91526M

915265

3

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Ahupūngao, Kaupae 3, 2017

91526M Te whakaatu māramatanga ki ngā pūnaha hiko

2.00 i te ahiahi Rāhina 20 Whiringa-ā-rangi 2017
Whiwhinga: Ono

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā pūnaha hiko.	Te whakaatu māramatanga hōhonu ki ngā pūnaha hiko.	Te whakaatu māramatanga matawhānui ki ngā pūnaha hiko.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

Tirohia mēnā kei a koe te Pukapuka Rauemi L3–PHYSMR.

Ki roto i ō tuhinga, whakamahia ngā whiriwhiringa tohutau mārama, ngā kupu, ngā hoahoa hoki, tētahi, ētahi rānei o ēnei, ki hea hiahiatia ai.

Me hoatu te wae tika o te Pūnaha Waeine ā-Ao (SI) ki ngā tuhinga tohutau, ki ngā tau tika o ngā tau tāpua.

Mēnā ka hiahia whārangi atu anō mō ō tuhinga, whakamahia te wāhi wātea kei muri o tēnei pukapuka.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–21 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

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

TAPEKE

MĀ TE KAIMĀKA ANAKE

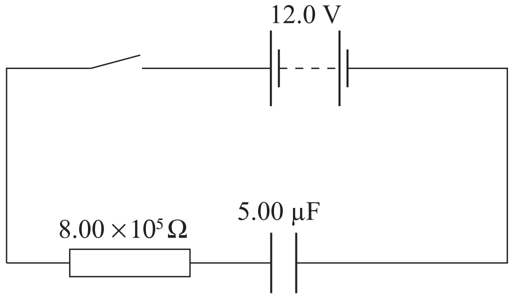
MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

He tūrama roto kei te waka o Thomas ka kā mai ina huakina te kūaha. I te katinga o te kūaha, he wā poto noa kātahi anō ka weto ngā tūrama. E whakaritea ana tēnei wā poto e te aumou wā o tētahi ara iahiko parenga-pūnga.

(a) Whakaahuatia mai te tikanga o te kupu aumou wā.

E whakaatu ana te hoahoa o raro i tētahi ara iahiko parenga-pūnga. He hiko-kore te pūnga iahiko i te tuatahi.
I te katinga o te panahiko, he 7.20×10^{-4} J te tuku pūngao a te pūhiko.



(b) (i) Tātaihia te pūngao e noho ana i roto i te pūnga iahiko ina hihiko katoa.

(ii) Whakamāramahia te take he iti iho tēnei pūngao e noho ana i te pūnga iahiko i te pūngao e tukuna ana e te pūhiko.

QUESTION ONE

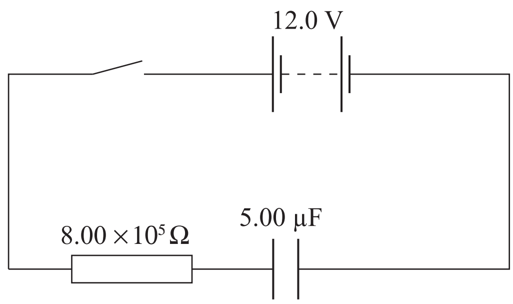
ASSESSOR'S USE ONLY

Thomas's car has an interior light that turns on when a door is opened. When the door closes, there is a time delay before the light turns off. The time delay is determined by the time constant of a resistor-capacitor (RC) circuit.

(a) Describe what is meant by the term time constant.

The diagram below shows an RC circuit. The capacitor is initially uncharged.

After the switch is closed, the battery supplies 7.20×10^{-4} J of energy.

