AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

# AS
# APPLIED SCIENCE

## Unit 2 Energy Transfer Systems

Wednesday 18 May 2016 Afternoon Time allowed: 1 hour 30 minutes

**Materials**
For this paper you must have:
- a pencil
- a ruler
- a calculator.

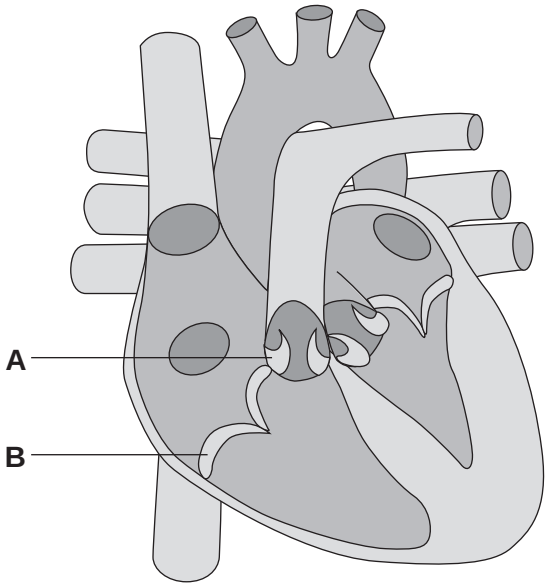
**Instructions**
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any 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)** **Figure 1** shows a cross section through a human heart.

**Figure 1**




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

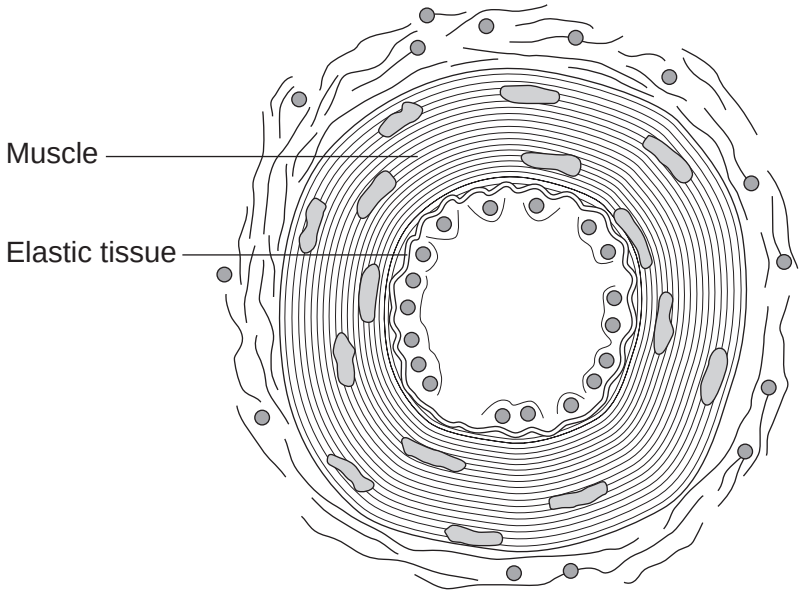
**[2 marks]**

**A** _____

**B** _____

**1 (b)** **Figure 2** shows a cross section through the wall of an artery.

**Figure 2**




**1 (b) (i)** Describe what **systole** means and how the tissues of the artery wall help to maintain blood pressure within the normal range during systole.

**[2 marks]**

_____

_____

_____

_____

**1 (b) (ii)** Describe what **diastole** means and how the tissues of the artery wall help to maintain blood pressure within the normal range during diastole.

**[2 marks]**

_____

_____

_____

_____

**Question 1 continues on the next page**

**1 (c)** A woman exercises regularly. When she exercises, her heart rate increases.

Describe how the brain and the nervous system cause the heart rate to increase during exercise.

**[3 marks]**

_____

_____

_____

_____

_____

_____

**1 (d)** A young man was worried because he tired very quickly when exercising.
He went to a doctor to have an electrocardiogram (ECG). The doctor compared the man's ECG trace with a normal ECG trace.

