

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
January 2013

Applied Science

SC02

Unit 2 Energy Transfer Systems

Friday 11 January 2013 1.30 pm to 3.00 pm

<p>For this paper you must have:</p> <ul style="list-style-type: none"> • 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.

A



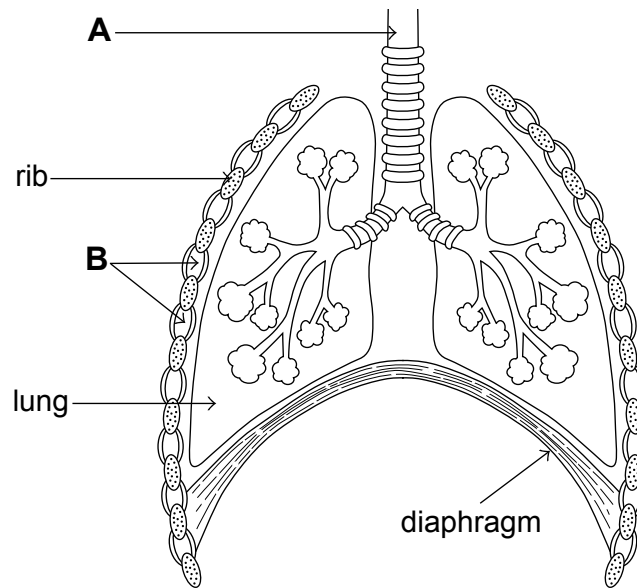
J A N 1 3 S C 0 2 0 1

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

1 As part of her training, a trainee at a sports centre learned how the respiratory system works.

1 (a) **Figure 1** shows the human respiratory system.

Figure 1



1 (a) (i) Complete **Table 1** with the name of the structures labelled **A** and **B** in **Figure 1**.

Table 1

Letter	Structure
A	
B	

(2 marks)



1 (a) (ii) Describe how air is expelled from the lungs during breathing.

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

(4 marks)

1 (b) State the **two** main functions of the respiratory system.

Function 1

Function 2

(2 marks)

1 (c) (i) Lung volumes, such as *tidal volume*, are measured to help decide if a person has a healthy respiratory system.

Define tidal volume.

.....
.....

(1 mark)

1 (c) (ii) What is the normal tidal volume for a healthy adult?

..... cm³
(1 mark)

Question 1 continues on the next page

Turn over ▶



- 1 (c) (iii) Tidal volume is affected by several factors.
These include the height and age of a person and whether or not they smoke.

Table 2 shows the tidal volume of a smoker when he was aged 25 and 55.

Table 2

	25 years old	55 years old
Tidal volume (cm ³)	450	340

Calculate the percentage fall in mean tidal volume between the ages of 25 and 55.

.....

Percentage fall =
(2 marks)

- 1 (d) **Table 3** shows average vital capacity measurements, in cubic decimetres, for men of different ages and heights.

Table 3

Height (cm)	Age (years)						
	20	30	40	50	60	70	80
130	2.7	2.6	2.4	2.2	2.0	1.8	1.5
140	3.1	3.0	2.8	2.6	2.3	2.1	1.8
149	3.6	3.4	3.2	2.9	2.7	2.4	2.0
156	3.9	3.7	3.5	3.2	2.9	2.6	2.2
163	4.8	4.1	3.8	3.5	3.2	2.9	2.5
173	4.8	4.6	4.3	4.0	3.6	3.2	2.8
182	5.3	5.1	4.8	4.4	4.0	3.7	3.1

Describe **two** trends that can be seen in the data in **Table 3**.

1.....

 2.....

(2 marks)



1 (e) (i) What is the normal range for the breathing rate of a healthy adult?

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

1 (e) (ii) The trainee ran for one mile. Explain why her breathing rate did not return to normal as soon as she had finished the run.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

19

Turn over for the next question

Turn over ▶



2 A group of people were staying in a hotel and decided to use the sauna.

2 (a) What is the normal core body temperature of a healthy adult?

..... °C
(1 mark)

2 (b) One person developed heat stroke while using the sauna.
At what core body temperature does heat stroke start to develop?

..... °C
(1 mark)

2 (c) Heat is produced by chemical reactions in the body.
Apart from heat lost from the surface of the skin, give **three** other ways in which heat is lost from the body.

