

Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
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6	
7	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
June 2015

Applied Science

SC02

Unit 2 Energy Transfer Systems

Tuesday 12 May 2015 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.



J U N 1 5 S C 0 2 0 1

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

1 (a) (i) What does **aerobic respiration** mean?

[1 mark]

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1 (a) (ii) Write a balanced chemical equation for aerobic respiration.

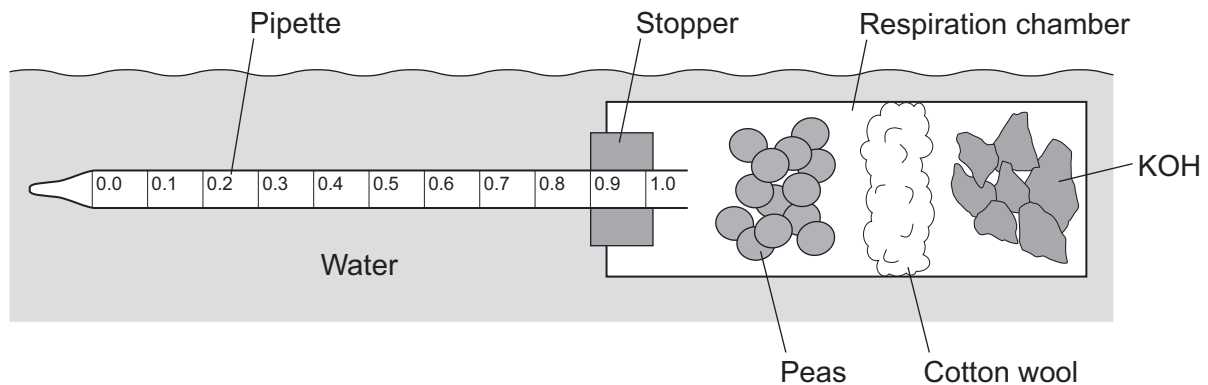
[2 marks]

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1 (b) A group of horticultural students designed a simple respirometer to measure the rate of aerobic respiration in peas. They decided to use a pipette and a respiration chamber as shown in **Figure 1**.

Figure 1



Before using the respirometer, the pipette was exposed to the air to allow it to reach equilibrium with the air in the respiration chamber. The pipette was then lowered into the water. The cotton wool prevented the peas from coming into contact with the potassium hydroxide (KOH). Potassium hydroxide absorbs carbon dioxide from the air.



1 (b) (i) State **two** measurements that could be made to determine the rate of aerobic respiration in the peas.

[2 marks]

Measurement 1

.....

Measurement 2

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1 (b) (ii) During the experiment water enters the pipette.

Explain why this happens.

[3 marks]

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1 (b) (iii) Explain how the students could use the measurements, obtained during the experiment, to determine the rate of respiration of the peas.

[2 marks]

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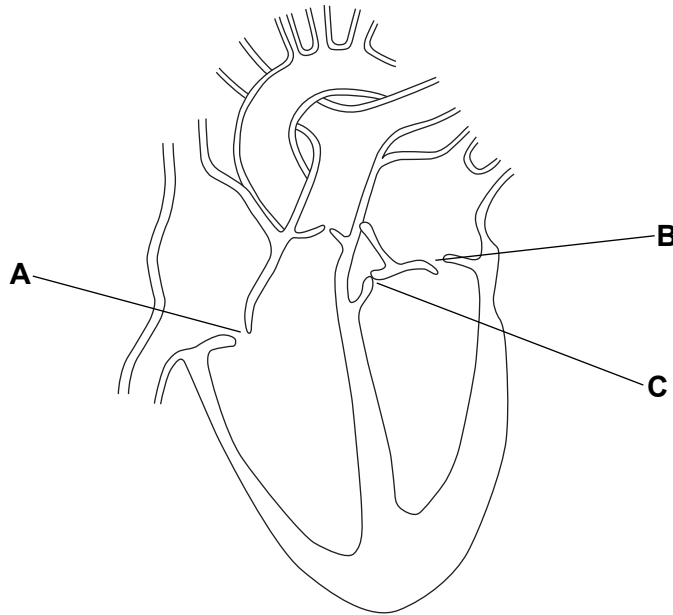
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- 2 (a) Figure 2 shows a diagram of the heart with three different valves labelled A, B and C.

Figure 2



In the box below write the letter, **A**, **B**, or **C**, that shows the position of a semilunar valve.

[1 mark]

- 2 (b) The valves in the heart help to maintain blood flow by preventing the back flow of blood.

Name the regions of the heart that blood would flow back into, during contraction of the ventricles, if the following valves were damaged:

[2 marks]

bicuspid valve

tricuspid valve



2 (c) (i) A woman has her cardiovascular fitness assessed before beginning a new exercise regime.