**1 (d) (i)** What is the function of an ECG?

**[1 mark]**

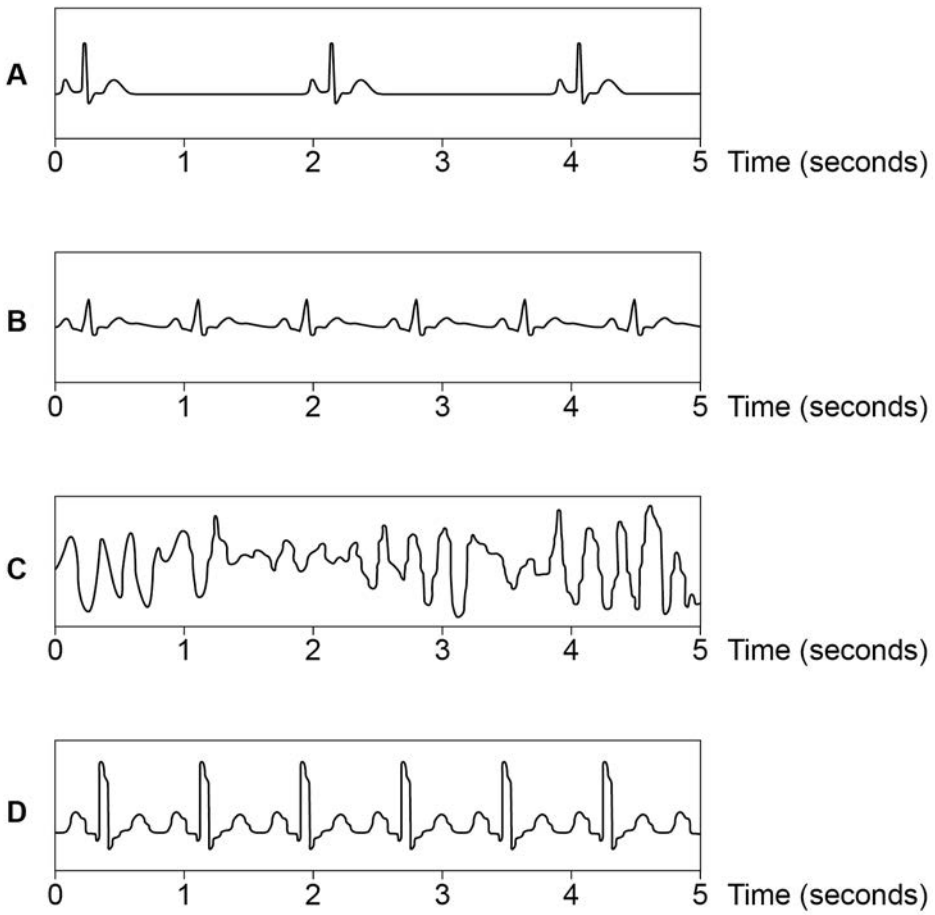
_____

_____

**1 (d) (ii)** The ECG revealed that the man had tachycardia.

Which ECG trace, **A**, **B**, **C** or **D**, in **Figure 3** shows evidence of tachycardia?

**Figure 3**




Write the correct letter in the box.

**[1 mark]**

Trace ☐

11

**Turn over for the next question**

**2** Healthcare professionals use imaging methods to diagnose illness and to monitor the health of patients.

**2 (a) (i)** State **two** advantages and **one** disadvantage of using X-rays compared with using magnetic resonance imaging.

