See back cover for an English translation of this cover

2

91173M

911735

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

SUPERVISOR'S USE ONLY

Ahupūngao, Kaupae 2, 2013

91173M Te whakaatu māramatanga ki te hiko me te autō ā-hiko

2.00 i te ahiahi Rāapa 13 Whiringa-ā-rangi 2013
Whiwhinga: Ono

Paetae	Paetae Kaiaka	Paetae Kairangi
Te whakaatu māramatanga ki te hiko me te autō ā-hiko.	Te whakaatu māramatanga hōhonu ki te hiko me te autō ā-hiko.	Te whakaatu māramatanga matawhānui ki te hiko me te autō ā-hiko.

Tirohia mehemea e ōrite ana te Tau Ākonga ā-Motu (NSN) kei tō pepa whakauru ki te tau kei runga ake nei.

Me whakautu e koe ngā pātai KATOA kei roto i te pukapuka nei.

Tirohia mēnā kei a koe te Rau Rauemi L2–PHYSMR.

Ki roto i ō whakautu, whakamahia ngā whiriwhiringa tohutau mārama, ngā kupu, ngā hoahoa hoki/rānei ki hea hiahiatia ai.

Me hoatu te wae tika o te Pūnaha o te Ao (SI) ki ngā whakautu tohutau.

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia ngā whārangi kei muri i te pukapuka nei, ka āta tohu ai i ngā tau pātai.

Tirohia mehemea kei roto nei ngā whārangi 2–17 e raupapa tika ana, ā, kāore hoki he whārangi wātea.

HOATU TE PUKAPUKA NEI KI TE KAIWHAKAHAERE HEI TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

Kia 60 meneti hei whakautu i ngā pātai o tēnei pukapuka.

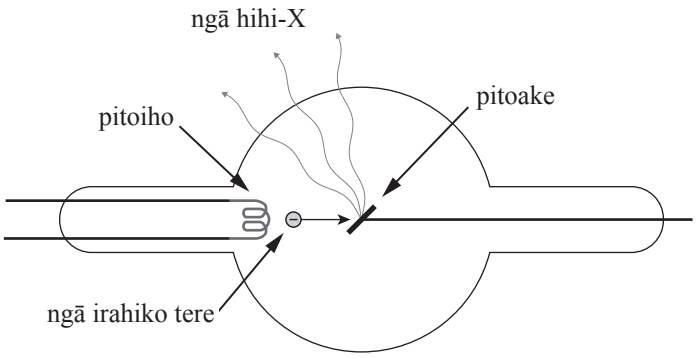
MĀ TE KAIMĀKA ANAKE

PĀTAI TUATAHI: TE NGONGO WHAKAAHUA WHAKAROTO

Kei te hoahoa a Tavita i tētahi ngongo whakaahua whakaroto mā ngā hōhipera. E whakaatu ana te hoahoa i raro i ngā wāhanga matua o te ngongo whakaahua whakaroto. E whakaputahia ana ngā irahiko mā tētahi kaka i roto i te pitoiho. Nā te ngaohiko kaha i waenga i te pitoiho (kawehiko tōraro) me te pitoake (kawehiko tōrunga) ka whakaterehia ake kia tukia rā anō ki te pitoake.

Papatipu o te irahiko = 9.1×10^{-31} kg

Te whana kei te irahiko = 1.6×10^{-19} C



(a) Tata ki te 1×10^{15} ngā irahiko ka wehe i te pitoiho ia hēkona.

Tātaitia te rahi o te iahiko.

(b) Kei roto te ngongo whakaahua whakaroto i te **papa autō** o Papatūānuku. Mai i te pitoiho ki te pitoake te ahunga o te papa autō.

Tuhia te rahi o te tōpana autō kei ngā irahiko kei te neke.

Whakamāramatia tō whakautu.

You are advised to spend 60 minutes answering the questions in this booklet.

