Paper Reference(s) 1SC0/1PH
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Combined Science

PAPER 3
Higher Tier

Total Marks

Thursday 25 May 2023 – Morning

Time: 1 hour 10 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

Pearson

YOU MUST HAVE

Calculator, ruler, Equation Booklet (enclosed)

YOU WILL BE GIVEN

Diagram Booklet
Formulae Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

INFORMATION

The total mark for this paper is 60.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

A list of equations is provided as a separate booklet.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) Which of these is a scalar quantity?
(1 mark)

- ☐ **A** acceleration
- ☐ **B** distance
- ☐ **C** force
- ☐ **D** weight

(continued on the next page)

1 continued.

(b) A student has some cupcake cases.

Look at the diagrams for Question 1(b) in the Diagram Booklet. One cupcake case is shown in Figure 1.

The student drops a stack of cupcake cases with the base facing downwards, as shown in Figure 2.

The speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.

(i) The student also has a stop clock and a metre rule.

Describe an investigation to show how the speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.
(4 marks)

Answer space continues on the next page.

1(b)(i) continued.

(continued on the next page)

1(b) continued.

(ii) A stack of cupcake cases has a mass of 0·005 kg.

Calculate the weight, in newtons, of the stack of cupcake cases.

Gravitational field strength = 10 N / kg
(2 marks)

Use the equation

W = mg

weight = _____ N

(continued on the next page)

1(b) continued.

Look at Figure 3 for Question 1(b)(iii) in the Diagram Booklet. It shows a cupcake case that is falling at a constant velocity.

(iii) Draw an arrow on Figure 3 to show the force due to air resistance on the cupcake case.
(1 mark)

(iv) State the value of the acceleration of the cupcake case when it is falling at a constant velocity.
(1 mark)

_____

_____

(Total for Question 1 = 9 marks)

2 (a) Look at Figure 4 for Question 2(a) in the Diagram Booklet. It shows a football kicked against a wall.

The football has a mass of 0·42 kg.

(i) The football gains 11 J of gravitational potential energy as it moves from the ground to the wall.

Calculate the height at which the ball hits the wall.
(3 marks)

Gravitational field strength = 10 N / kg

Use the equation

$\Delta GPE = m \times g \times \Delta h$

height = _____ m

(continued on the next page)

2(a) continued.

(ii) Calculate the kinetic energy of the football when it is moving at a velocity of 12 m/s. (2 marks)

Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

kinetic energy = _____ J

(continued on the next page)

2(a) continued.

(iii) Describe the energy transfers that happen when the ball hits the wall.
(2 marks)

(continued on the next page)

2 continued.

(b) A stone is held at rest above the ground.

The stone is released and falls until its velocity is 17 m/s.

Calculate the distance the stone has fallen when its velocity has reached 17 m/s.
(2 marks)

distance = _____ m

(Total for Question 2 = 9 marks)

3 Look at Figure 5 for Question 3 in the Diagram Booklet. It shows a velocity / time graph for a lift moving upwards in a tall building.

(a) For what length of time is the lift at rest during the first 16 s?
(1 mark)

☐ A 1·4 s

☐ B 3·0 s

☐ C 3·6 s

☐ D 4·0 s

(continued on the next page)

3 continued.

(b) Use the graph in Figure 5 to determine the maximum velocity of the lift during the first 16 s. (1 mark)

maximum velocity = _____ m/s

(c) Use the graph in Figure 5 to determine the acceleration of the lift during the first 1·4 s. (3 marks)

acceleration = _____ m/s^2

(continued on the next page)

3 continued.

(d) Use the graph in Figure 5 to determine the distance that the lift travelled during the first 6·0 s.
(3 marks)

distance = _____ m

(e) At 18 s, the lift starts to move downwards.

Sketch a line on Figure 5 in the Diagram Booklet to show the lift moving downwards after 18 s.
(1 mark)

(Total for Question 3 = 9 marks)

4 (a) Look at Figure 6 for Question 4(a) in the Diagram Booklet. It shows two technicians, L and M, measuring the speed of sound in air.

L fires a starting pistol.

M starts a stopwatch when first seeing the smoke from the starting pistol.

M stops the stopwatch when hearing the bang made by the starting pistol.

