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

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2022

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 (50 marks)

- 9 short response questions

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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 (2 marks)

Two spaceports are stationary relative to each other.

Astronaut A moves from one spaceport to the other at relativistic speed and observes the lights on both spaceports turn off at the same time.

Astronaut B is at a stationary position equally distant relative to each spaceport and observes the lights turn off one after the other.

Explain why the astronauts view these events differently.

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QUESTION 2 (2 marks)

Contrast the properties of up quarks and tau particles.

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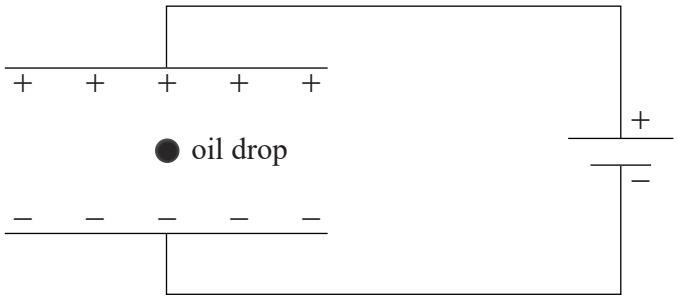
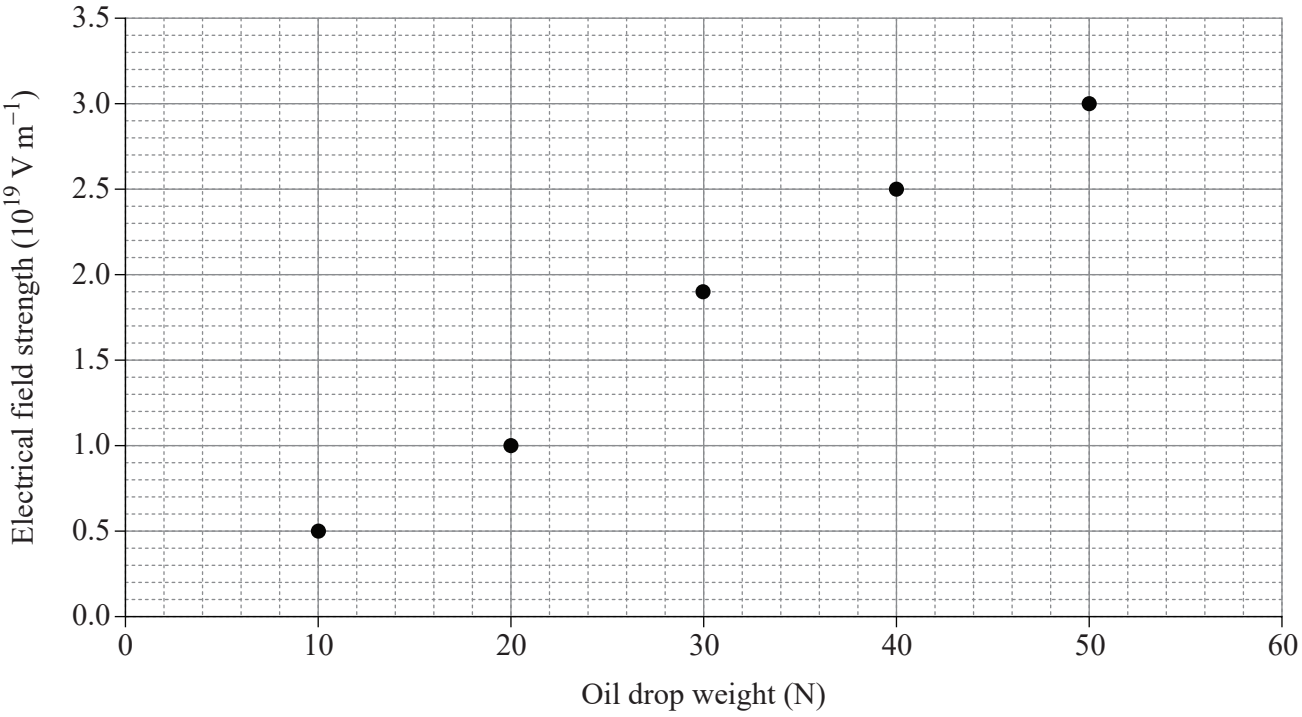
QUESTION 3 (8 marks)

Negatively charged oil drops were placed in a uniform electric field generated by two parallel plates. By altering the applied voltage between the plates, the oil drops were suspended in the air between the plates.



Not to scale

The graph shows the electric field strength required (achieved by altering the applied voltage) to suspend negatively charged oil drops of varying weight.



