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

Combined Science

PAPER 3

Higher Tier

Total Marks

Time: 1 hour 10 minutes plus your additional time allowance

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

Surname					
Other names					
Centre Number					
Candidate Number					

X66625A

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet, Equation Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided – there may be more space than you need.

Calculators may be used.

Any diagrams may NOT be accurately drawn, unless otherwise indicated.

You must show all your working out with your answer clearly identified at the end of your solution.

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.

An Equation Booklet is provided.

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) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows part of a wave.

Use data from Figure 1 to calculate the wavelength of the wave.
(2 marks)

wavelength = _____ cm

(continued on the next page)

1 continued.

(b) (i) Look at Figure 2 for Question 1(b)(i) in the Diagram Booklet. A student is sitting on the shore of a lake watching ripples on the surface of the water moving past a toy boat.

Figure 2 shows the ripples on the surface of the water moving past the boat.

The student has a stopwatch.

Describe how the student could determine the frequency of the ripples on the lake.
(3 marks)

(continued on the next page)

1 continued.

_____

_____

(continued on the next page)

1 continued.

(ii) The speed of a water wave is 1·5 m/s.

The frequency of the wave is 0·70 Hz.

Calculate the wavelength of this wave.
(2 marks)

Use the equation

$v = f \times \lambda$

wavelength = _____ m

(continued on the next page)

1 continued.

(iii) Water waves are transverse waves.

Describe the difference between transverse waves and longitudinal waves.
(2 marks)

(Total for Question 1 = 9 marks)

2 This question is about radioactivity.

(a) Alpha (α), beta (β) and gamma (γ) are three types of radioactive emissions.

Which statement describes ALL of these radioactive emissions?
(1 mark)

- ☐ **A ionising and emitted by stable nuclei**
- ☐ **B ionising and emitted by unstable nuclei**
- ☐ **C neutral and emitted by stable nuclei**
- ☐ **D neutral and emitted by unstable nuclei**

(continued on the next page)

2 continued.

(b) Fluorine-19 is a stable isotope of the element fluorine.

The element fluorine also has several radioactive isotopes.

Describe ONE similarity and ONE difference between the numbers of particles in one nucleus of fluorine-19 and one nucleus of a radioactive isotope of fluorine.
(2 marks)

similarity

_____

_____

_____

difference

_____

_____

_____

(continued on the next page)

2 continued.

(c) Look at Figure 3 for Question 1(c) in the Diagram Booklet. It shows a Geiger–Muller (G–M) tube attached to a counter.
The G–M tube is used to measure the activity of a source of beta (β) radiation.
There is an aluminium sheet between the beta source and the G–M tube.
The counter is switched on and after 1 minute shows a count of 268.

(i) The aluminium sheet is taken away.
The counter is reset to zero and then switched on again.
A new count is taken for 1 minute.

Explain why the new count is greater than 268.
(2 marks)

(continued on the next page)

2 continued.

(ii) The beta source is then also taken away. The counter is reset to zero and switched on again. A new count is taken for 1 minute.

Give a reason why there would now be a reading on the counter.
(1 mark)

(iii) State the SI unit for the activity of a radioactive source.
(1 mark)

(continued on the next page)

2 continued.

(d) Radium-223 is a radioactive substance.

Radium-223 is an alpha emitter.

The half-life of radium-223 is 11 days.

A radioactive source contains $1{\cdot}7 \times 10^{23}$ nuclei of radium-223.

Calculate the number of radium-223 nuclei remaining in the source after a time of 33 days.
(2 marks)

number of radium-223 nuclei remaining = _____

(Total for Question 2 = 9 marks)

3 A student is investigating the refraction of light.

Look at Figure 4 for Question 3 in the Diagram Booklet. It shows part of the apparatus and the angles to be measured.

The student measures angle r for several different values of angle i.

Look at Figure 5 for Question 3(a)(i) in the Diagram Booklet. It shows the student's results.

(a) (i) On the graph in Figure 5, draw the best fit curve.
(1 mark)

(ii) Use the graph in Figure 5 to estimate the value of angle r when angle i is 80^{o}.
(1 mark)

angle r = _____ ^{o}

(continued on the next page)

3 continued.

(iii) Describe how angle r changes with angle i for the results shown on the graph in Figure 5. (2 marks)

(continued on the next page)

3 continued.

(b) In Figure 4, the frequency of the light remains the same in glass as in air.

Which row of the table describes what happens to the wave velocity and to the wavelength of the light when the light travels from air to glass? (1 mark)

	wave velocity	wavelength
☐ A	decreases	decreases
☐ B	decreases	increases
☐ C	increases	decreases
☐ D	increases	increases

(continued on the next page)

3 continued.

(c) Look at Figure 6 for Question 3(c) in the Diagram Booklet only refraction of light is shown.

Other things happen to the light as it travels from **P** to **Q**.