- 1.....
.....
 - 2.....
.....
 - 3.....
.....
- (3 marks)

2 (d) How does the body maintain its core body temperature when exposed to very hot surroundings?

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

(4 marks)



- 2 (e)** One person became ill and developed a fever.
Above what core body temperature would he be considered to have a fever?

..... °C
(1 mark)

10

Turn over for the next question

Turn over ▶



3 A group of business colleagues are enrolled on an activities weekend to help encourage teamwork. The activities include hill climbing and swimming.

The medic at the activity centre checks the blood pressures of course members before they start the activities.

3 (a) (i) Name the equipment that the medic would use to measure blood pressure.

.....
(1 mark)

3 (a) (ii) What is the normal blood pressure for a healthy 40-year-old male?

..... mm Hg
(1 mark)

3 (b) During exercise, the level of oxygen in the blood starts to fall as more oxygen is needed by the muscles.

How would the man's body respond to the fall in oxygen levels in his blood?

.....
.....
.....
.....
.....
.....
(3 marks)



3 (c) Halfway through the weekend another colleague joins the group. The medic checks the cardiovascular fitness of the new colleague. Using heart rate as an indicator, describe how the medic would assess the cardiovascular fitness of the new colleague.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

11

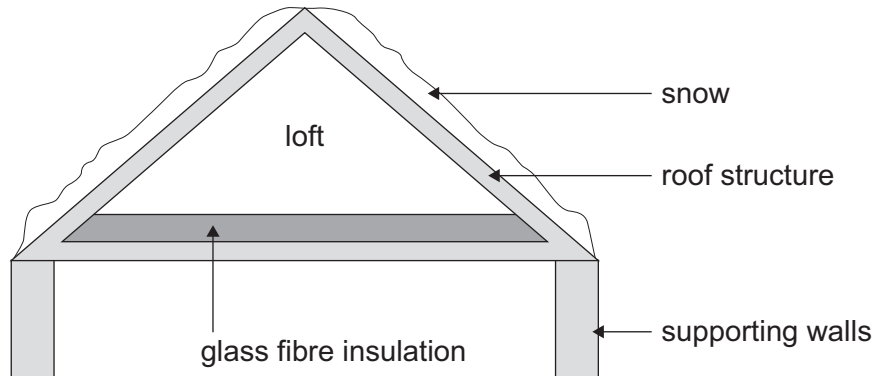
Turn over for the next question

Turn over ▶



- 4** An architect notices that snow melts on some houses later than it does on others. She knows that the snow melts more slowly if the heat energy from a house passes from the inside to the outside at a slower rate. Many houses have a layer of glass fibre insulation in their loft as shown in **Figure 2**.

Figure 2



- 4 (a)** How does glass fibre insulation reduce the rate of heat flow from the inside to the outside of the house?

.....

.....

.....

.....

.....

.....

(3 marks)

- 4 (b)** The architect is thinking about buying a house called The Old Rectory. She notices that the snow on its roof melts before that on any other nearby house. She is concerned that there may not be enough insulation in the loft of The Old Rectory. The owner claims that the Sun's rays are melting the snow.

Explain why the owner's statement is unlikely to be true.

.....

.....

.....

.....

(2 marks)



4 (c) The architect measures the insulation in the loft of The Old Rectory and finds that it is 50 mm thick. Current building regulations recommend fitting a layer of loft insulation 250 mm thick.

4 (c) (i) Explain why a layer of insulation 250 mm thick is better than one that is 50 mm thick.

.....
.....

(1 mark)

4 (c) (ii) Suggest **two** reasons why the building regulations do not require a layer 1000 mm thick.

1.....

.....

2.....

.....

(2 marks)

4 (d) The present owner of The Old Rectory heats the house using electric heaters. The architect is concerned that this is inefficient and that it uses fossil fuels. The present owner claims that his electric heating is highly efficient and that he does not burn any fossil fuels.

Comment on the claims made by the present owner.

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

(2 marks)

Question 4 continues on the next page

Turn over ▶



4 (e) (i) A different house is losing heat through its roof at a rate of 240 W.
The roof is flat, 8 m wide and 10 m long. The temperature inside the loft space is 6 °C,
and the outside temperature is 1 °C.

