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

Total Marks

Combined Science
PAPER 3
Higher Tier

Time: 1 hour 10 minutes

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

Surname						
Other names						
Centre Number						
Candidate Number						

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Pearson

YOU MUST HAVE

Calculator, ruler, Equation Booklet

YOU WILL BE GIVEN

Diagram Booklet, Additional Equations Insert

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.

(continued on the next page)

INFORMATION continued.

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 statement describes conservation of energy in a closed system?
(1 mark)

☐ A when there are energy transfers, the total energy reduces

☐ B when there are energy transfers, the total energy does not change

☐ C when there are no energy transfers, the total energy reduces

☐ D when there are no energy transfers, the total energy increases

(continued on the next page)

1 continued.

(b) Look at FIGURE 1 for Question 1(b) in the Diagram Booklet.

A student uses the apparatus in Figure 1 to find out which of two materials, sand or sawdust, is the better insulator.

The student also has a kettle to boil water, a thermometer and a stop clock.

(i) On page 7 draw a labelled diagram to show how the student should set up the equipment to investigate which material is the better insulator.
(3 marks)

(continued on the next page)

1 continued.

(continued on the next page)

1 continued.

(ii) Give THREE factors that the student must control in this investigation. (3 marks)

1

2

3

(continued on the next page)

1 continued.

(c) Expanded polystyrene, used to insulate buildings, has different densities.

Look at FIGURE 2 for Question 1(c) in the Diagram Booklet. It shows how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

(continued on the next page)

1 continued.

Using the graph in Figure 2, describe how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene. (2 marks)

(Total for Question 1 = 9 marks)

2 (a) Look at FIGURE 3 for Question 2(a) in the Diagram Booklet. It is a speed limit sign from a European motorway.

The speeds shown are in km/h (kilometres per hour).

(i) The sign tells drivers to drive at a slower speed in wet weather.

Explain why it is safer for drivers to drive at a slower speed in wet weather.
(2 marks)

(continued on the next page)

2 continued.

(ii) Show that a speed of 31 m/s is less than a speed of 130 km/h. (2 marks)

(continued on the next page)

2 continued.

(iii) The driver's reaction time is the time between the driver seeing an emergency and starting to brake.

A car is travelling at a speed of 31 m/s.

The car travels 46 m between the driver seeing an emergency and starting to brake.

Calculate the driver's reaction time.

Give your answer to 2 significant figures.

(3 marks)

(begin your answer on the next page)

2 continued.

driver's reaction time _____ s

(Total for Question 2 = 7 marks)

3 (a) (i) An aircraft starts from rest and accelerates along the runway for 36 s to reach take-off velocity.

Take-off velocity for this aircraft is 82 m/s.

Show that the acceleration of the aircraft along the runway is about $2\,m/s^2$.

Assume the acceleration is constant.
(2 marks)

(continued on the next page)

3 continued.

(ii) Calculate the distance the aircraft travels along the runway before take-off.
(3 marks)

Use the equation

$$v^2 - u^2 = 2ax$$

distance = _____ m

(continued on the next page)

3 continued.

(iii) Suggest ONE reason why the length of the runway used is always much longer than the calculated distance that the aircraft travels along the runway before take-off.

(1 mark)

(continued on the next page)

3 continued.

(b) (i) The aircraft lands with a velocity of 71 m/s.

The mass of the aircraft is $3{\cdot}6 \times 10^5$ kg.

Calculate the kinetic energy of the aircraft as it lands.
(2 marks)

kinetic energy of aircraft = _____ J

(continued on the next page)

3 continued.

(ii) When the aircraft has come to a stop, all the kinetic energy has been transferred to the surroundings.

Give ONE way that the energy has been transferred to the surroundings.
(1 mark)

(Total for Question 3 = 9 marks)

4 (a) Which of these is a unit of momentum?
(1 mark)

☐ A $kg\,m/s$

☐ B $kg/m/s$

☐ C $kg\,m/s^2$

☐ D $kg/m/s^2$

(continued on the next page)

4 continued.

(b) Look at FIGURE 4 for Question 4(b) in the Diagram Booklet.