**[3 marks]**

Advantage 1 _____

_____

Advantage 2 _____

_____

Disadvantage _____

_____

**2 (a) (ii)** State **two** advantages and **one** disadvantage of using ultrasound compared with using X-rays.

**[3 marks]**

Advantage 1 _____

_____

Advantage 2 _____

_____

Disadvantage _____

_____

**2 (b)** Radioactive tracers are used to diagnose medical conditions inside the body.

**2 (b) (i)** State **two** reasons for using radioactive tracers to diagnose a medical condition.

**[2 marks]**

1_____

_____

2_____

_____

**2 (b) (ii)** State **one** possible problem with using radioactive tracers to diagnose a medical condition.

**[1 mark]**

_____

_____

**2 (c)** One quarter of all liver transplants in the UK are given to people who drink too much alcohol.

A 50-year-old man needed a liver transplant. A doctor told the man that he must stop drinking alcohol for six months before he could have a liver transplant.

**2 (c) (i)** Give **two** reasons why the doctor could be right to say that the man must stop drinking alcohol for six months.

**[2 marks]**

1_____

_____

2_____

_____

**2 (c) (ii)** Give **two** reasons why the doctor could be wrong to say that the man must stop drinking alcohol for six months.

**[2 marks]**

1_____

_____

2_____

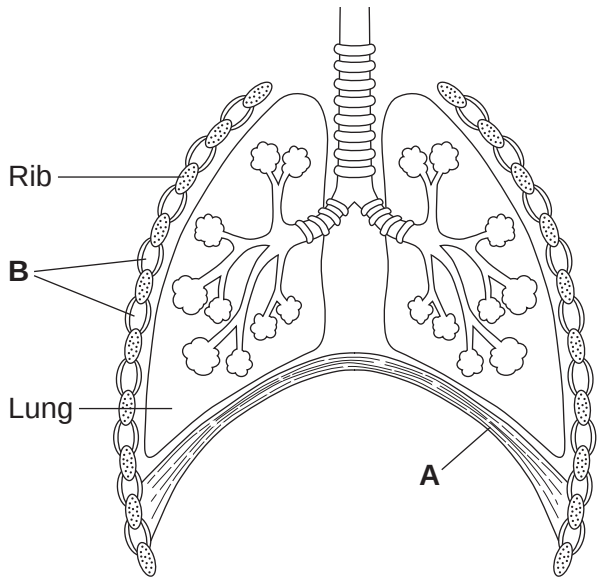
_____

13

**Turn over for the next question**

**3 (a)** A medical student learned how the human respiratory system works.
The human respiratory system is shown in **Figure 4**.

**Figure 4**



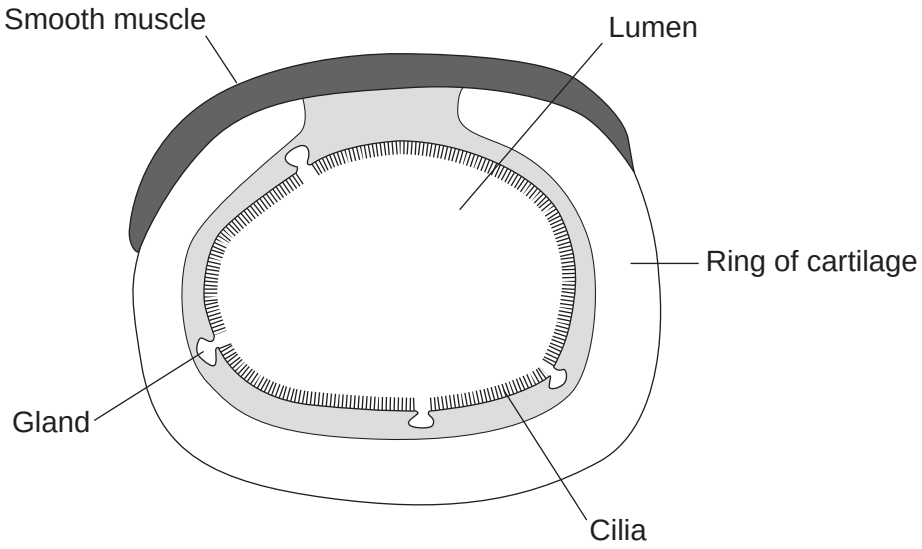

Complete **Table 1** by writing the names of the structures labelled **A** and **B** in **Figure 4**.
**[2 marks]**

**Table 1**

| | **Name of structure** |
|---|---|
| **A** | |
| **B** | |

**3 (b)** Air travels into and out of the lungs through the trachea.
**Figure 5** shows a cross section through the trachea.

