LUI | | | | | | | | | | | School code | | | | |

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment

Question and response book

Physics

Paper 2

Time allowed

- Perusal time — 10 minutes
- Working time — 90 minutes

General instructions

- Answer all questions in this question and response book.
- Write using black or blue pen.
- QCAA-approved calculator permitted.
- QCAA formula and data book provided.
- Planning paper will not be marked.

Section 1 (37 marks)

- 9 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

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Section 1

Instructions

- If you need more space for a response, use the additional pages at the back of this book.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page …
  - If you do not do this, your original response will be marked.

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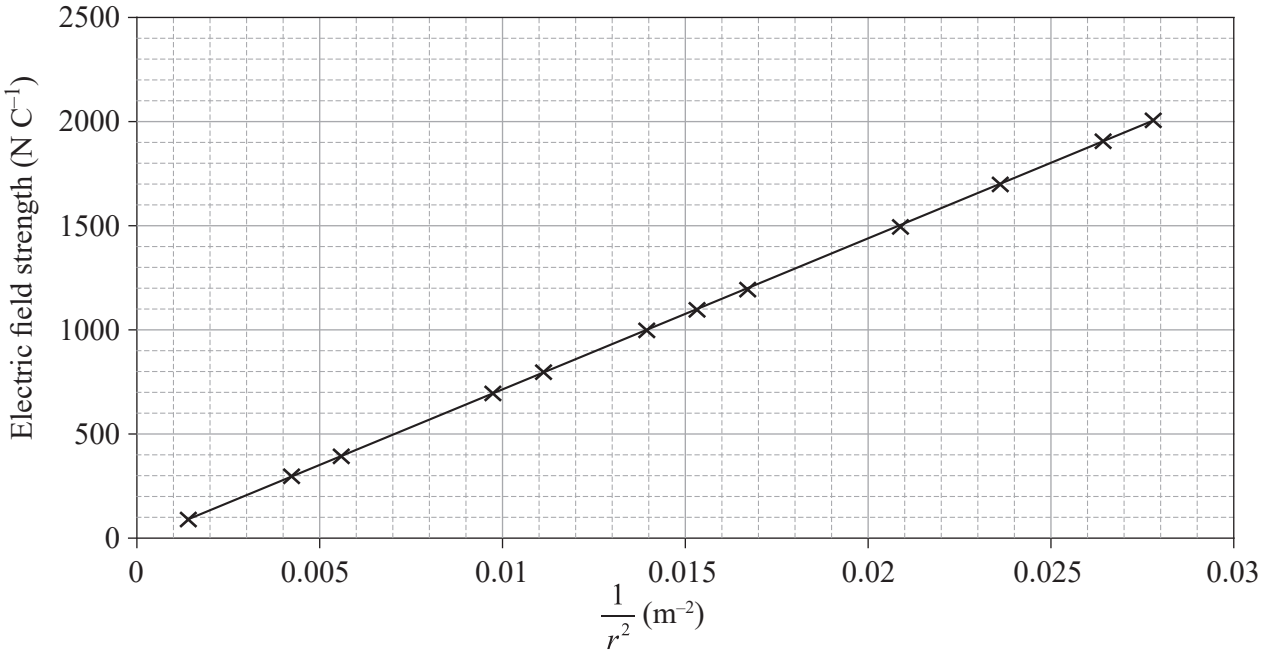
QUESTION 1 (1 mark)

Explain why an object with mass cannot travel at the speed of light in a vacuum.

QUESTION 2 (6 marks)

A physicist measured the electric field strength at different distances away from a point charge. The data is plotted in the graph.