The distance between L and M is 120 m.

M's reaction time is 0·23 s.

The speed of sound in air is 330 m/s.

(continued on the next page)

4(a) continued.

(i) Calculate M's reaction time as a percentage of the time sound takes to travel from L to M. (3 marks)

_____ %

(continued on the next page)

4(a) continued.

(ii) Which of these would improve the technicians' measurement of the speed of sound?
(1 mark)

☐ A Use a firework 'banger' instead of the starting pistol.

☐ B Use a stop clock that measures time in minutes.

☐ C Increase the distance between L and M.

☐ D Decrease the distance between L and M.

(continued on the next page)

4 continued.

(b) Look at Figure 7 for Question 4(b) in the Diagram Booklet. Figure 7 shows the difference in refraction of sound waves and light waves when these waves travel from air into water.

Explain why the refraction of the sound wave is different from the refraction of the light wave in Figure 7.
(3 marks)

(continued on the next page)

4 continued.

(c) Light is one example of an electromagnetic wave.

Light can transfer energy from a lamp to the leaf of a plant, causing chemical reactions in the leaf.

Describe examples of TWO other electromagnetic waves transferring energy.
(4 marks)

Answer space continues on the next page.

1 _____

_____

_____

_____

_____

_____

4(c) continued.

2 _____

_____

_____

_____

_____

_____

(Total for Question 4 = 11 marks)

5 (a) Look at the Figure 8 for Question 5(a) in the Diagram Booklet. It shows the symbol for a nucleus of americium-241.

Americium-241 is a radioactive isotope of americium.

Americium-241 decays by emitting alpha (α) particles.

(i) Which of these is the symbol for another radioactive isotope of americium? (1 mark)

☐ A $^{241}_{97}Am$

☐ B $^{243}_{96}Am$

☐ C $^{245}_{95}Am$

☐ D $^{247}_{94}Am$

(continued on the next page)

5(a) continued.

(ii) Which of these is the approximate maximum distance that alpha particles can travel in air at normal atmospheric pressure?
(1 mark)

☐ A 5 mm

☐ B 5 cm

☐ C 5 m

☐ D 5 km

(iii) Look at Figure 9 for Question 5(a)(iii) in the Diagram Booklet. Complete the equation in Figure 9 for americium-241 decaying into neptunium (Np).
(3 marks)

(continued on the next page)

5 continued.

(b) Look at Figure 10 for Question 5(b) in the Diagram Booklet.

The activity of a radioactive source is measured as 128 Bq.

This is shown as a point on the graph in Figure 10.

The half-life of this radioactive source is 17 s.

Use this information to plot three more points on the graph grid in Figure 10 to show how the activity of the source changes with time.
(3 marks)

(continued on the next page)

5 continued.

(c) Describe what happens in the nucleus of an atom when a positron is emitted.
(2 marks)

(Total for Question 5 = 10 marks)

6 (a) An atom of mass $6{\cdot}6 \times 10^{-26}$ kg is moving with a velocity of 480 m/s.

Calculate the momentum of the atom.
(3 marks)

momentum = _____ kg m/s

(continued on the next page)

6 continued.

(b) Look at Figure 11 for Question 6(b) in the Diagram Booklet. It shows a ball before and after it collides with a wall.

The arrows show the direction of movement of the ball.

Before the collision, the momentum of the ball is 0·80 kg m/s.

After the collision, the momentum of the ball is 0·60 kg m/s in the opposite direction.

The ball is in contact with the wall for a time of 70 ms during the collision.

Calculate the force exerted on the ball by the wall. (3 marks)

Use an equation selected from the list of equations in the Equation Booklet.

Answer space continues on the next page.

6(b) continued.

force = _____ N

(continued on the next page)

6 continued.

*(c) Look at Figure 12 for Question 6(c) in the Diagram Booklet.

Newton's second law can be stated as

force = mass × acceleration

A student is provided with a trolley and a runway on a bench, as shown in Figure 12, and access to other equipment.

Describe a procedure the student could use to investigate how the acceleration of the trolley depends on the force applied to the trolley.

You may add to the diagram in Figure 12 to help your answer.
(6 marks)

Answer space continues on the next page.

6(c) continued.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

END OF PAPER