AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.2

Work done and energy transfer

Past-paper questions

Tier	**Higher**
Question groups	**5**
Available paper years	**2021–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

6.5.2 Work done and energy transfer

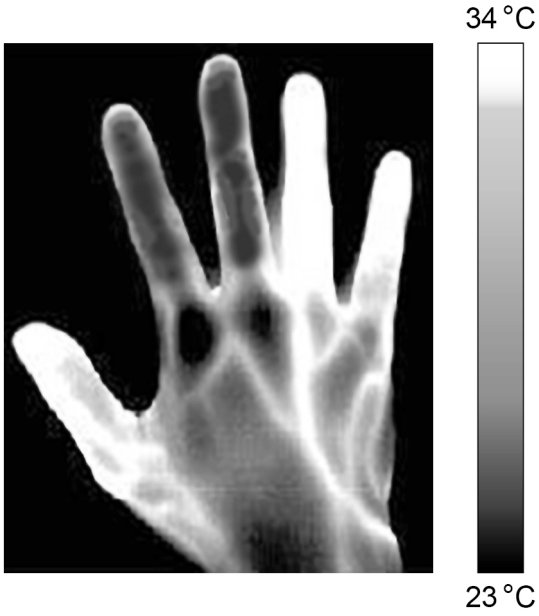
Question 01

November 2021 | 8464/P/2H | Original Q5

0 5 Different parts of the electromagnetic spectrum are used in medical imaging.

Figure 8 shows an image of a person's hand taken with an infrared camera.

Figure 8



0 5 . 1 Explain why the infrared camera is able to show that parts of the hand are at different temperatures.

[2 marks]

Question 5 continues on the next page

6.5.2 Work done and energy transfer

Question 01 · continued

0 5 . 2 Infrared has a range of wavelengths from 700 nm to 1 mm.

Which part of the electromagnetic spectrum would have waves with a wavelength of 6.5×10^{-7} m?

[1 mark]

Tick (✓) **one** box.

- Infrared ☐
- Microwaves ☐
- Radio waves ☐
- Visible light ☐

Question 01 · continued

0 5 . 3 **Figure 9** shows X-rays and gamma rays being used for medical imaging.

Figure 9

X-rays **Gamma rays**





To use X-rays for medical imaging, a machine produces a very brief burst of X-rays.

To use gamma rays for medical imaging, a radioactive isotope is injected into the patient's blood. The isotope is circulated around the body in the blood. The isotope emits gamma rays.

Compare the potential risks to a patient of using X-rays and gamma rays for medical imaging.

[4 marks]

Question 5 continues on the next page

Question 01 · continued

X-rays are produced by colliding high-energy electrons into a metal target.

The electrons have high energy because they are accelerated to high speeds.

Only a small proportion of the kinetic energy of an electron is converted into an X-ray when it collides with the metal target.

0 5 . 4 An electron is accelerated through a distance of 15 mm.

The work done on the electron is 1.2×10^{-13} J.

Calculate the force on the electron.

[3 marks]

Force = _____ N

0 5 . 5 The metal target is made from tungsten.

Tungsten has the highest melting point of any metal.

Explain why using tungsten as the metal target enables the X-ray machine to be more powerful.

[3 marks]

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6.5.2 Work done and energy transfer