**Figure 5**




**3 (b) (i)** State the function of the gland shown in **Figure 5** and why it is important.

**[2 marks]**

Function_____

_____

Importance_____

_____

**3 (b) (ii)** State the function of the cilia shown in **Figure 5** and why they are important.

**[2 marks]**

Function_____

_____

Importance_____

_____

**Question 3 continues on the next page**

**3 (c)** Four men planned to climb a mountain in Scotland. Before climbing the mountain, the men decided to assess their fitness.

Their cardiovascular fitness was tested. The test results are shown in **Table 2**.

**Table 2**

| Man | Pulse rate before exercise (beats per minute) | Pulse rate immediately after exercise has finished (beats per minute) | Pulse rate 3 minutes after exercise has finished (beats per minute) |
|---|---|---|---|
| **A** | 85 | 120 | 90 |
| **B** | 76 | 95 | 76 |
| **C** | 97 | 156 | 133 |
| **D** | 82 | 133 | 120 |

Two more tests were done to determine the peak expiratory flow rate and blood pressure for each man in the group. The results are shown in **Table 3**.

**Table 3**

| Man | Peak expiratory flow rate ($dm^3\ min^{-1}$) | Blood pressure (mmHg) |
|---|---|---|
| **A** | 500 | 137 / 90 |
| **B** | 540 | 115 / 75 |
| **C** | 350 | 175 / 100 |
| **D** | 400 | 126 / 98 |

State which man, **A**, **B**, **C** or **D**, is the fittest. Use information from **Table 2** and **Table 3** to explain your answer.

**[4 marks]**

Fittest man _____

Explanation _____

_____

_____

_____

_____

_____

10

**Turn over for the next question**

**4** A zip wire ride is made from a pulley suspended from a cable. The cable is connected to two platforms. The ride uses the force of gravity so that riders travel from the top to the bottom, as shown in **Figure 6**.

**Figure 6**

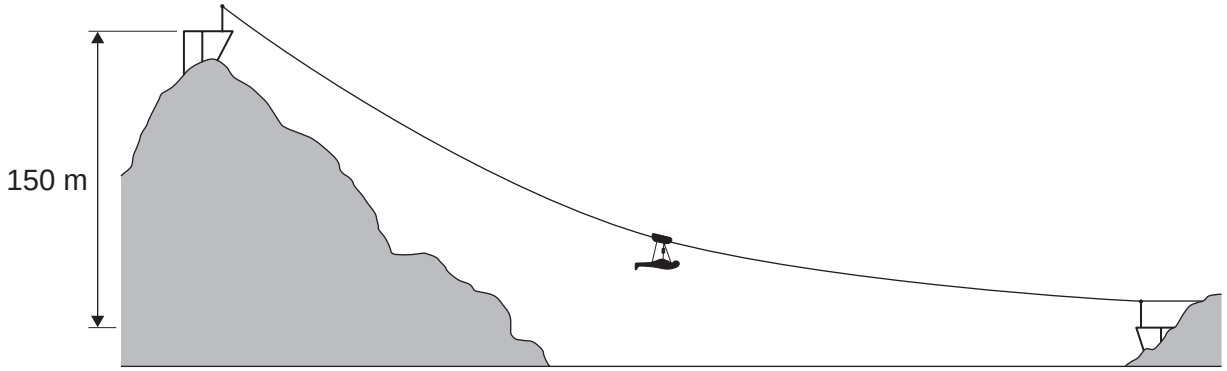



Diagram not to scale

**4 (a) (i)** A rider travels from the top platform to the end of the ride. The rider has a mass of 76 kg and he falls through a height of 150 m.