Describe how you would assess cardiovascular fitness, using heart rate as an indicator, and using only standard school or college equipment.

[4 marks]

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2 (c) (ii) The woman exercises regularly by jogging on the spot. This causes an increased demand for blood supply to the muscles.

Describe how the brain and nervous system cause the heart rate to increase to meet this demand.

[4 marks]

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2 (d) (i) What is the normal value of blood pressure for a healthy 40-year-old woman?

[1 mark]

..... mm Hg

2 (d) (ii) A blood pressure reading consists of two figures.

What name is used for the higher of these two figures?

[1 mark]

.....

2 (d) (iii) Everyone's blood pressure changes over a 24-hour period.

What might a healthy person be doing when their blood pressure is at its lowest?

[1 mark]

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2 (d) (iv) State **three** things that might cause a healthy person's blood pressure to rise.

[3 marks]

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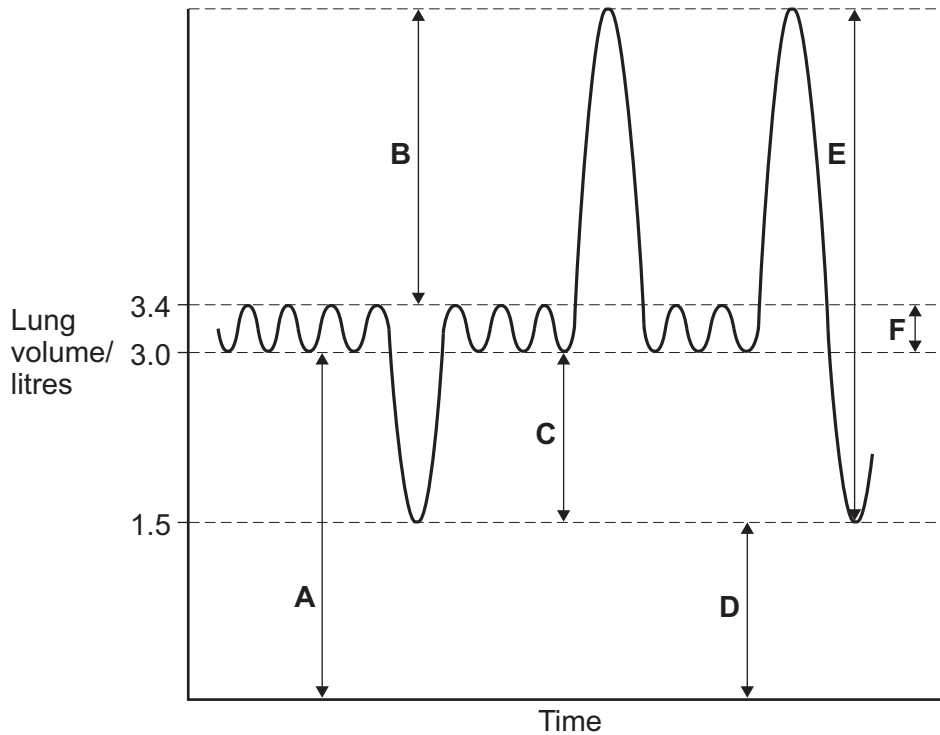
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- 3 (a)** A student, studying physiology, was learning how to interpret a spirometer trace. A spirometer is used to test lung function. The spirometer trace in **Figure 3** shows the main lung functions of a healthy person.

Figure 3



- 3 (a) (i)** What is meant by tidal volume?

[1 mark]

.....

- 3 (a) (ii)** Which letter on the spirometer trace in **Figure 3** shows tidal volume?

[1 mark]

.....

- 3 (a) (iii)** What is meant by vital capacity?

[1 mark]

.....



3 (a) (iv) Which letter on the spirometer trace in **Figure 3** shows vital capacity?

[1 mark]

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3 (b) (i) What is meant by inspiratory reserve volume?

[1 mark]

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3 (b) (ii) Which letter on the spirometer trace in **Figure 3** shows inspiratory reserve volume?

[1 mark]

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3 (b) (iii) Residual volume may be defined as ‘the volume of gases remaining in the alveoli after a person has breathed out as hard as they can.’

Which letter from the spirometer trace in **Figure 3** shows the residual volume?

[1 mark]

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3 (c) A pharmaceutical company manufactured a new asthma drug that they needed to test. This involves conducting clinical trials using human beings as subjects. Spirometer traces were obtained to form the basis for the clinical trials.

The company has to inform the subjects of any possible risks.

Give **two** pieces of information about the risks involved that the company should tell the subjects before the subjects agree to volunteer.

