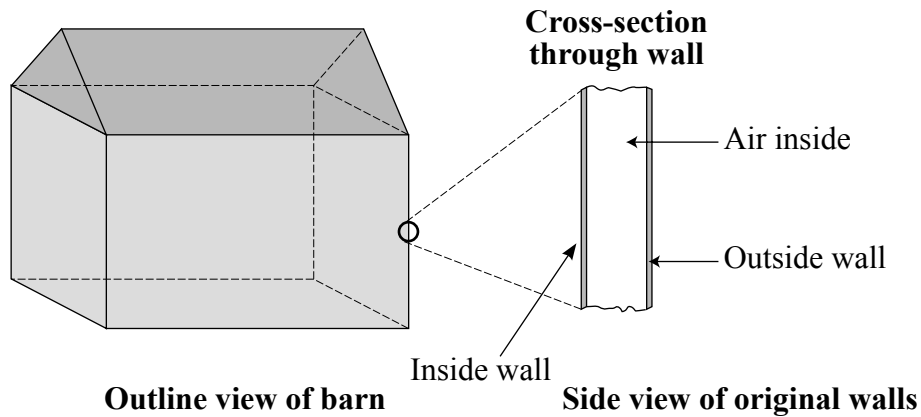
**Turn over for the next question**

12

**Turn over ▶**



- 5 An architect is converting two identical barns into houses. The original barns have hollow walls as shown in the diagram.



The  $U$ -value of the original barn is considered to be too high.

- 5 (a) Explain what is meant by the  $U$ -value of the building.

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(3 marks)

- 5 (b) The architect suggests filling the gap between the inside and outside walls with foam. Explain how this change would reduce convection in the walls.

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(2 marks)

- 5 (c) The water in each converted barn will be heated using solar panels on the roof.

- 5 (c) (i) What form of energy transfer moves heat from the Sun to the Earth?

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(1 mark)



5 (c) (ii) What colour should the surface of the solar panels be to be most efficient in collecting heat energy from the Sun?

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*(1 mark)*

5 (c) (iii) State **two** reasons for having a second way of heating the water in the converted barns, as well as the solar panels.

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.....  
*(2 marks)*

5 (d) The two new families living in the converted barns are considering if it is worth fitting extra loft insulation. They decide to run an experiment for one month. One family fits extra insulation, and the other one does not. Both families measure the energy used for heating their converted barn for one month.

5 (d) (i) State **two** precautions to help the families make this a fair test.

1 .....  
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2 .....  
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*(2 marks)*

5 (d) (ii) How could they change the experiment to get more valid results?

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*(1 mark)*

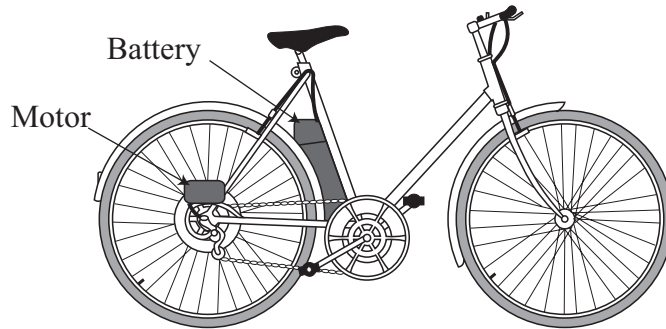
5 (e) Why is a thick layer of insulation in the loft more effective at reducing the converted barn's heating bills than a thick carpet laid on the floor?

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*(2 marks)*

Turn over ▶



6 A man uses an electrically powered bicycle to go to work every day. A battery powers the motor, which propels the bicycle at a steady speed.



6 (a) (i) State the useful energy changes that occur in  
 the battery .....  
 .....  
 the motor.....  
 .....  
 (2 marks)

6 (a) (ii) Describe **one** energy change in the bicycle that is **not** useful.  
 .....  
 .....  
 (1 mark)

6 (b) Electrical bicycles sometimes use regenerative braking. During regenerative braking, the bicycle's motor is used as a generator to recharge the battery.

How is this more energy efficient than the normal method of slowing a bicycle by friction brakes?

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 .....  
 .....  
 .....  
 (2 marks)



- 6 (c) The man keeps the bicycle's tyres inflated to the recommended value. However, he finds that it is more comfortable to ride over rough surfaces if the tyre pressure is reduced. Reducing the pressure in the tyres allows them to change shape more easily because the air inside is more easily squashed.

Explain why it is more comfortable to ride over rough surfaces with under inflated (reduced pressure) tyres.

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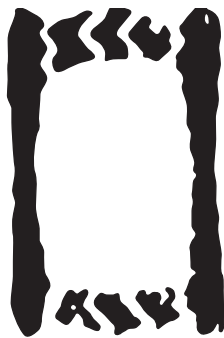
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(2 marks)

- 6 (d) The amount of pressure in the tyres affects the bicycles efficiency. The diagram shows the difference in the tyre surface in contact with the road at different tyre pressures.

**Tyre surface in contact with the road**



Under inflated (reduced pressure)



Correct inflation (correct pressure)



Over inflated (high pressure)

Explain how high pressure in the tyres makes the bicycle more efficient.

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(3 marks)

**Question 6 continues on the next page**

**Turn over ▶**



- 6 (e) For legal reasons, the bicycle has a maximum speed of  $6.6 \text{ ms}^{-1}$  (15 mph).  
The total mass of the man and the bicycle is 90 kg.  
Calculate the kinetic energy of the man and the bicycle when travelling at the maximum legal speed.  
State the correct unit in your answer.

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(4 marks)

14

**END OF QUESTIONS**