Calculate the change in gravitational potential energy of the rider as he travels from the top to the bottom of the zip wire ride. Assume $g = 10\ m\,s^{-2}$.

**[2 marks]**

Change in gravitational potential energy = _____ J

**4 (a) (ii)** The zip wire ride lasts for exactly 1 minute.

Calculate the average power generated during the ride.
State the correct unit in your answer.

**[2 marks]**

Average power = _____

**4 (a) (iii)** As the rider approaches the lowest point of the zip wire ride, his kinetic energy is 46 000 J.

Calculate the percentage efficiency of the zip wire ride.

**[2 marks]**

Percentage efficiency = _____%

**4 (a) (iv)** The efficiency of the zip wire ride is **not** 100%.

Name **one** way in which energy is wasted during the zip wire ride and explain why this happens.

**[2 marks]**

_____

_____

_____

_____

**4 (b)** The owners of the zip wire ride are considering installing a power fan.
A power fan uses the energy transferred during braking to generate electricity. The owners can then use the electricity generated.

Give **two** advantages of installing a power fan.

**[2 marks]**

1_____

_____

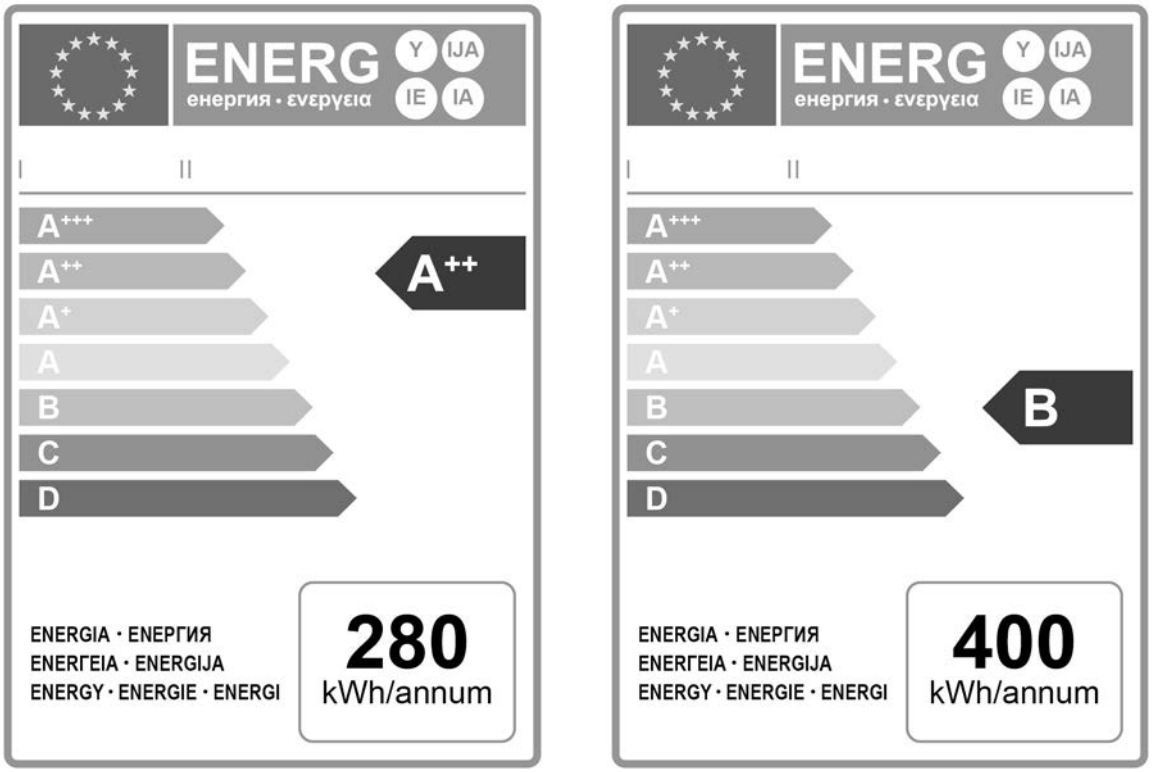
2_____

_____

**10**

**5** **Figure 7** shows the energy rating labels for two different fridge-freezers.

**Figure 7**




**5 (a)** An A$^{++}$-rated fridge-freezer has less impact on the environment than a B-rated fridge-freezer.

State and explain **one** other reason why an A$^{++}$-rated fridge-freezer is better than a B-rated fridge-freezer.