Use the equation:

$$\text{rate of heat loss} = \text{temperature difference} \times U\text{-value} \times \text{area of roof}$$

Calculate the *U*-value of the roof material.

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

U-value = $\text{Wm}^{-2}\text{K}^{-1}$
(2 marks)

4 (e) (ii) The roof of the house is covered with snow. The architect calculates that it would take
8.64 MJ (8.64×10^6 J) of heat to melt all the snow on the roof.
Heat is lost through the roof at a rate of 240 W.

How long will it take to melt all the snow on the roof?
Assume that no other energy is received by the snow.
Give the correct unit in your answer.

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

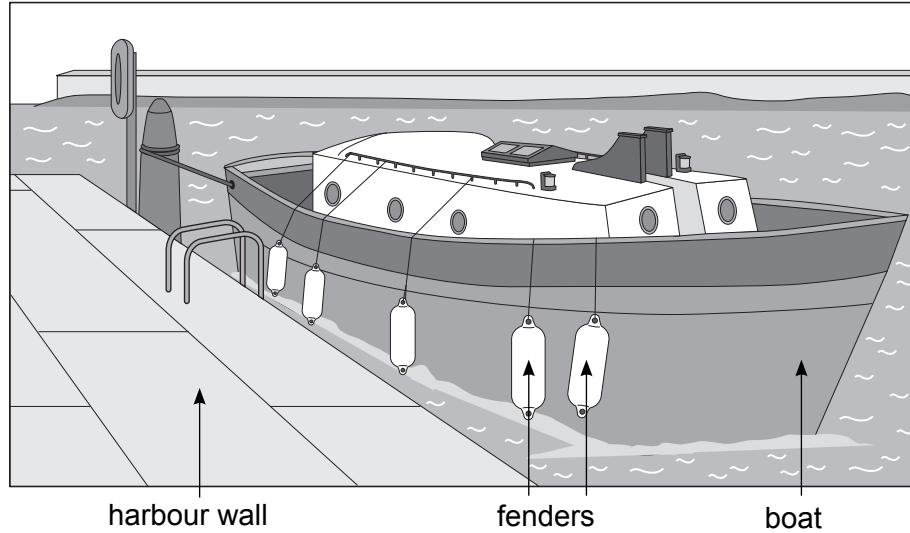
Time =
(2 marks)

14



- 5 A sailing instructor is buying some fenders for his boat. A fender is designed to prevent damage to the boat if it hits a harbour wall. Fenders compress slightly when they make contact with a hard object like a wall.

Figure 3



- 5 (a) Use ideas about momentum to explain how the fenders reduce the damage to the boat if it hits the wall.

.....

.....

.....

.....

.....

.....

(3 marks)

Question 5 continues on the next page

Turn over ►



5 (b) Small sailing boats can be propelled by wind or by an outboard motor. Outboard motors are small petrol engines.
State **two** advantages and **one** disadvantage of propelling a boat by wind rather than by an outboard motor.

Advantage 1.....

.....

Advantage 2.....

.....

Disadvantage.....

.....

(3 marks)

5 (c) When he is not sailing, the instructor likes to go ‘wild swimming’. This involves swimming in the sea or in natural lakes, and not in constructed swimming pools. He notices that deep water is usually warmer nearer the surface than it is lower down.

Explain why this is so.

.....

.....

.....

.....

(2 marks)

5 (d) The instructor decides to investigate how water temperature changes with depth. He anchors his boat over a patch of deep water and lowers an electronic thermometer on a rope.

He measures the temperature of the water at the surface and then at depths of 10 m, 20 m and 30 m below the surface.