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a) Identify the mathematical relationship between E and $\frac{1}{r^2}$ *[3 marks]*

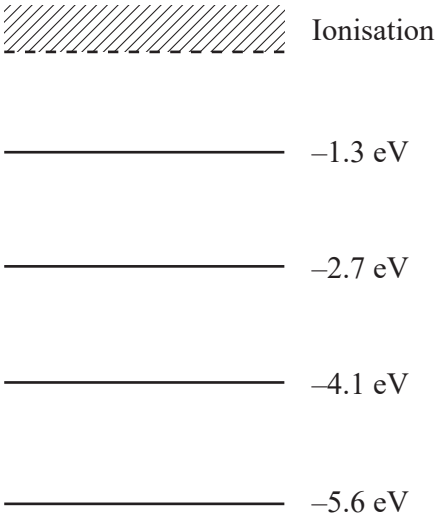
b) Use the mathematical relationship identified in 2a) to deduce the magnitude of the charge creating the electric field. *[3 marks]*

Charge = _____ C (to 1 decimal place)

Do not write outside this box.

QUESTION 3 (5 marks)

The diagram shows the atomic energy levels of the atoms in an unknown gas.



Predict the shortest wavelength of visible light that could be emitted from this unknown gas.
(**Note:** The range of visible wavelengths of light is between 400 nm and 700 nm.)

Do not write outside this box.

Wavelength = _____ nm

Do not write outside this box.

QUESTION 4 (5 marks)

Describe how experiments on the photoelectric effect provide evidence of the quantised nature of photons.

Do not write outside this box.

QUESTION 5 (4 marks)

An electron is situated halfway between two nuclei that are separated from each other by a distance of 4.5×10^{-10} m. The first nucleus contains two protons. The second nucleus contains three protons.

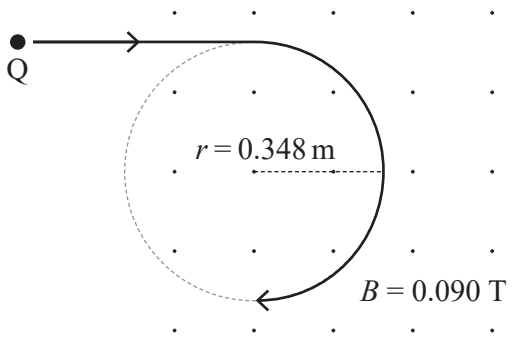
Calculate the magnitude of the overall electromagnetic force experienced by the electron.

Force = _____ N (to 1 decimal place)

Do not write outside this box.

QUESTION 6 (4 marks)

The diagram shows a particle, Q, entering a uniform magnetic field of 0.090 T. The particle has a speed of 1.5×10^6 m s^{-1}. Once in the magnetic field, the particle moves in a circular path as shown.



It is suspected that Q is one of the particles listed in the table.

Particle number	Charge, q (C)	Mass, m (kg)
1	-1.60×10^{-19}	9.11×10^{-31}
2	$+1.60 \times 10^{-19}$	9.11×10^{-31}
3	$+1.60 \times 10^{-19}$	1.67×10^{-27}
4	$+1.60 \times 10^{-19}$	3.34×10^{-27}
5	-1.60×10^{-19}	3.34×10^{-27}

