Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Time 1 hour 10 minutes

Paper reference **1SC0/1PH**

Combined Science
PAPER 3
Higher Tier

You must have:
Calculator, ruler, Equation Booklet (enclosed)

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *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 included at the end of this exam paper.

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.

Turn over

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)

☒ **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

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

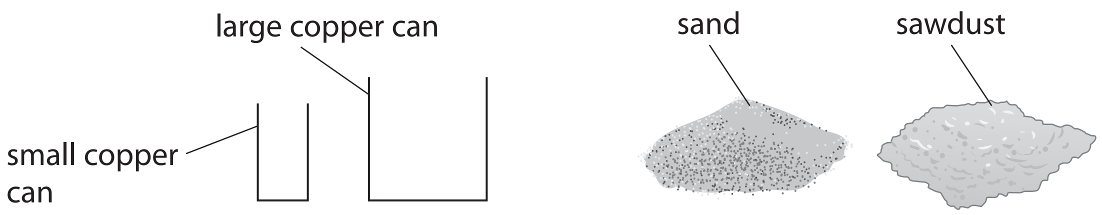

Figure 1

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

(i) Draw a labelled diagram to show how the student should set up the equipment to investigate which material is the better insulator.

(3)

(ii) Give **three** factors that the student must control in this investigation.

(3)

1 ....

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2 ....

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3 ....

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

Figure 2 shows how the thermal conductivity of expanded polystyrene changes with the density of expanded polystyrene.

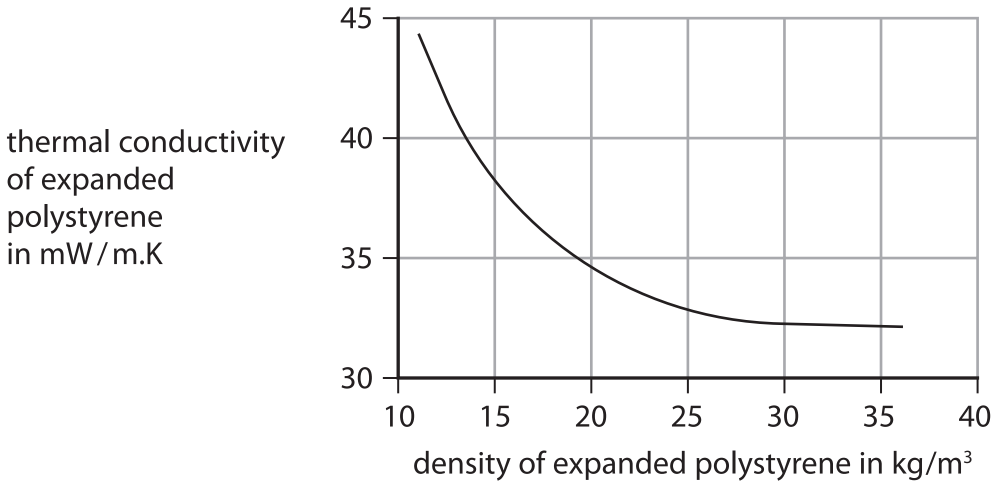

Figure 2

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

(2)

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(Total for Question 1 = 9 marks)

2 (a) Figure 3 is a speed limit sign from a European motorway.

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

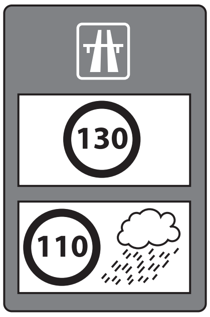

Figure 3

(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)

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

(2)

(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)

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)

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

Use the equation

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

(3)

distance = ... m

(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)

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....

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

The mass of the aircraft is 3.6×10^5 kg.

Calculate the kinetic energy of the aircraft as it lands.

(2)

kinetic energy of aircraft = ... J

(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)

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(Total for Question 3 = 9 marks)

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

(1)

☒ **A** kg m/s

☒ **B** kg/m/s

☒ **C** kg m/s^2

☒ **D** kg/m/s^2

(b) 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.