**[2 marks]**

_____

_____

_____

_____

**5 (b)** The power of another fridge-freezer is 0.15 kW and the electricity it uses costs 16p per unit.

How much would it cost to use this fridge-freezer for 100 hours?

**[2 marks]**

_____

_____

_____

Cost = £_____

**5 (c)** Explain why the fridge-freezer may not run effectively when the room temperature is high.

**[3 marks]**

_____

_____

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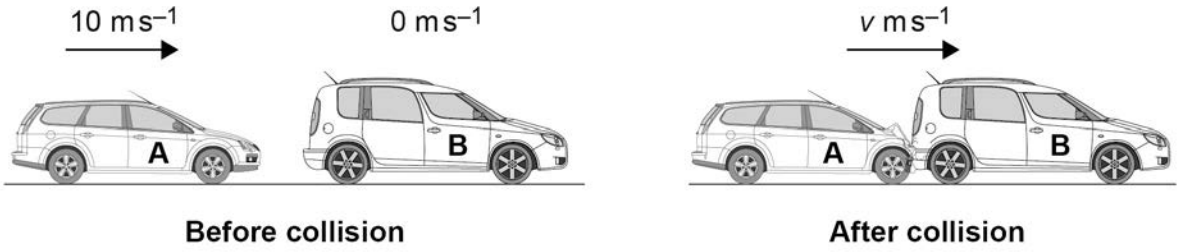
7

**Turn over for the next question**

**6** **Figure 8** shows car **A** of mass 400 kg travelling at a velocity of 10 m s$^{-1}$.
Car **A** collides with car **B**. Car **B** has a mass of 500 kg and is initially stationary.

**Figure 8**




**6 (a) (i)** Calculate the kinetic energy of car **A** before the collision.

**[2 marks]**

Kinetic energy = _____ J

**6 (a) (ii)** Calculate the total kinetic energy of car **A** and car **B** before the collision.

**[1 mark]**

Total kinetic energy = _____ J

**6 (a) (iii)** Calculate the momentum of each car before the collision.

Use the equation:
momentum = mass × velocity

**[2 marks]**

Momentum of car **A** = _____ kg m s$^{-1}$

Momentum of car **B** = _____ kg m s$^{-1}$

**6 (a) (iv)** **Figure 8** also shows that the two cars become stuck together during the collision.

Calculate the velocity *v* of the two cars after the collision.

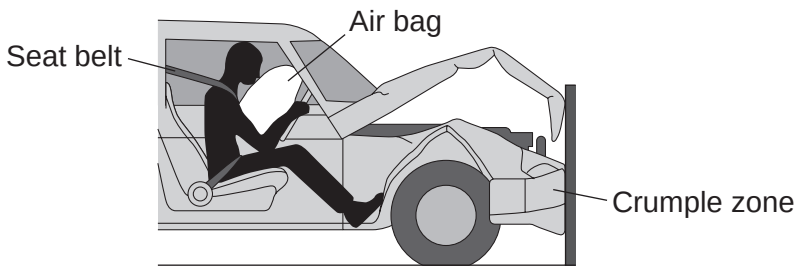
Use the law of conservation of momentum to help you:
total momentum before a collision = total momentum after the collision.