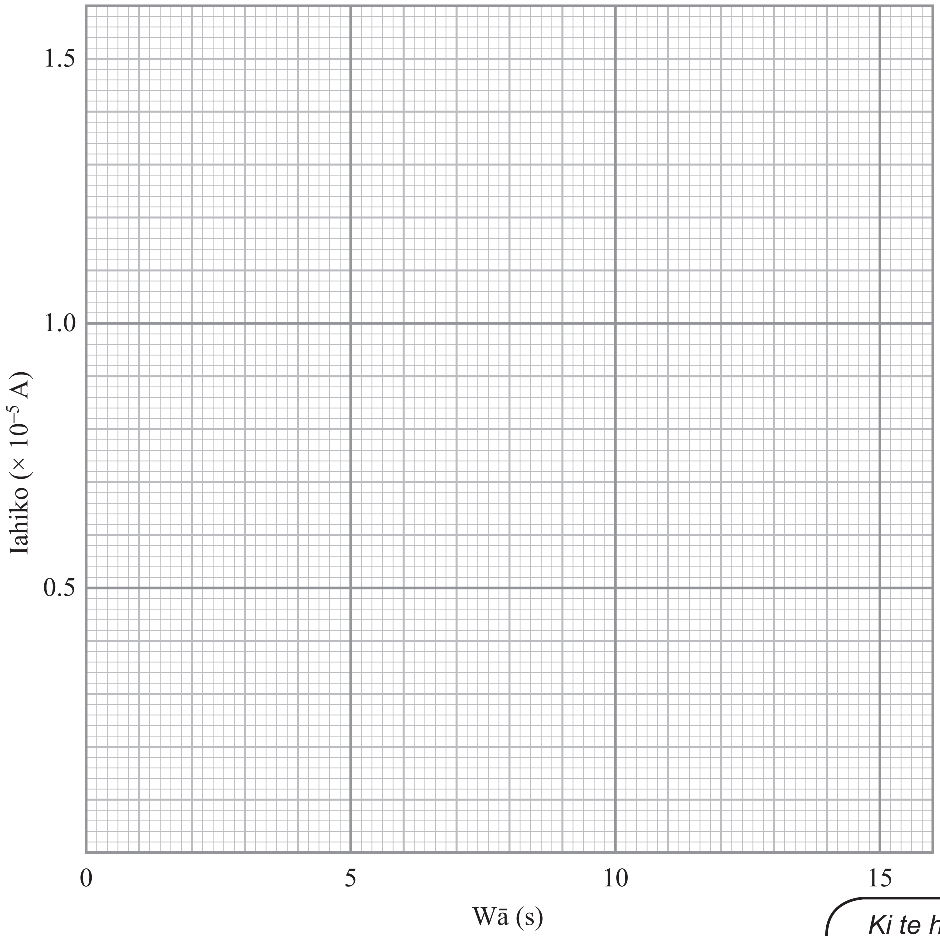


(b) (i) Calculate the energy stored in the capacitor when it is fully charged.

(ii) Explain why this energy stored in the capacitor is less than the energy supplied by the battery.

(c) (i) Tātuhia he kauwhata o te iahiko ki te wā mō te 15 hēkona i muri i te katinga o te panahiko.

Me uru ki ngā pūwāhi raraunga ko te iahiko i te tuatahi me te iahiko i muri i tētahi aumou wā kotahi.



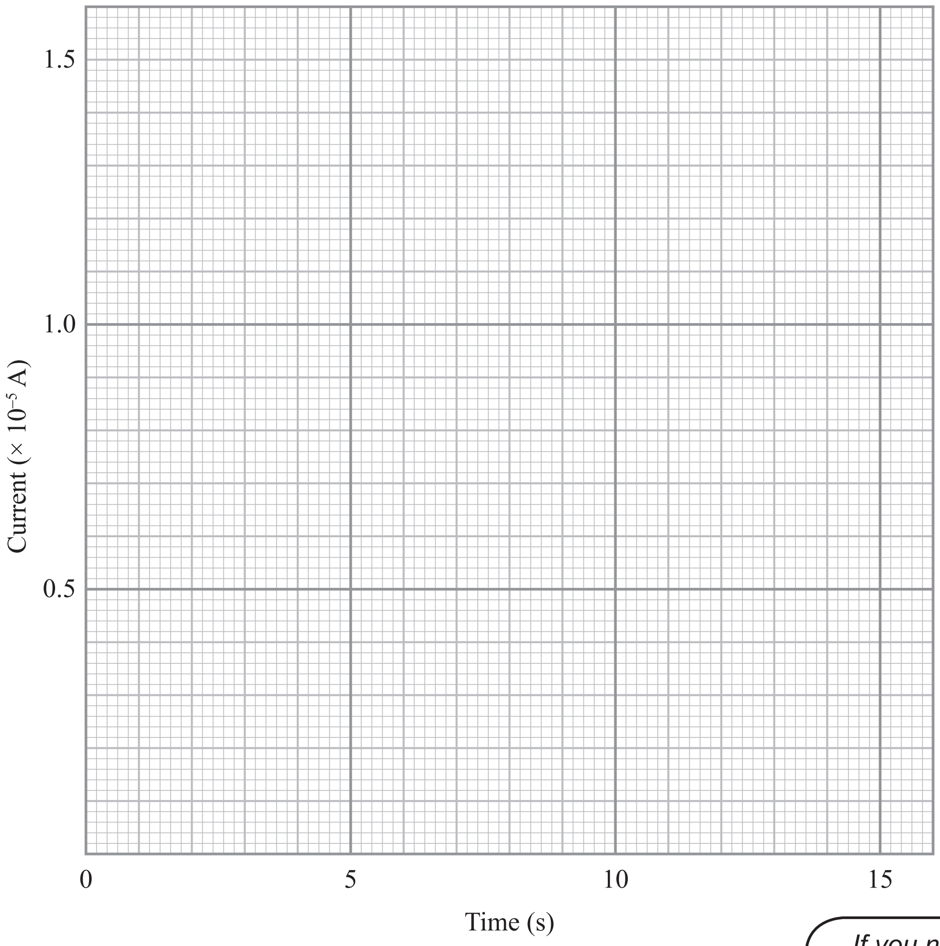
Ki te hiahia koe ki te tuhi anō i tō kauwhata, whakamahia te tukutuku i te whārangi 18.