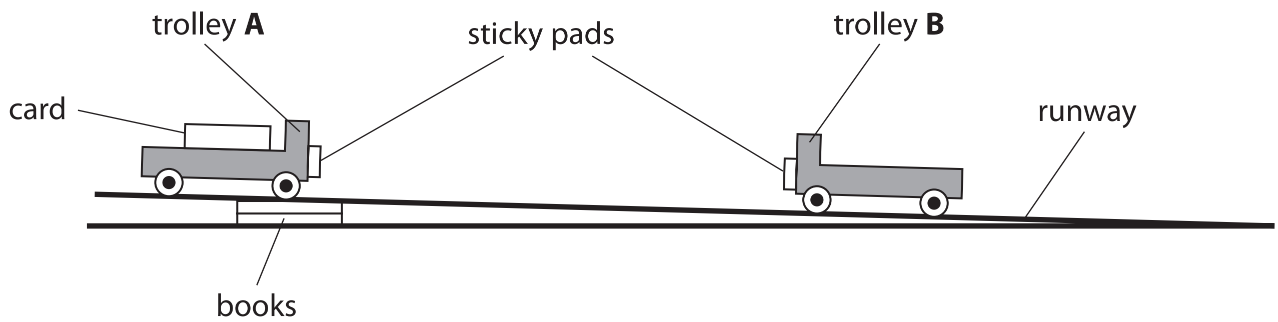

Figure 4

(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)

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

(1)

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(c) Figure 5 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.

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

Use the equation

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

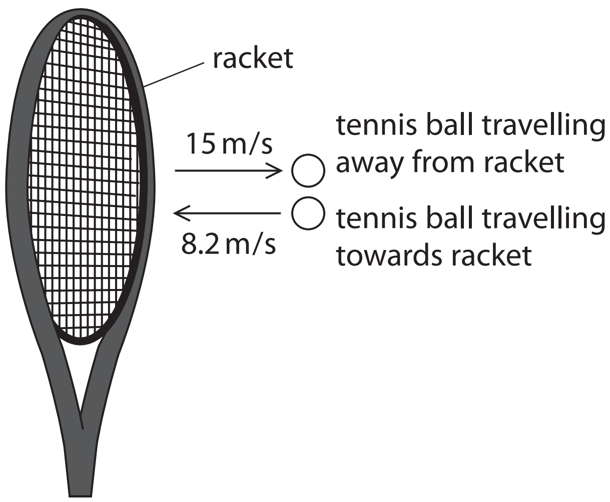

Figure 5

(3)

force = ... N

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

(2)

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(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 4.0×10^{-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)

number of atoms = ...

(b) The apparatus that was used in the experiment is shown in Figure 6.

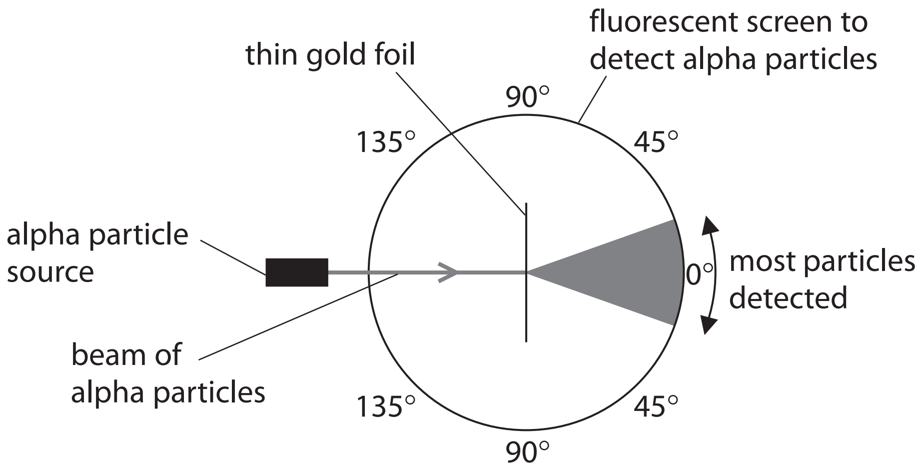

Figure 6

(i) The number of particles detected at each angle in a given time is shown on the graph in Figure 7.