The intensity (brightness) of the light at **Q** is less than the intensity of the light at **P**.

Explain the decrease in intensity as the light travels from **P** to **Q**.

You may add to Figure 6 to help your answer.
(3 marks)

(continued on the next page)

3 continued.

(d) **Look at the sketch graphs for Question 3(d) in the Diagram Booklet. Which of these sketch graphs represents the speed of light as it travels from P to Q?**
(1 mark)

- ☐ **A Graph A**
- ☐ **B Graph B**
- ☐ **C Graph C**
- ☐ **D Graph D**

(Total for Question 3 = 9 marks)

4 (a) Look at the graphs for Question 4(a) in the Diagram Booklet. Which of these graphs represents an object moving with a constant velocity of 2 m / s?
(1 mark)

☐ A Graph A

☐ B Graph B

☐ C Graph C

☐ D Graph D

(continued on the next page)

4 continued.

(b) Look at Figure 7 for Question 4(b) in the Diagram Booklet. It is a velocity/time graph showing a 34 s part of a train's journey.

(i) Calculate the acceleration of the train in the 34 s.

Give your answer to an appropriate number of significant figures.
(3 marks)

acceleration = _____ m/s^2

(continued on the next page)

4 continued.

(ii) Calculate the distance the train travels in the 34 s.
(3 marks)

distance _____ m

(continued on the next page)

4 continued.

(c) A rocket taking off rises upwards, blasting flames and clouds of smoke towards the ground.

The force that the rocket engines produce remains constant during the first few seconds after take-off.

Explain what happens to the acceleration during the first few seconds.
(3 marks)

(Total for Question 4 = 10 marks)

5 (a) Look at Figure 9 for Question 5(a) in the Diagram Booklet. It shows a small steel ball held at a height, h, above the ground.

The ball is released and allowed to fall to the ground.

The height h is 1·4 m.

Calculate the time, t, for the ball to reach the ground. (2 marks)

Use the equation

$$t^2 = \frac{2h}{g}$$

$g = 10\,m/s^2$

(continue your answer on the next page)

5 continued.

t = _____ s

(continued on the next page)

5 continued.

(b) Two students use the arrangement shown in Figure 9.

They use a stopwatch to time the ball falling through the height of 1·4 m.

The students repeat the measurement many times, but their average value for t is different from the calculated value.

(i) Suggest a reason why the students' value for t is different from the calculated value.
(1 mark)

(continued on the next page)

5 continued.

(ii) Suggest ONE improvement the students could make to their procedure so that their value for t is closer to the calculated value. (1 mark)

_____

_____

_____

(continued on the next page)

5 continued.

(c) Look at Figure 10a for Question 5(c) in the Diagram Booklet. It shows a box falling towards a hard floor.

Look at Figure 10b for Question 5(c) in the Diagram Booklet. The box hits the floor and crumples a little before it comes to rest as shown in Figure 10b.

The momentum of the box just before it hits the floor is 8·7 kg m/s.

The box comes to rest 0·35 s after it first hits the floor.

(continued on the next page)

5 continued.

(i) Calculate the magnitude of the force exerted by the floor on the box.
(2 marks)

Use an equation selected from the Equation Booklet.

force exerted by the floor on the box = _____ N

(continued on the next page)

5 continued.

(ii) State the magnitude and direction of the force exerted by the box on the floor.
(2 marks)

magnitude _____

direction _____

(continued on the next page)

5 continued.

(d) Look at Figure 11 for Question 5(d) in the Diagram Booklet. It shows a ball held in a clamp at **R**, above the ground.

The ball is released from the clamp and falls.

S is 3·8 m below **R**.

At **S** the momentum of the ball is 0·40 kg m/s.

Calculate the mass of the ball.
(4 marks)

Acceleration due to gravity, g, = 10 m/s^2

(continue your answer on the next page)

5 continued.

mass of the ball _____ kg

(Total for Question 5 = 12 marks)

6 (a) Sometimes food can become contaminated with radioactive substances.

Describe the harmful effects of eating food contaminated with radioactive substances.
(2 marks)

(continued on the next page)

6 continued.

(b) Gamma radiation can be used in food processing to irradiate food.

Explain why some food is irradiated with gamma radiation.
(2 marks)

(continued on the next page)

6 continued.

(c) Gamma radiation is part of the electromagnetic spectrum.

When the nucleus of an atom emits a gamma ray, the number of protons in the nucleus and the number of neutrons in the nucleus DO NOT change.

State how the nucleus DOES change when it emits a gamma ray.
(1 mark)

_____

_____

_____

(continued on the next page)

6 continued.

*(d) Gamma radiation is produced by radioactive decay.

Alpha radiation and beta radiation are also produced by radioactive decay.

Compare the processes of alpha decay and beta decay.

Your answer should include what each radiation is and what effect each decay has on the original nucleus.
(6 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS
END OF PAPER