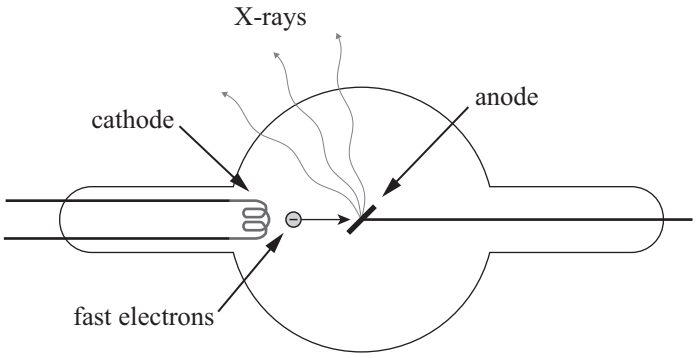
ASSESSOR'S USE ONLY

QUESTION ONE: THE X-RAY TUBE

Tavita is working on the design of an X-ray tube for hospitals. The diagram below shows the main parts of the X-ray tube. Electrons are emitted by a filament in the cathode. A high voltage between the cathode (negative electrode) and anode (positive electrode) causes them to accelerate until they crash into the anode.

Mass of an electron = 9.1×10^{-31} kg

Charge on an electron = 1.6×10^{-19} C



(a) Approximately 1×10^{15} electrons leave the cathode every second.

Calculate the size of the current.

(b) The X-ray tube is in the Earth's **magnetic field**. The direction of the magnetic field is from the cathode to the anode.

State the size of the magnetic force on the moving electrons.

Explain your answer.

(c) Tīmata ai ngā irahiko mai i te okioki ka eke ki te 3.0×10^7 m s^{-1} te tere.

Mā te whai whakaaro ki ngā pūngao kei roto, tātaitia te rahi o te ngaohiko i waenga i te pitoiho me te pitoake.

MĀ TE KAIMĀKA ANAKE

(d) Ka whakarite a Tavita ki te whakaiti i te tawhiti i waenga i te pitoiho me te pitoake mā te haurua.

Āta whakamāramahia ka ahatia:

(i) te rahi o te tōpana kei runga i te irahiko

(ii) te pūngao neke ka whiwhi tētahi irahiko.

ASSESSOR'S USE ONLY

(c) The electrons start from rest and reach a speed of 3.0×10^7 m s^{-1}.

By considering the energies involved, calculate the size of the voltage between the cathode and the anode.

(d) Tavita decides to reduce the distance from the cathode to the anode by half.

Explain fully what will happen to:

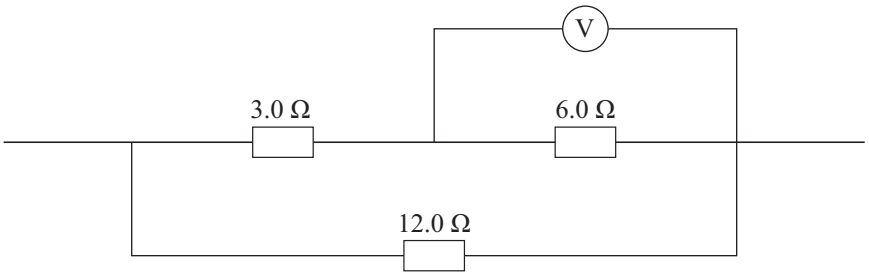
(i) the size of the force acting on an electron

(ii) the kinetic energy gained by an electron.

PĀTAI TUARUA: NGĀ ARA IAHIKO

MĀ TE KAIMĀKA ANAKE

Kei te mahi anō a Tavita i te puna hiko mō te ngongo whakaahua whakaroto. E whakaatu ana te hoahoa i raro i tētahi wāhanga o te ara iahiko e whakamātautau ana a Tavita.



(a) E tohu ana te ine-ngaohiko i te 18.0 V.

Tātaitia te rahinga o te iahiko mā te parenga iahiko 6.0 Ω.

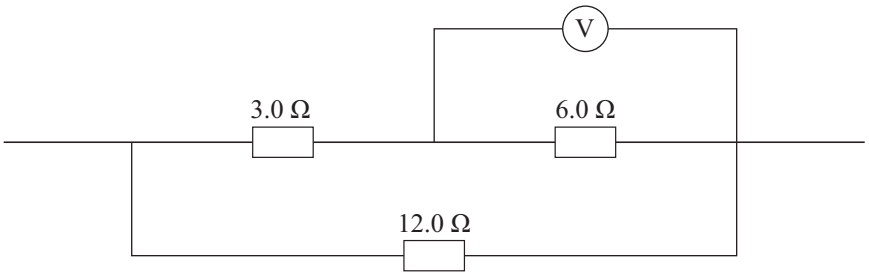
Tuhia mai tō whakautu ki te maha tika o ngā mati tāpua.