**[1 mark]**

Velocity = _____ $m\,s^{-1}$

**6 (b)** **Figure 9** shows a car during a road traffic accident.

**Figure 9**




Choose **one** of the safety features shown in **Figure 9** and explain how it protects the driver in the event of an accident.

**[4 marks]**

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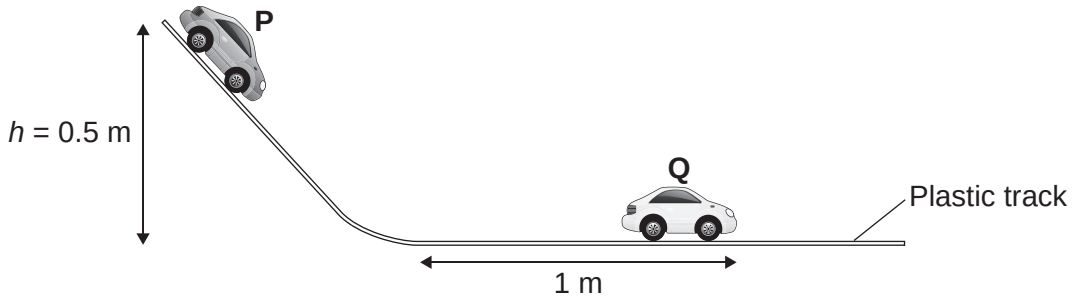
**Question 6 continues on the next page**

**Turn over ▶**

**6 (c)** A student uses the equipment shown in **Figure 10** to calculate the combined momentum of two toy cars, **P** and **Q**, after they collide.

**Figure 10**




When released, car **P** rolls down the plastic track, then collides with car **Q**, which is stationary. The cars join together after the collision and move forward.

The student uses a 15 cm ruler to measure *h*. She uses kitchen scales to measure the masses of car **P** and car **Q**.

State **three** improvements that could be made to the investigation.

**[3 marks]**

1 _____

_____

2 _____

_____

3 _____

_____

13

**7** Athletes running in long-distance races can generate an excess of body heat as a result of the energy transferred in respiration.

**7 (a) (i)** Which part of the body monitors an athlete's core temperature?

**[1 mark]**

_____

_____

**7 (a) (ii)** Describe **one** mechanism by which the body can lose excess heat energy to ensure the core body temperature does not rise too high.

**[2 marks]**

_____

_____

_____

_____

**7 (a) (iii)** Explain why it is important that core body temperature does not rise too high.

**[2 marks]**

_____

_____

_____

_____

**7 (b)** An athlete running a long-distance race in humid conditions is more at risk of heat exhaustion than when running in a dry climate, even if the temperatures are the same.

Explain why.

**[2 marks]**

_____

_____

_____

_____

**Question 7 continues on the next page**

**7 (c)** At the end of a long-distance race, athletes are given a thin silver-coloured foil blanket to stop them from cooling down too quickly.

Which heat-loss mechanism is the silver-coloured foil blanket designed to reduce? Explain your answer.

**[2 marks]**

_____

_____

_____

_____

**7 (d)** An athletics association wants to determine whether or not it can improve the blanket used to keep athletes warm. Their research department does an experiment to test different materials to find which material would be most effective to use.

Three containers are filled with hot water.

- Container 1 is wrapped in a single layer of silver-coloured foil.
- Container 2 is wrapped in a single layer of thin white cotton.
- Container 3 is left unwrapped.

**7 (d) (i)** Why is container 3 left unwrapped?

**[1 mark]**

_____

_____

**7 (d) (ii)** Suggest **two** other pieces of equipment that would be needed to do this experiment.

**[2 marks]**

_____

_____

_____

_____

**7 (d) (iii)** State **three** variables that should be controlled to make the results valid.

**[3 marks]**

1 _____

_____

2 _____

_____

3 _____

_____

**7 (d) (iv)** How would you identify the most effective material for the blanket from this experiment?

**[1 mark]**

_____

_____

**16**

**END OF QUESTIONS**

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