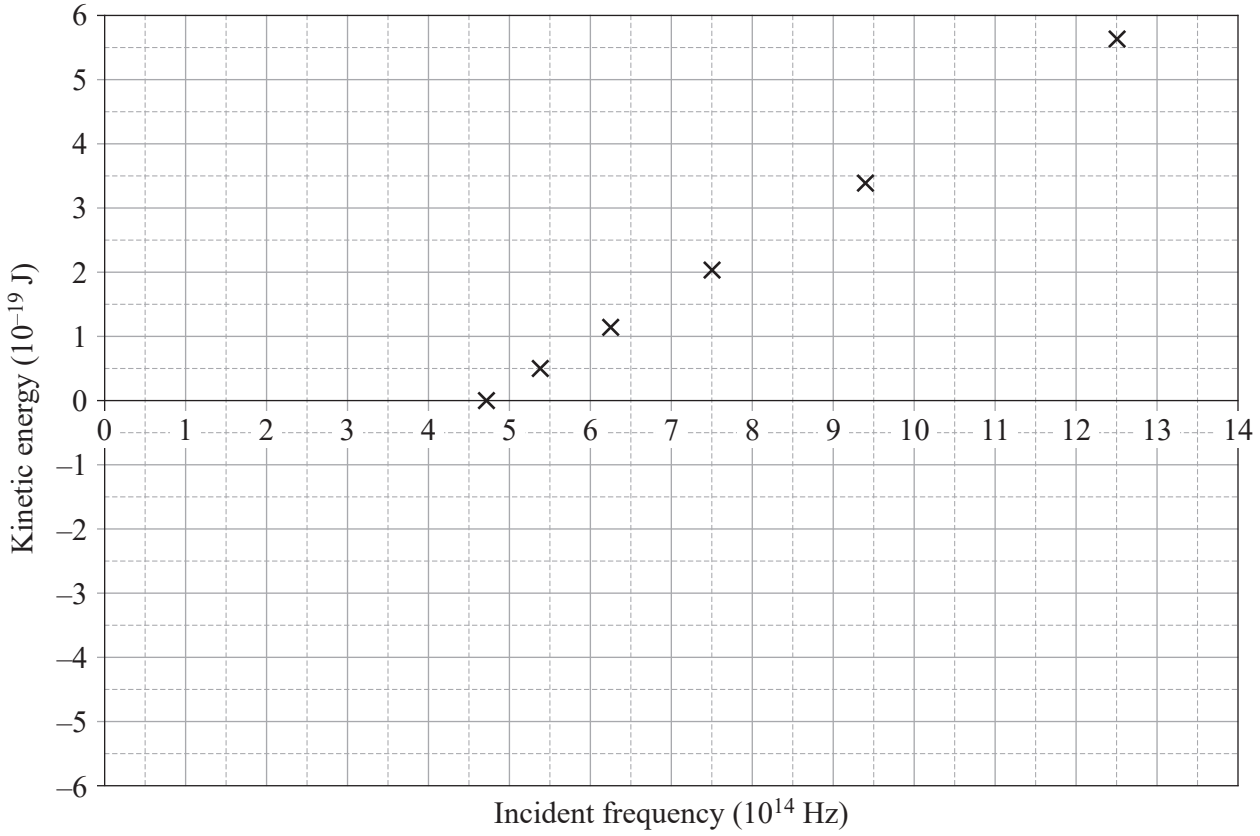
Determine which particle Q is most likely to be.

Particle Q = _____

Do not write outside this box.

QUESTION 7 (3 marks)

A photoelectric effect experiment is conducted by shining different frequencies of light on a sample of aluminium. The kinetic energy of the ejected photoelectrons was measured. The data is plotted in the graph.



Identify the mathematical relationship between kinetic energy, E_k, and incident frequency, f.

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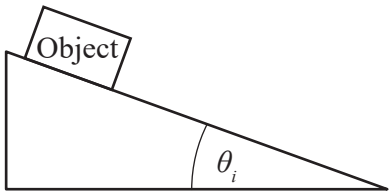
QUESTION 8 (4 marks)

The diagram shows an object sliding down a frictionless inclined plane.