(b) Whakamāramatia ka ahatia te whakaputanga ngoi o te parenga 6.0 Ω ki te pūruatia te ngaohiko e rere ana mā taua parenga.

QUESTION TWO: CIRCUITS

ASSESSOR'S USE ONLY

Tavita is also working on the power supply for the X-ray tube. The diagram below shows part of the circuit that Tavita is testing.



(a) The voltmeter reads 18.0 Volts.

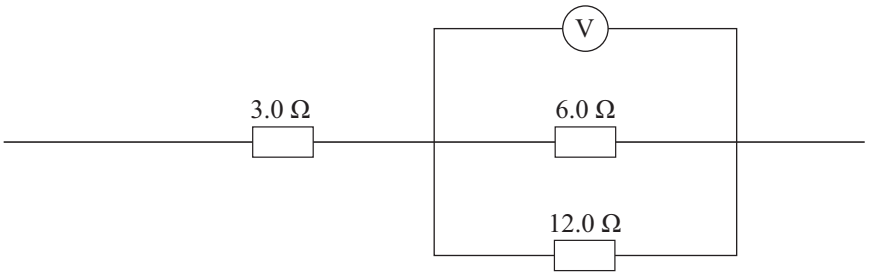
Calculate the size of the current through the 6.0 Ω resistor.

Write your answer with the correct number of significant figures.

(b) Explain what happens to the power output of the 6.0 Ω resistor if the voltage across it doubles.

Ka tūhono anō a Tavita i ngā parenga e toru e ai ki tērā e whakaaturia ana i raro.

MĀ TE KAIMĀKA ANAKE



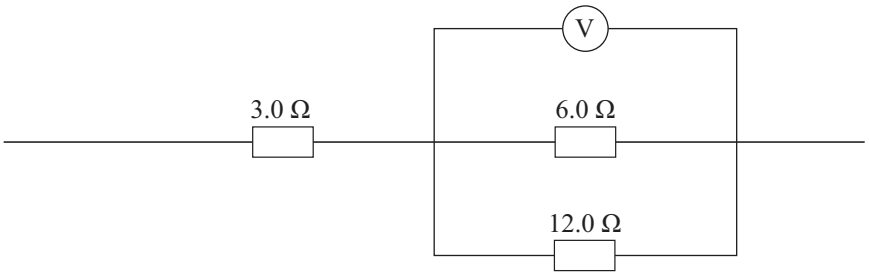
(c) Kua hurihia te ara iahiko kia noho ai te iahiko mā te parenga 6.0 Ω hei 2.0 A.

Tātaitia te whakaputanga hiko o te parenga 3.0 Ω.

(d) Whakamāramahia ka ahatia te ngaohiko e rere ana mā te parenga 3.0 Ω mēnā ka tangohia te parenga 12.0 Ω, engari ka ōrite tonu te ngaohiko tapeke.

Tavita reconnects the three resistors as shown below.

ASSESSOR'S USE ONLY



(c) The circuit is changed so that the current through the 6.0 Ω resistor is now 2.0 A.

Calculate the power output of the 3.0 Ω resistor.

(d) Explain what would happen to the voltage across the 3.0 Ω resistor if the 12.0 Ω resistor is removed, but the total voltage remains the same.