[2 marks]

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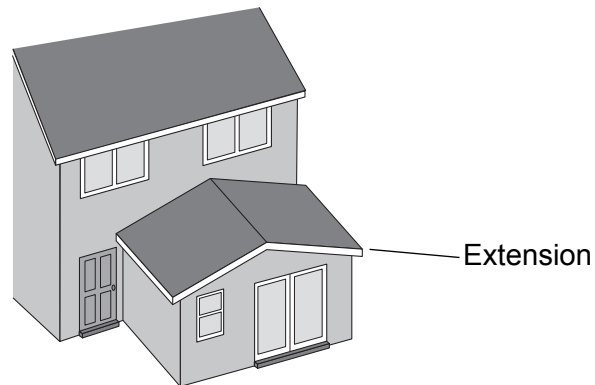
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- 4 A family want to build an extension at the back of their house.

Figure 4



The family want the extension to be energy efficient. Their architect showed them **Table 1** and **Table 2** which give the U -values of possible materials to be used in building the extension.

Table 1 U -values for the roof insulation material

Insulation thickness (mm)	U -value ($\text{W m}^{-2} \text{K}^{-1}$)
50	0.46
70	0.32
100	0.23

Table 2 U -values for the different parts of the extension

Part of extension	U -value ($\text{W m}^{-2} \text{K}^{-1}$)
Cavity wall	1.5
Foam-insulated wall	0.3
Double glazing	2.8



4 (a) Each side of the roof of the extension shown in **Figure 4** measures 3.5 m by 4.0 m. The average temperature inside the extension is estimated to be 20 °C.

Calculate the rate of heat loss through the roof when insulation of thickness 50 mm is fitted and the outside temperature is 5 °C.

Use **Table 1** and the following formula to help you answer the question.

Rate of heat loss = total surface area × *U*-value × temperature difference

[2 marks]

Rate of heat loss = W

4 (b) The family would like to have four roof windows in their extension to make the room as light as possible.

Would having four roof windows in their extension be energy efficient or would fewer roof windows be better? Use the information in **Table 1** and **Table 2** to explain your choice.

[1 mark]

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4 (c) **Table 2** shows that when foam insulation is placed in the cavity wall it reduces the *U*-value from 1.5 W m⁻² K⁻¹ to 0.3 W m⁻² K⁻¹.

Explain how the foam reduces heat losses by conduction and convection.

[2 marks]

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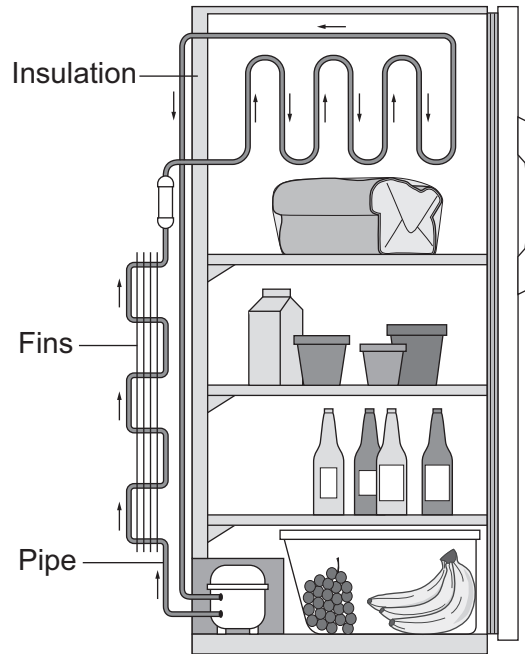
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4 (d) The family have bought an energy-efficient refrigerator.

Refrigerators keep food cool by transferring thermal energy from the food to the surroundings using a liquid called Freon, which passes through the pipes as shown by the arrows in **Figure 5**.

Figure 5



4 (d) (i) Why is the pipe at the back of the refrigerator painted black?

[1 mark]

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4 (d) (ii) Why does this pipe have fins attached as shown in **Figure 5**?

[1 mark]

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4 (e) What effect will the Freon passing through the pipe at the back of the refrigerator have on the air around the refrigerator?

[1 mark]

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4 (f) Why is there a layer of insulation between the inside wall and the outside wall of the refrigerator?

[1 mark]

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4 (g) Why is the outside surface of a refrigerator often coloured white?