Students investigate conservation of momentum using two identical trolleys.

A card is then added to trolley A.

Some of the apparatus is set up as shown in Figure 4.

(continued on the next page)

4 continued.

(i) Describe an investigation the students could carry out to show that momentum is conserved when these two trolleys collide.

You may add to the diagram to help with your answer.
(4 marks)

(continued on the next page)

4 continued.

(continued on the next page)

4 continued.

(ii) Give a reason for the runway being at a slope.
(1 mark)

(continued on the next page)

4 continued.

(c) Look at FIGURE 5 for Question 4(c) in the Diagram Booklet. It shows a racket and a tennis ball.

The tennis ball is travelling towards the racket at a velocity of 8·2 m/s.

The ball is hit back in the opposite direction at a velocity of 15 m/s.

The ball has a mass of 0·075 kg.

The ball is in contact with the racket for 12 ms.

(continued on the next page)

4 continued.

(i) Calculate the average force exerted by the ball on the racket. (3 marks)

Use the equation

$$F = \frac{mv - mu}{t}$$

force = _____ N

(continued on the next page)

4 continued.

(ii) Describe how Newton's Third Law of Motion applies to the collision between the racket and the ball.
(2 marks)

(Total for Question 4 = 11 marks)

5 (a) Rutherford devised an experiment to fire alpha particles at thin gold foil.

It was found that alpha particles were scattered by the gold foil.

The gold foil was about $4{\cdot}0 \times 10^{-7}$ m thick.

A gold atom has a diameter of about 0·15 nm.

Estimate how many gold atoms would fit across this thickness of gold foil.
(2 marks)

number of atoms = _____

(continued on the next page)

5 continued.

(b) Look at FIGURE 6 for Question 5(b) in the Diagram Booklet. The apparatus that was used in the experiment is shown.

(continued on the next page)

5 continued.

(i) Look at FIGURE 7 for Question 5(b)(i) in the Diagram Booklet. The number of particles detected at each angle in a given time is shown on the graph.

Use information from the graph.

Estimate the ratio of the number of particles scattered through 5° to the number of particles scattered through 100°.
(2 marks)

ratio = _____

(continued on the next page)

5 continued.

(ii) Explain how the difference in the number of particles scattered at different angles gives evidence for the current model of the structure of the atom.
(4 marks)

(continued on the next page)

5 continued.

(continued on the next page)

5 continued.

(c) Look at FIGURE 8 for Question 5(c) in the Diagram Booklet. Students are given the apparatus shown in Figure 8 and a protractor.

(i) Describe how the students could use the apparatus to model the scattering of alpha particles. (2 marks)

(continued on the next page)

5 continued.

(ii) Give ONE limitation of this model.
(1 mark)

(Total for Question 5 = 11 marks)

6 This question is about waves in the electromagnetic (e.m.) spectrum.

(a) The potential danger associated with the waves of the e.m. spectrum increases as
(1 mark)

☐ A frequency decreases

☐ B frequency increases

☐ C velocity decreases

☐ D velocity increases

(continued on the next page)

6 continued.

(b) (i) A microwave oven uses waves of frequency 2·45 GHz.

Calculate the wavelength of the microwaves.

The velocity of light is $3{\cdot}00 \times 10^8$ m/s.

(3 marks)

wavelength = _____ m

(continued on the next page)

6 continued.

(ii) The microwave oven is 55% efficient and transfers 42 000 J of energy to some food when it is heated.

Calculate the total amount of energy that must be supplied to the oven.
(3 marks)

energy supplied to oven = _____ J

(continued on the next page)

6 continued.

*(c) X-rays and radio waves are part of the electromagnetic spectrum and have different uses.

These radiations are produced in different ways.

X-rays are emitted when electrons within an atom go through energy changes.

Radiowaves are produced by electrons in circuits.

Compare X-rays with radio waves.

Your answer should refer to

- the uses of both types of radiation
- the different ways that electrons are involved in producing X-rays and radio waves.

(6 marks)

(begin your answer on the next page)

6 continued.

(continued on the next page)

6 continued.

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

END OF PAPER