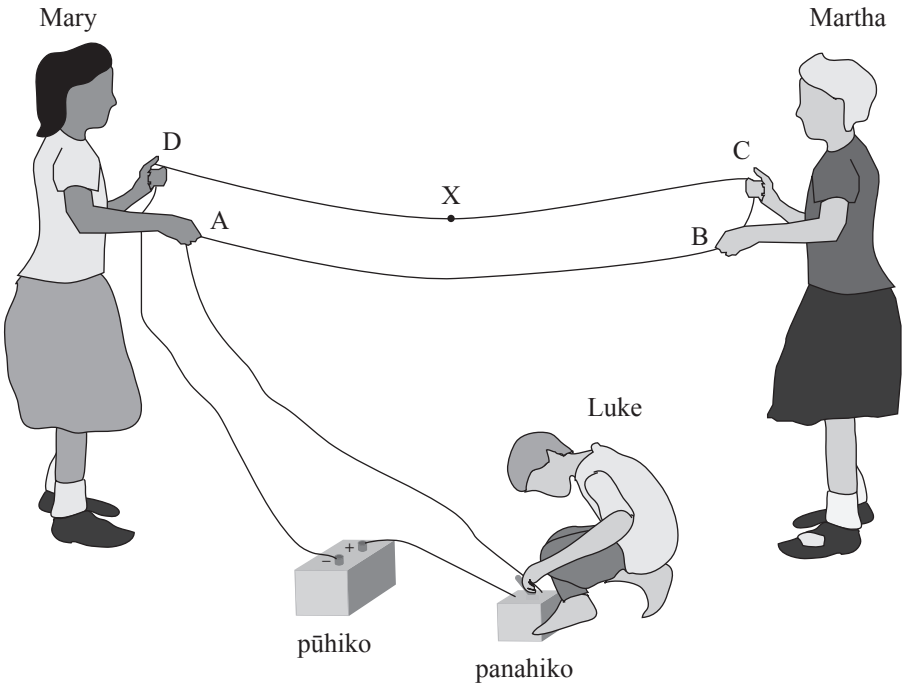
PĀTAI TUATORU: AUTŌ Ā-HIKO

MĀ TE KAIMĀKA ANAKE

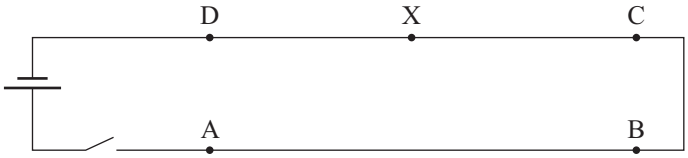
Kei te whakamātautau a Mary rātou ko Martha ko Luke i ngā waea me ngā pūhiko. Ka tūhono rātou i tētahi waea roa ki tētahi pūhiko motokā me tētahi panahiko, ka pupuri i te waea e ai ki te hoahoa i raro.

Ina kati a Luke i te panahiko, ka kitea rātou i ngā waea e neke ana.

Te whana kei te irahiko $= 1.6 \times 10^{-19}$ C



He tirohanga mai i runga ki raro te hoahoa o te whakamātauranga.



(a) Tirohia te hoahoa tuarua, ka whakatau i te ahunga o te **papa autō** i te pūwāhi "X" nā te waea AB.

Nō reira whakatauhia te ahunga o te **tōpana autō** kei te waea CD.

Kōwhirihia mai i ēnei:
Ki waho i te whārangi
Ki roto i te whārangi
Ki runga rawa o te whārangi
Ki raro rawa o te whārangi
Mauī
Matau