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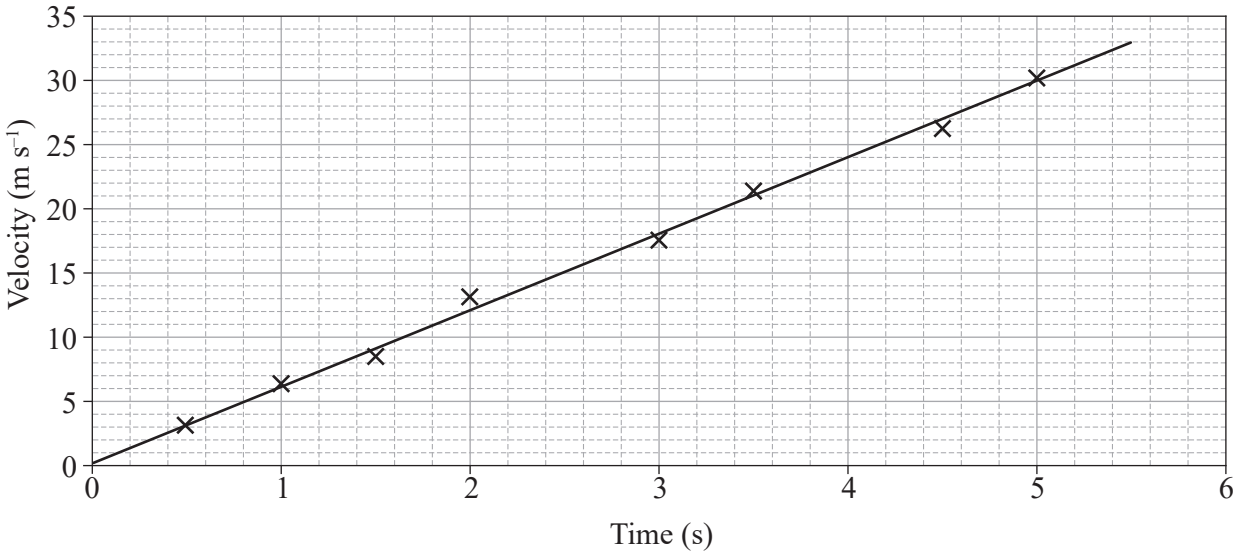
The graph shows the velocity of the object measured at various times.



Determine the angle of incline, θ_i, of the inclined plane. Show your working.

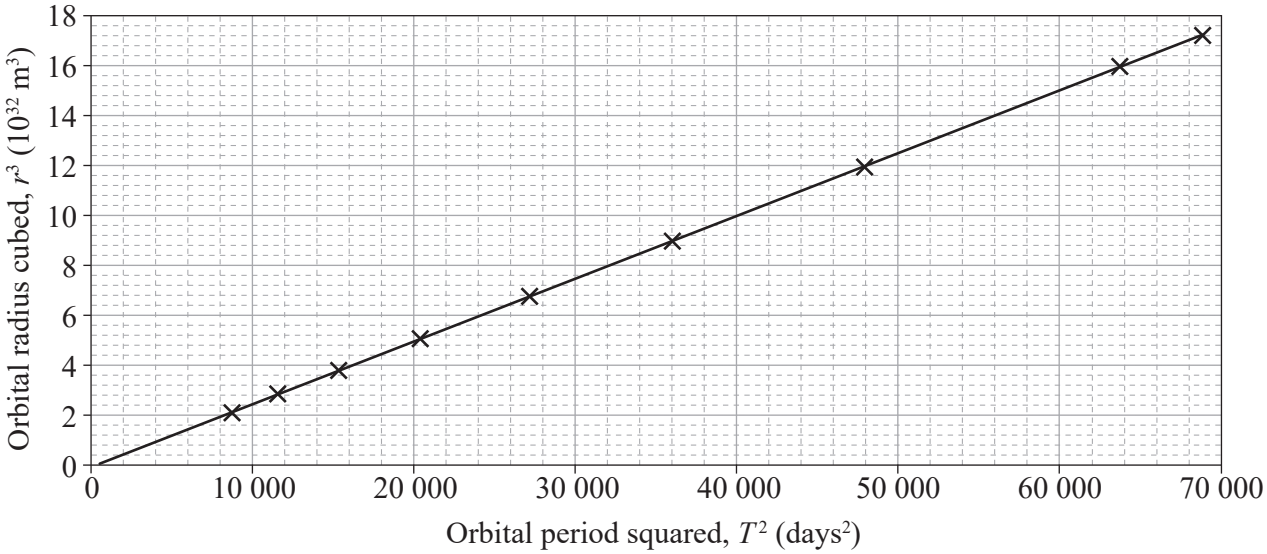
Do not write outside this box.

$\theta_i =$ _____ °

Do not write outside this box.

QUESTION 9 (5 marks)

Nine planets orbit the same star. The orbital radius and orbital period of each planet was measured. The graph shows the cube of the orbital radius of each planet, r^3, compared to its orbital period squared, T^2.



Determine the mass of the star. Show your working.

Do not write outside this box.

Mass = _____ kg (to 1 decimal place)

END OF PAPER

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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