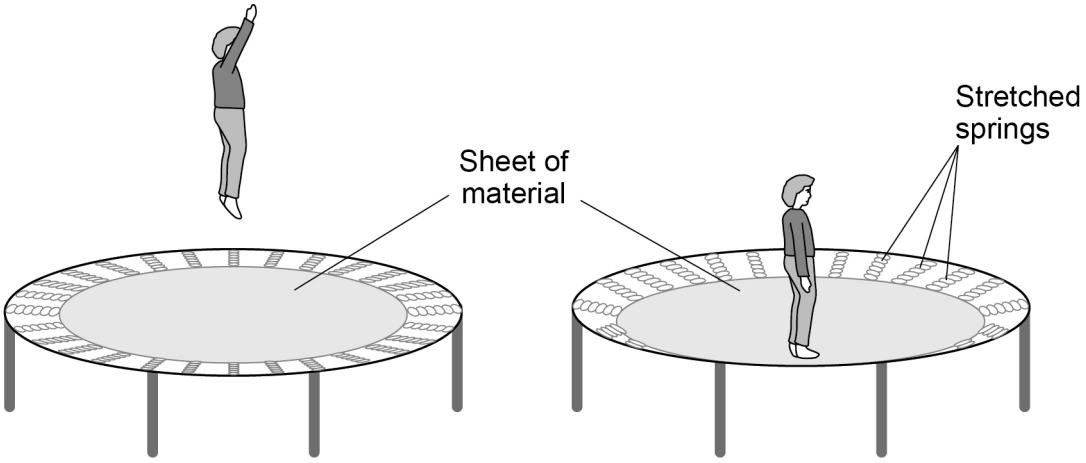
Question 02

June 2022 | 8464/P/1H | Original Q3

0 3 A trampoline is made from a sheet of material held in place by stretched springs.

Figure 5 shows a child on a trampoline.

Figure 5



6.5.2 Work done and energy transfer

Question 02 · continued

0 3 . 1 Position **A** shows the child's maximum height above the trampoline.

Position **B** shows the lowest position reached by the child when landing on the trampoline.

Describe the changes to the stores of energy of the:

- child
- springs
- surroundings

as the child moves from position **A** to position **B**.

[4 marks]

Child _____

Springs _____

Surroundings _____

Question 3 continues on the next page

Question 02 · continued

0 3 . 2 When the child is at position **A**, each trampoline spring is stretched by 0.056 m

The elastic potential energy of each spring is 4.9 J

When the child is at position **B**, the elastic potential energy of each spring increases to 8.1 J

Calculate the extension of each spring when the child is at position **B**.

Use the Physics Equations Sheet.

[5 marks]

Extension = _____ m

0 3 . 3 As the child bounces on the trampoline the child does work.

What is the work done by the child equal to?

[1 mark]

Tick (✓) **one** box.

- The average force applied by the child ☐
- The maximum force applied by the child ☐
- The total energy store of the child ☐
- The total energy transferred by the child ☐

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6.5.2 Work done and energy transfer

Question 03

0 2 **Figure 3** shows competitors in the wheelchair race at the London Marathon.

The distance of the London Marathon is 42 000 m

Figure 3



6.5.2 Work done and energy transfer

Question 03 · continued

Use the Physics Equations Sheet to answer questions **02.1** and **02.2**.

0 2 . 1 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 2 . 2 During the race competitors work against air resistance.

The work done against air resistance by the winner of the race was 3 360 000 J

Calculate the average air resistance acting on the winner of the race.

[3 marks]

Average air resistance = _____ N

Question 2 continues on the next page

Use the Physics Equations Sheet to answer questions **02.3** and **02.4**.

0 2 . 3 Which equation links distance travelled, speed and time?

[1 mark]

Tick (✓) **one** box.

distance travelled = speed × time ☐

time = distance travelled × speed ☐

speed = distance travelled × time ☐

0 2 . 4 The distance of the London Marathon is 42 000 m

The winning time for the race was 5600 seconds.

Calculate the average speed of the winner of the race.

[3 marks]

Average speed = _____ m/s

6.5.2 Work done and energy transfer

Question 03 · continued

0 2 . 5 Explain why the speed of a competitor changes during the race.

[4 marks]

12

Turn over for the next question

6.5.2 Work done and energy transfer

Question 04

June 2024 | 8464/P/1H | Original Q1

0 1 **Figure 1** shows an electric whisk that plugs into the mains electricity supply.

The whisk can mix food by spinning a beater.

Figure 1



0 1 . 1 Give **two** energy stores that increase when the whisk is switched on.

[2 marks]

1 _____

_____

2 _____

_____

6.5.2 Work done and energy transfer

Question 04 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Work is done by the whisk when it is used to mix food.

Write down the equation that links power (*P*), time (*t*) and work done (*W*).

[1 mark]

0 1 . 3 The power output of the whisk is 92 W.

Calculate the time for the whisk to do 23 000 J of work.