Ahunga o te papa autō i X: _____

Ahunga o te tōpana autō kei runga i CD: _____

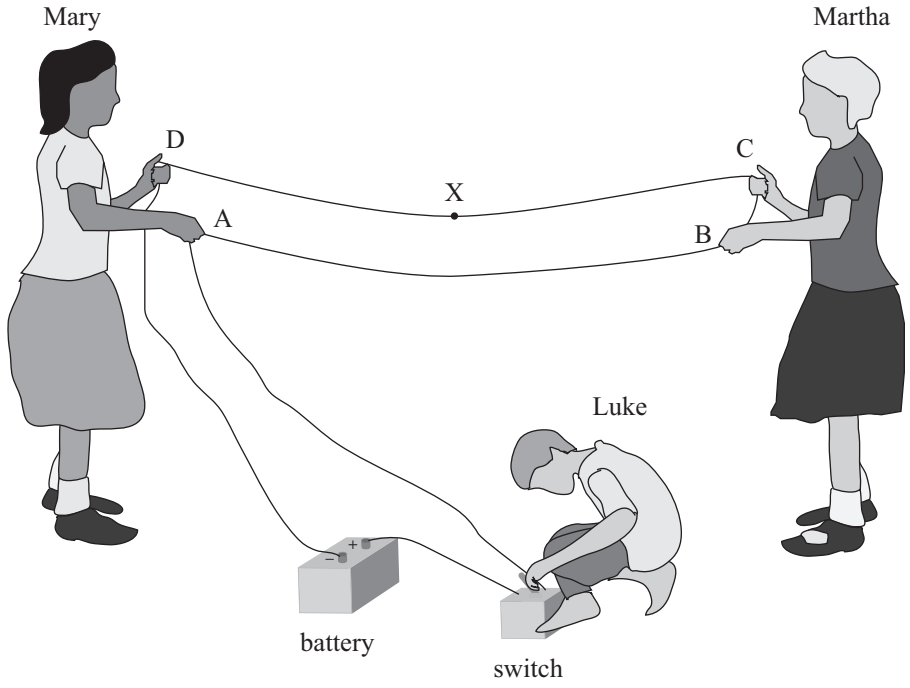
QUESTION THREE: ELECTROMAGNETISM

ASSESSOR'S USE ONLY

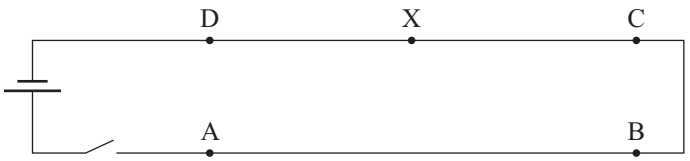
Mary, Martha and Luke are doing some experiments with wires and batteries. They connect a long wire to a car battery and a switch, and hold the wire as shown in the diagram below.

When Luke closes the switch, they notice that the wires move.

Charge on an electron = 1.6×10^{-19} C



The diagram below shows the experiment looking down from above.



(a) Referring to the second diagram, determine the direction of the **magnetic field** at the point "X" due to the wire AB.

Hence determine the direction of the **magnetic force** on the wire CD.

Choose from:
Out of the page
Into the page
Towards the top of the page
Towards the bottom of the page
Left
Right

Direction of magnetic field at X: _____

Direction of magnetic force on CD: _____

(b) He 5.0 m te roa o te waea i waenga i a Mary rāua ko Martha. He 0.013 N te rahi o te tōpana i waenga i ngā waea. He 35 A te iahiko i roto i te waea.

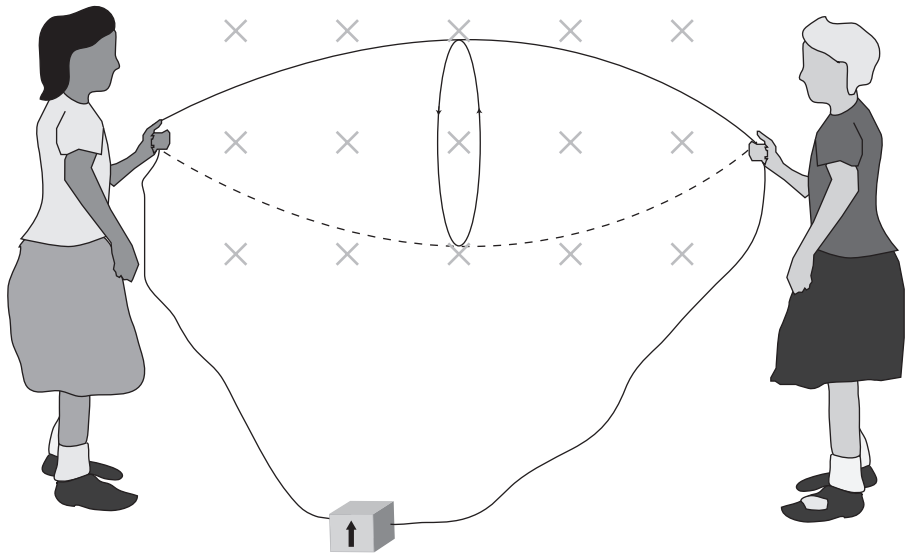
Tātaitia te rahi o te papa autō i te pūwāhi "X".