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a) Determine the average charge on the oil drops. Show your working. *[4 marks]*

Average charge = _____ C (to two significant figures)

Another oil drop was suspended between the plates with an electric field strength of 2.0×10^{19} V m^{-1}.

b) Determine the work done to move this oil drop a distance of 5 mm towards the negatively charged plate. Show your working. *[4 marks]*

Work done = _____ J (to two significant figures)

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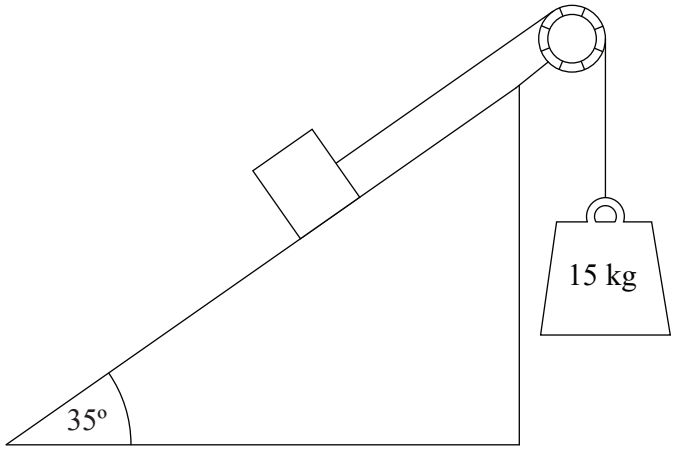
QUESTION 4 (5 marks)

A stationary object on a frictionless inclined plane is connected to a 15 kg weight as shown.



Not to scale

Calculate the mass of the object on the inclined plane.

Mass = _____ kg (to two significant figures)

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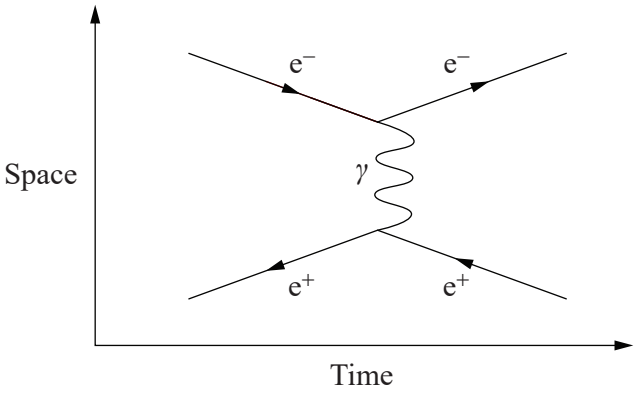
QUESTION 5 (3 marks)

The Feynman diagram for a particle interaction is shown.



Describe the particle interaction taking place.

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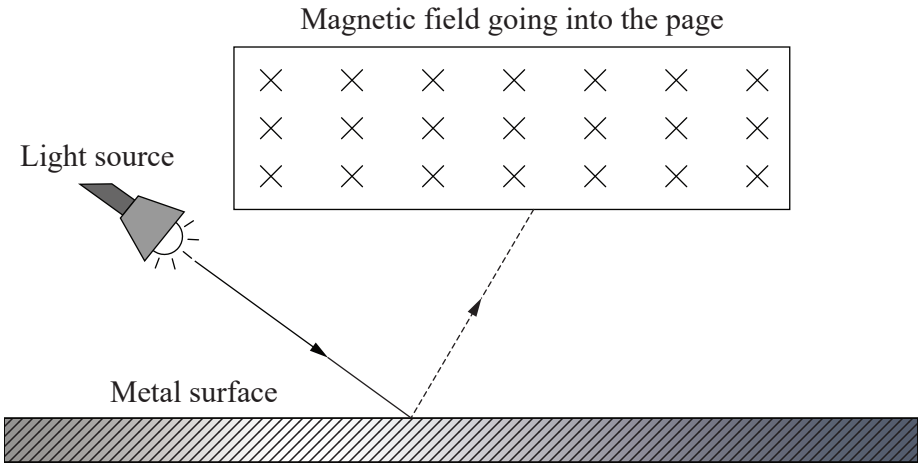
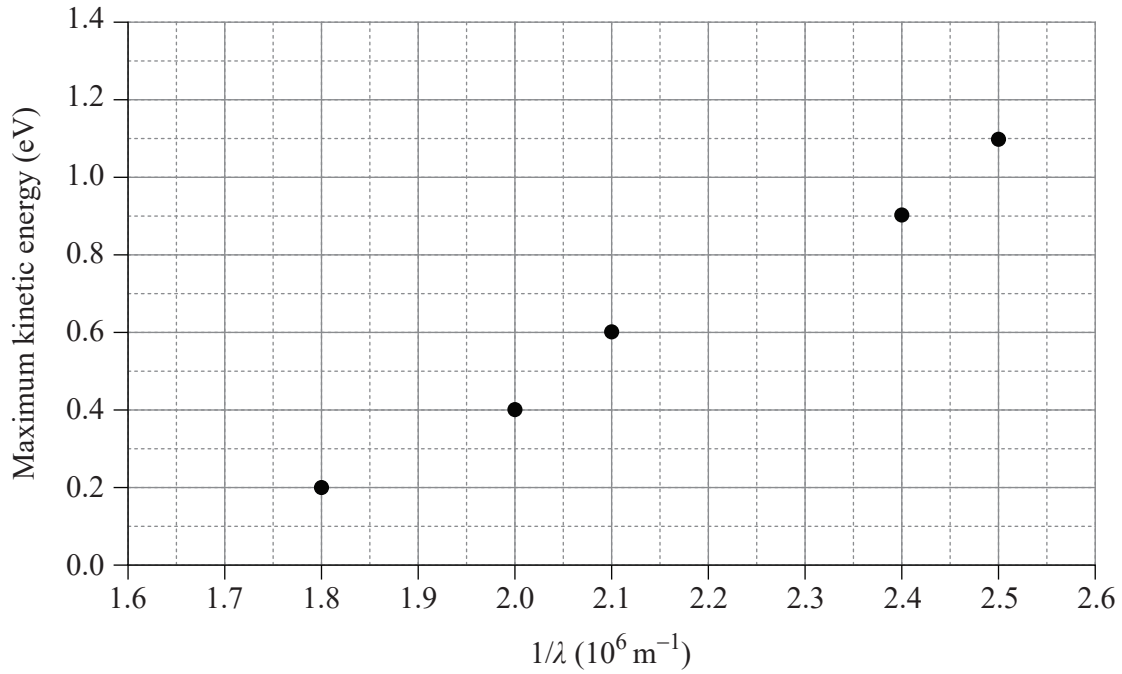
QUESTION 6 (14 marks)