[3 marks]

Time = _____ s

Question 1 continues on the next page

Question 04 · continued

Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R^2}$ ☐

$P = I R^2$ ☐

$P = \frac{I^2}{R}$ ☐

$P = I^2 R$ ☐

0 1 . 5 The current in the whisk is 500 mA.

The resistance of the whisk is 640 Ω.

Calculate the power of the whisk.

[3 marks]

Power = _____ W

6.5.2 Work done and energy transfer

Question 04 · continued

The whisk has several settings that allow the beater to spin at different speeds.

A faster beater speed needs a greater power input from the mains electricity supply.

0 1 . 6 What is the potential difference between the live wire and neutral wire in the mains electricity supply?

[1 mark]

_____ V

0 1 . 7 Changing the beater speed does **not** change the potential difference between the live wire and neutral wire.

The power input to the whisk changes because the current in the whisk changes.

Complete the sentence.

[1 mark]

When the beater speed increases, the current in the whisk increases because the resistance of the whisk _____.

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6.5.2 Work done and energy transfer

Question 05

0 6 A triathlon race consists of swimming, cycling and running.

0 6 . 1 One athlete in a triathlon swims at a speed of 1.5 m/s.

How does the athlete's swimming speed compare with the typical speed of a person walking?

[1 mark]

Tick (✓) **one** box.

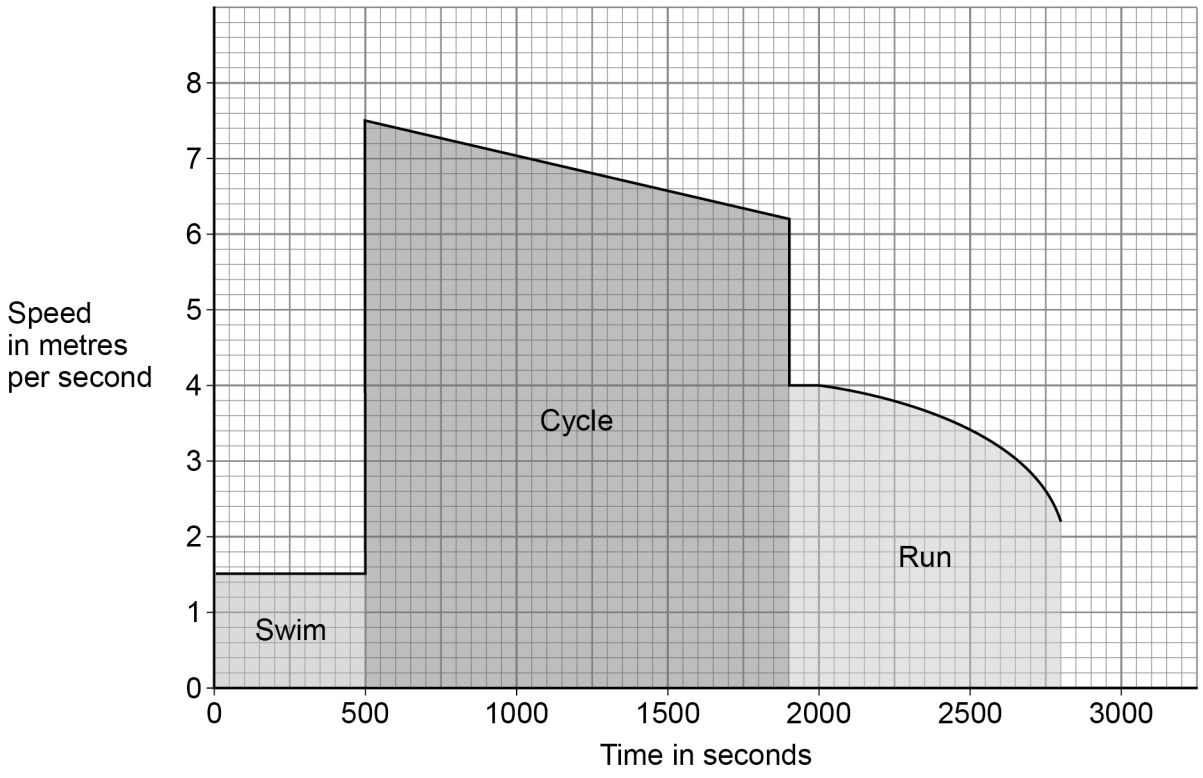
athlete's swimming speed > typical walking speed ☐

athlete's swimming speed = typical walking speed ☐

athlete's swimming speed < typical walking speed ☐

Figure 8 shows a speed–time graph for the athlete for the whole triathlon.