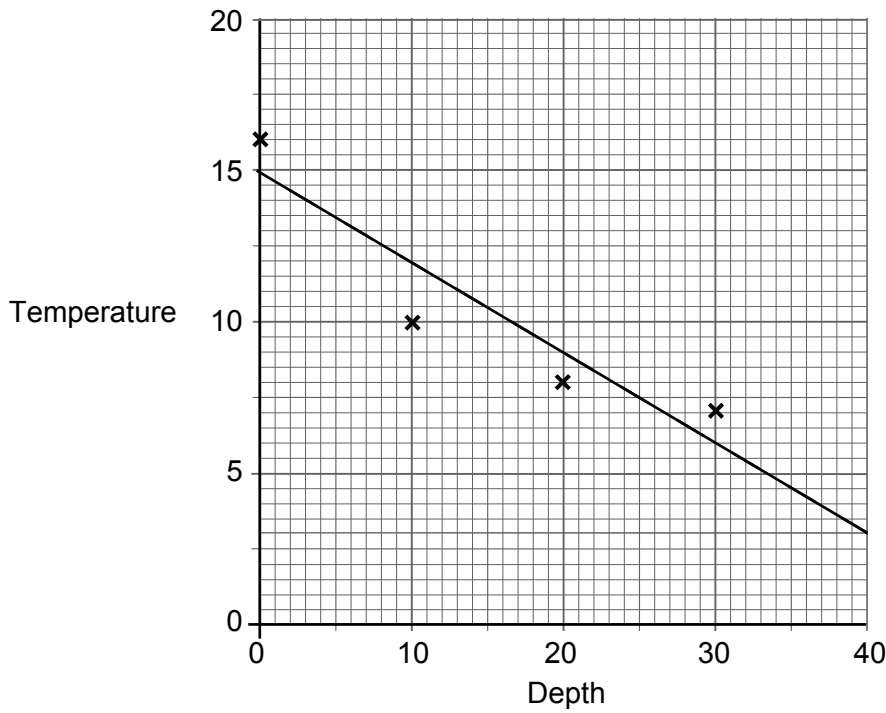
His results are shown in **Table 4** and the graph in **Figure 4**.

Table 4

Depth (m)	0	10	20	30
Temperature (°C)	16	10	8	7



Figure 4



5 (d) (i) State **two** different mistakes that you can see the instructor has made on the graph.

Mistake 1

Mistake 2

(2 marks)

5 (d) (ii) Suggest **three** changes he could make to improve his investigation.

Change 1

Change 2

Change 3

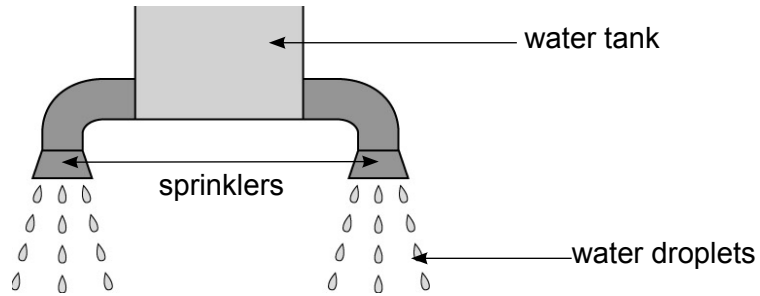
(3 marks)



6 A firework manufacturer has a sprinkler system in the area where the fireworks are made, as shown in **Figure 5**.

There is a water tank that holds 120 kg of water. If a flame detector triggers, the water from the tank is sprayed into the area.

Figure 5



The gravitational potential energy (GPE) stored in the tank is 15 000 J.

Assume that the acceleration due to gravity, $g = 10 \text{ m s}^{-2}$.

6 (a) How high above ground level would 120 kg of water have to be to have 15 000 J of GPE?

.....

.....

.....

..... m
(2 marks)

6 (b) (i) Assume that all the GPE from the water will be turned into kinetic energy (KE) when the water is sprayed on the fire.

At what speed would 120 kg of water have to be moving to have 15 000 J of KE?

.....

.....

.....

.....

.....

..... m s^{-1}
(3 marks)



6 (b) (ii) The actual speed of the water droplets from the sprinkler is much slower than your answer to part (b) (i) would suggest. What force has caused this?

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

(2 marks)

6 (c) An electric pump lifts water to refill the tank. The pump uses 50 000 J of energy to give 15 000 J of energy to the water in the tank. What is the efficiency of the pump?

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

(3 marks)

6 (d) The firework manufacturer had an electricity bill for last year as follows:

Average power used during the year = 2.1 kW
Total time that electricity was used = 8000 hours
Cost of supplying electricity = £1848.00

The manufacturer has been approached by a rival electricity supply company offering to sell electricity at a cost of 12 p per unit.

Use calculations to decide if the firework manufacturer should accept this offer.

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

(3 marks)

END OF QUESTIONS



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