He wāhi mō ō tātaihanga

(ii) Whakamāramahia mai he aha i pērā ai te āhua o te kauwhata i tātuhia e koe.

ASSESSOR'S USE ONLY

(c) (i) Draw a graph of circuit current against time for 15 seconds after the switch is closed. Data points should include the initial current and the current after one time constant.



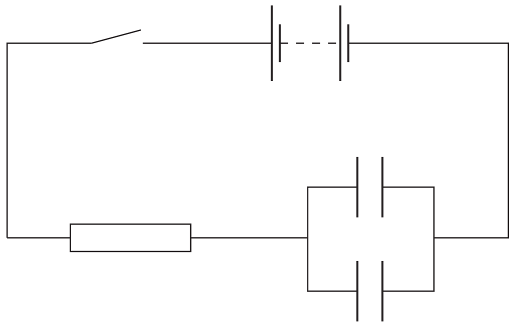
If you need to redraw your graph, use the grid on page 19.

Space for working

(ii) Explain why the graph has the shape you have drawn.

MĀ TE KAIMĀKA ANAKE

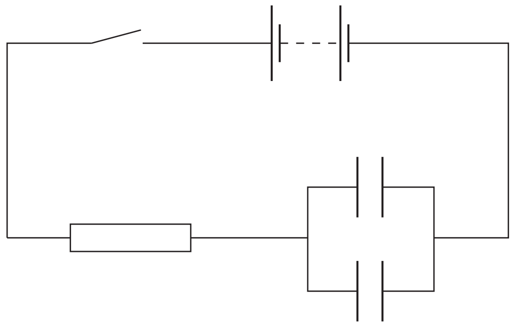
(d) Ka taea te aumou wā o te ara iahiko parenga-pūnga te huri mā te tāpiri mai i tētahi pūnga iahiko tuarua, e whakaaturia ana i raro.



Whakamāramahia mai he pēhea te pānga o tēnei ki te wā e whakahihiko ana te pūnga iahiko.

ASSESSOR'S USE ONLY

(d) The time constant of the RC circuit can be changed by adding a second capacitor, as shown below.



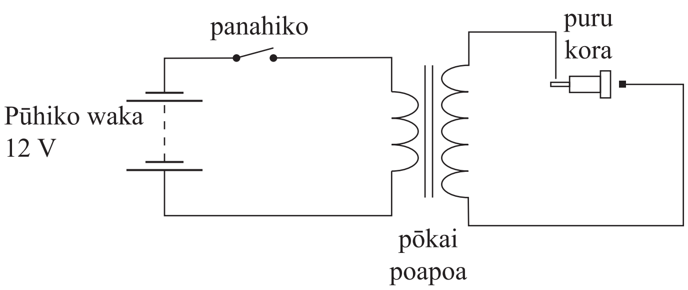
Explain how this affects the time taken for the capacitor to charge up.

TŪMAHI TUARUA

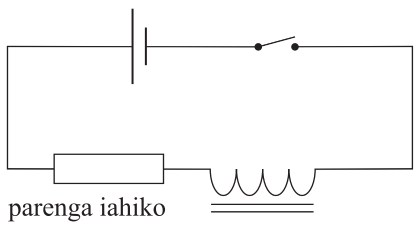
I tētahi pūkaha waka, ka whakamahia he pōkai poapoa ki te whakaputa i tētahi korakora ngaohiko tino kaha. He āhua ōrite te mahi a te pōkai poapoa ki tētahi whitihiko.