Homai te wae tika me tō whakautu.

Ka whakamātau a Mary rāua ko Martha ki te whakanao i tētahi iahiko mā te tāwhiowhio i te waea pēnei i te taura pekepeke kia tapahi atu ai i te papa autō o Papatūānuku e ai ki te hoahoa i raro.

E tūhono ana ngā pito o te waea ki tētahi ine-iahiko pokapū-0 tairongo.

He whakarara te papa autō o Papatūānuku ki te papa, ā, he 3.1×10^{-5} T te kaha.



ine-iahiko pokapū-0 × – papa autō ki te whārangi

(c) Ko te tere toharite o te waea puta noa he 3.0 m s^{-1}. Ko te parenga iahiko o te waea he 1.5 Ω. Ka noho tonu te roa o te waea ki te 5.0 m.

Tātaitia te rahi o te iahiko mōrahi i roto i te waea.

ASSESSOR'S USE ONLY

(b) The length of the wire between Mary and Martha is 5.0 m. The size of the force between the wires is 0.013 N. The current in the wire is 35 A.

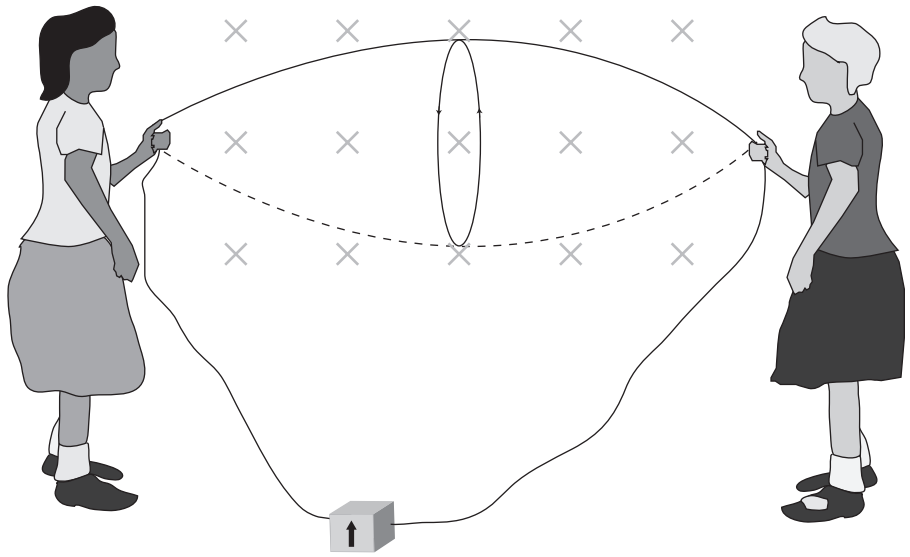
Calculate the size of the magnetic field at the point "X".

Give the correct unit with your answer.

Mary and Martha next try to produce an electric current by spinning the wire in a circle like a skipping rope so that it cuts across the Earth's magnetic field as shown in the diagram below.

The ends of the wire are connected to a sensitive centre-zero ammeter.

The earth's magnetic field is parallel to the ground and has a strength of 3.1×10^{-5} T.



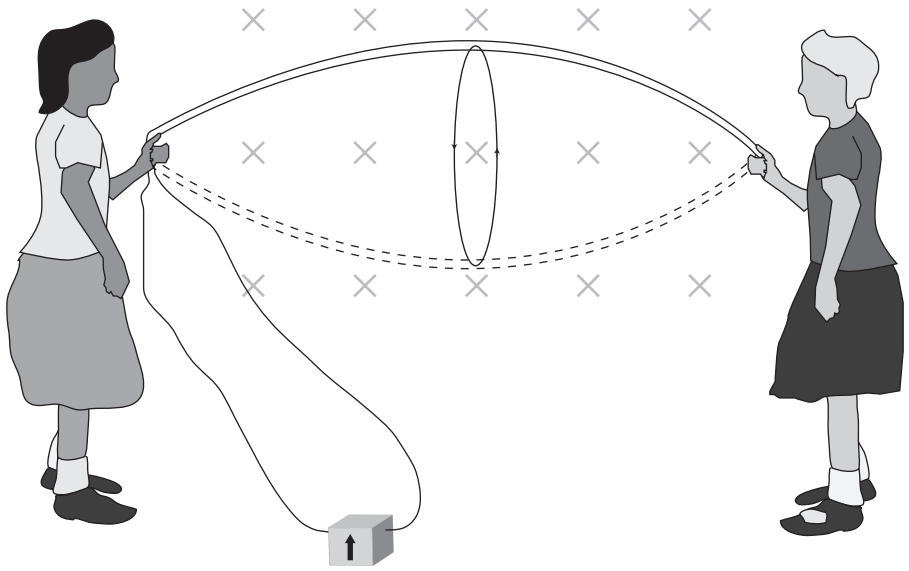
centre-zero ammeter × – magnetic field into page