[1 mark]

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10

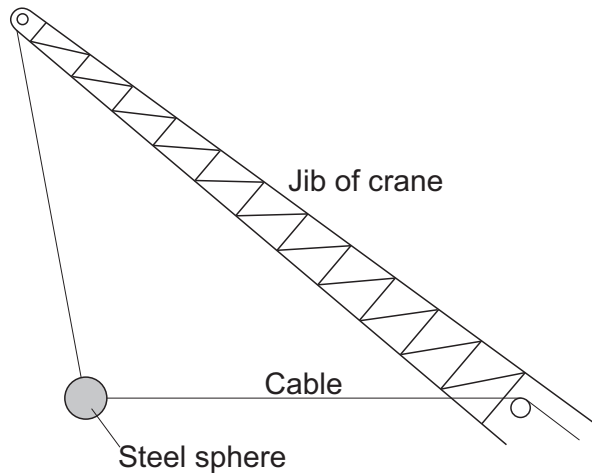
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- 5** A builder plans to knock down a house and garage using demolition equipment as shown in **Figure 6**.
A 1200 kg steel sphere is suspended by a cable and then released.

Figure 6



- 5 (a)** When the steel sphere is raised to its dropping position, its gravitational potential energy is increased by 10 800 J. The steel sphere is then released.
- 5 (a) (i)** Calculate the velocity of the steel sphere just before it smashes into the house and garage. State the unit in your answer.

[4 marks]

Velocity =

- 5 (a) (ii)** What assumption have you made in your calculation?

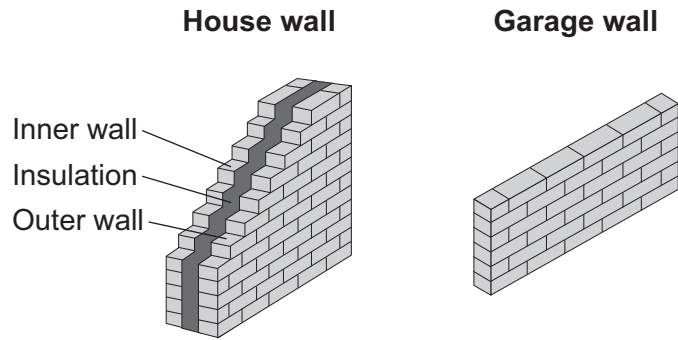
[1 mark]

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5 (b) The house wall and the garage wall are shown in **Figure 7**.

Figure 7



The steel sphere causes more damage to the garage wall than it does to the house wall.

Use your knowledge of momentum to explain this difference.

[3 marks]

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8

Turn over for the next question

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6 There are many alternative energy resources that can be used to generate electricity and reduce our dependence on fossil fuels.

A company manufactures wind turbines and solar cells. The company wants to be able to give its customers advice on which of these products best suits their needs.

6 (a) (i) State **one** advantage that is common both to solar cells and to wind turbines compared with using fossil fuels.

[1 mark]

.....
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6 (a) (ii) State **two** advantages and **one** disadvantage of using solar cells compared with wind turbines.

[3 marks]

Advantage 1.....
.....

Advantage 2.....
.....

Disadvantage.....
.....

6 (b) The company thinks that solar cells could be the most efficient form of electricity production if their process is developed further.

State what advantage solar cells have over **all** other forms of electricity generation, and explain why that might help solar cells to be more efficient than any other method.

[2 marks]

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6 (c) The company has developed several prototype solar cells and wants to conduct some tests to determine which of them is most effective at generating electricity.

6 (c) (i) Draw a diagram indicating what equipment should be used to do this experiment and how it should be arranged. Think carefully about the measurements that need to be taken and the equipment required to do this.

[3 marks]

6 (c) (ii) Name the **two** main variables in this experiment.

[2 marks]

Independent variable

Dependent variable.....

6 (c) (iii) How will the results be used to determine which type of solar cell is the most effective?

[1 mark]

.....
.....

6 (c) (iv) Give **two** precautions that could be taken to ensure the validity of the results.

[2 marks]

Precaution 1.....

.....

Precaution 2.....

.....

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Turn over ▶



7 (a) A climber weighing 750 N ascends a climbing wall. On average, he climbs 0.6 m upwards in one second.

7 (a) (i) Calculate the power output required to do this.

[3 marks]

Power = W

7 (a) (ii) State the useful energy change involved in the activity. Remember to include all the useful types of energy involved.

[2 marks]

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7 (a) (iii) The processes in the climber's muscles are 85% efficient.

Using your answer from part (a) (i), calculate the total power his muscles must transfer to give the useful output needed to ascend the wall at this speed.

[3 marks]

Total power = W



7 (a) (iv) Assuming that the wasted energy within the muscles is converted into heat, calculate the rate of heat production in the climber's muscles.

[1 mark]

Rate of heat production = W

7 (b) Give **three** reasons why the total rate of energy transfer in the muscles is actually much higher than the output calculated in part (a) (i).

[3 marks]

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- 2.....
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- 3.....
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END OF QUESTIONS



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