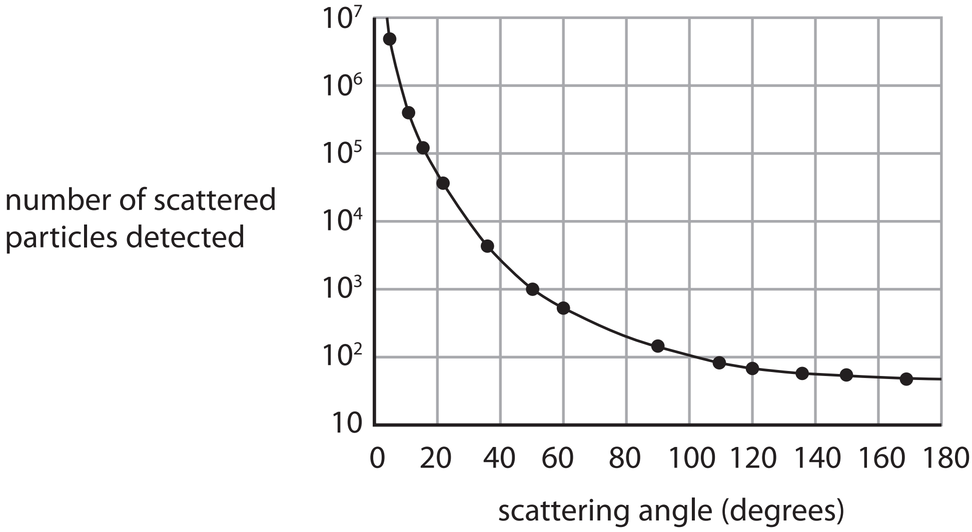

Figure 7

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)

ratio = ...

(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)

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(c) Students are given the apparatus shown in Figure 8 and a protractor.

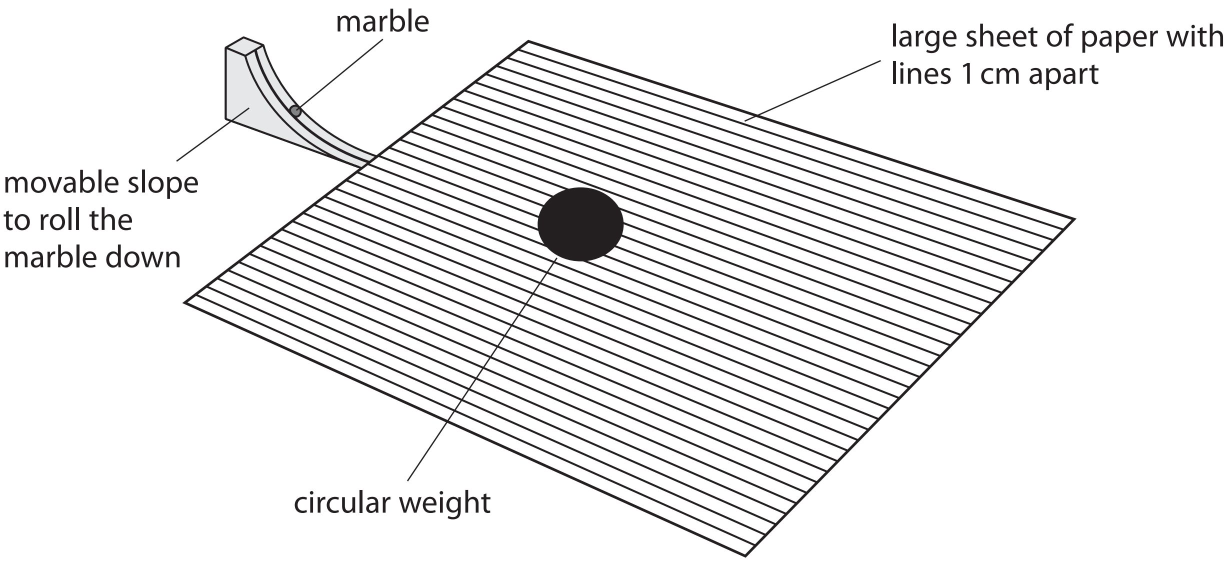

Figure 8

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

(2)

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(ii) Give **one** limitation of this model.

(1)

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(Total for Question 5 = 11 marks)

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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)

☒ **A** frequency decreases

☒ **B** frequency increases

☒ **C** velocity decreases

☒ **D** velocity increases

(b) (i) A microwave oven uses waves of frequency 2.45 GHz.

Calculate the wavelength of the microwaves.

The velocity of light is 3.00×10^8 m/s.

(3)

wavelength = ... m

(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)

energy supplied to oven = ... J *(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)

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(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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Equations

(final velocity)^2 − (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
force = change in momentum ÷ time $F = \frac{(mv - mu)}{t}$
energy transferred = current × potential difference × time $E = I \times V \times t$
force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length $F = B \times I \times l$
$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$ $\frac{V_p}{V_s} = \frac{N_p}{N_s}$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
to calculate pressure or volume for gases of fixed mass at constant temperature $P_1 V_1 = P_2 V_2$
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = ½ \times k \times x^2$
pressure due to a column of liquid = height of column × density of liquid × gravitational field strength $P = h \times \rho \times g$