(c) The average speed of any part of the wire is 3.0 m s^{-1}. The wire's resistance is 1.5 Ω. The length of the wire remains at 5.0 m.

Calculate the size of the maximum current in the wire.

(d) Kua kīia atu a Mary rāua ko Martha mā te tiki waea atu anō ka nui ake te iahiko. Ka whakamātau rāua i te whakanahatanga e whakaaturia ana ki te hoahoa i raro, me te piu haere tahi i ngā pito e rua o te pīrori waea.

MĀ TE KAIMĀKA ANAKE

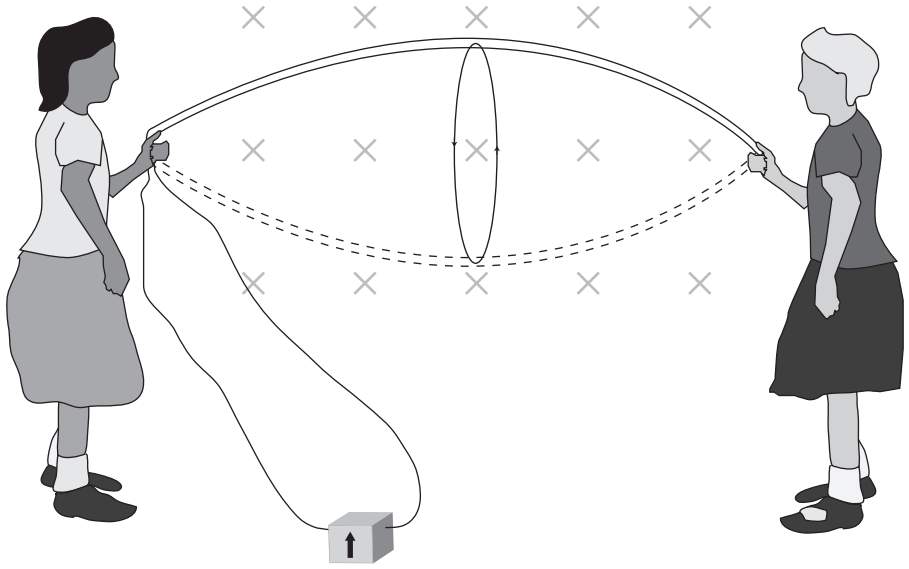


ine-iahiko pokapū-0 × – papa autō ki te whārangi

Whakamāramahia mai ka ahatia te rahi o te iahiko mōrahi.

ASSESSOR'S USE ONLY

(d) Mary and Martha have been told that more wire will produce a larger current. They try the arrangement shown in the diagram below, swinging both sides of the wire loop together.



centre-zero ammeter × – magnetic field into page

Explain what happens to the size of the maximum current.

He puka anō mēnā ka hiahiatia.
Tuhia te (ngā) tau pātai mēnā e hāngai ana.

TAU PĀTAI

MĀ TE KAIMĀKA ANAKE

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 2 Physics, 2013

91173 Demonstrate understanding of electricity and electromagnetism

2.00 pm Wednesday 13 November 2013
Credits: Six

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of electricity and electromagnetism.	Demonstrate in-depth understanding of electricity and electromagnetism.	Demonstrate comprehensive understanding of electricity and electromagnetism.

91173M

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have Resource Sheet L2–PHYSR.

In your answers use clear numerical working, words and / or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–17 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.