Figure 8



0 6 . 2 The cycling part of the race was on a straight road.

The work done by the forward force on the bicycle was 110 000 J.

Determine the mean forward force on the bicycle.

Use the Physics Equations Sheet.

[6 marks]

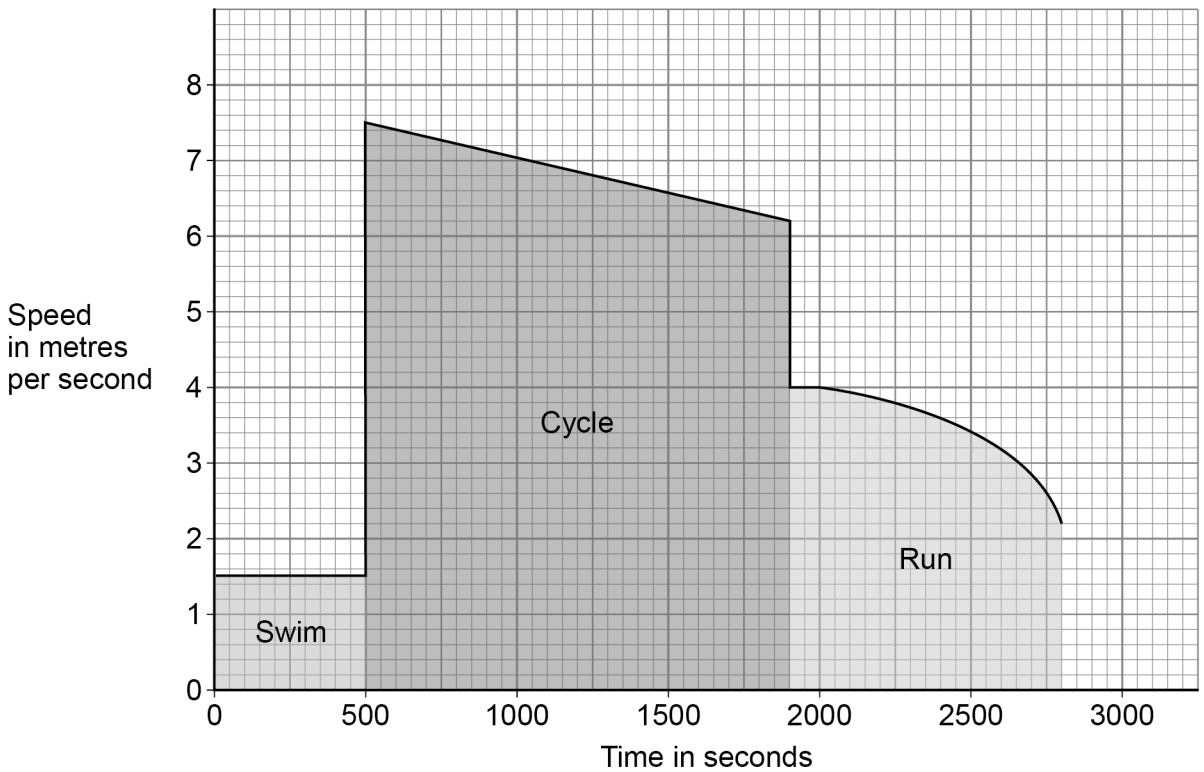
Mean forward force = _____ N

Question 6 continues on the next page

Question 05 · continued

Figure 8 is repeated below.

Figure 8



0 6 . 3 The first part of the **run** was on a circular track.

The time taken for the athlete to run round the track was 100 s.

Describe the velocity of the athlete during the first 100 s of the **run**.

Use **Figure 8**.

[2 marks]

6.5.2 Work done and energy transfer

Question 05 · continued

0 6 . 4 After running round the track once, the rest of the run was on a straight, horizontal road.

Explain how **Figure 8** shows that the magnitude of the deceleration of the athlete increased.

[2 marks]

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