A light was shone onto a metallic surface and the subsequently released photoelectron passed through a magnetic field.



a) Identify the direction the photoelectron would have curved as it passed through the magnetic field. *[1 mark]*

The graph shows the maximum kinetic energy of the photoelectron as the frequency of the light was changed.



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b) Determine the work function for the metal. Show your working. *[4 marks]*

Work function = _____ J (to two significant figures)

c) If the strength of the magnetic field is 5 μT, determine the maximum radius of the photoelectron's path through the magnetic field, when light of wavelength 450 nm was shone onto the metallic surface. Show your working. *[9 marks]*

Do not write outside this box.

Radius = _____ m (to two significant figures)

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QUESTION 7 (3 marks)

Two asteroids experience a gravitational force of 3.3×10^3 N between them. Their masses are 2.7×10^{17} kg and 6.1×10^{15} kg.

Calculate the distance between the two asteroids. Show your working.

Distance = _____ m (to two significant figures)

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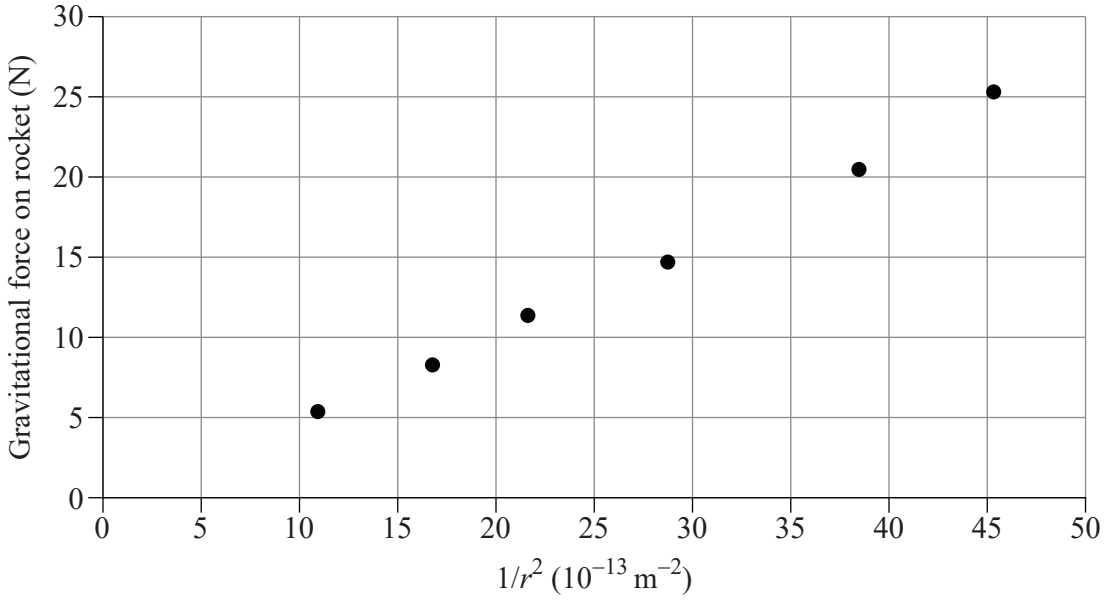
QUESTION 8 (4 marks)

The graph shows the gravitational force experienced by a rocket of mass 750 kg as it approaches an asteroid.



Determine the mass of the asteroid. Show your working.

Mass = _____ kg (to two significant figures)

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QUESTION 9 (9 marks)

A person spins an object 4.3 m above the ground in a horizontal circular path of radius 0.8 m. They release the object horizontally, allowing it to travel to the ground.

a) Calculate the centripetal acceleration of the object before it is released, given it takes 5 s for the object to complete 12 revolutions. Show your working. *[4 marks]*

Centripetal acceleration = _____ m s^{-2} (to two significant figures)

b) Calculate the total horizontal displacement for the object after it is released. Show your working. *[5 marks]*

Do not write outside this box.

Total horizontal displacement = _____ m (to two significant figures)

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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Write the question number you are responding to.

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