E whakaatu ana te hoahoa i raro i te whakanahanga ara iahiko e puta ai he korakora i roto i te puru kora ina huakina te panahiko.

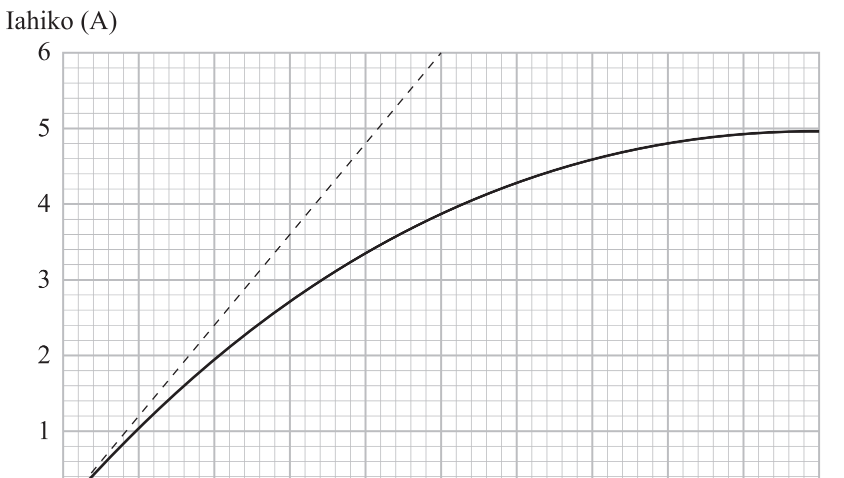
E 50 ngā huringa o te pōkai poapoa i roto i te pōkai matua, ā, 8000 ngā huringa i te pōkai tuarua. E tākaia ana ngā pōkai e rua ki tētahi iho rino.



Ka taea te pōkai matua o te pōkai poapoa te whakatauira mā tētahi parenga iahiko e noho hātepe ana me tētahi pūpoapoa parenga-kore e ai ki te hoahoa i raro.



E whakaatu ana te kauwhata e whai ake i te iahiko e huri ana ki te wā i muri i te katinga o te panahiko (rārangi motukore).



MĀ TE KAIMĀKA ANAKE

(a) Tuhia te uara o te ngaohiko whakawhiti te pūpoapoa parenga-kore ina eke te iahiko ki te uara mōrahi o te 5.0 A.

(b) Whakamāramahia mai he aha i kore ai e tae tika tonu atu te iahiko ki te uara mōrahi i te katinga o te panahiko.

(c) I muri tonu i te katinga o te panahiko, ko te EMF kōaro whakawhiti te pūpoapoa parenga-kore he 12.0 V.

Mā te whakamahi i te rārangi iraira kei te kauwhata i te whārangi 8, tātaitia te poapoatanga-ake o te pūpoapoa parenga-kore.

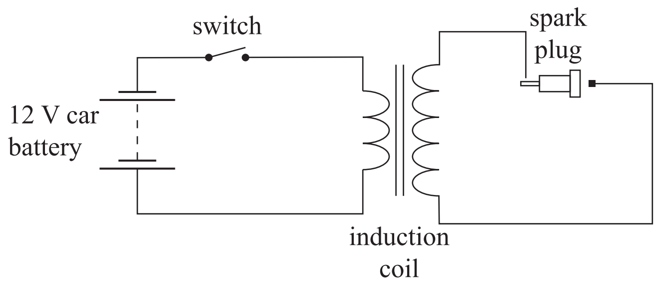
QUESTION TWO

ASSESSOR'S USE ONLY

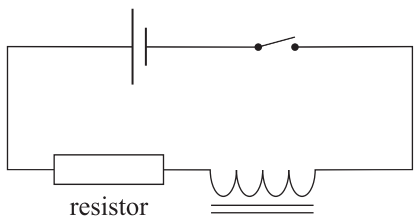
In a car engine, an induction coil is used to produce a very high voltage spark. An induction coil acts in a similar way to a transformer.

The diagram below shows the circuit arrangement that will enable a spark to be produced in the spark plug when the switch is opened.

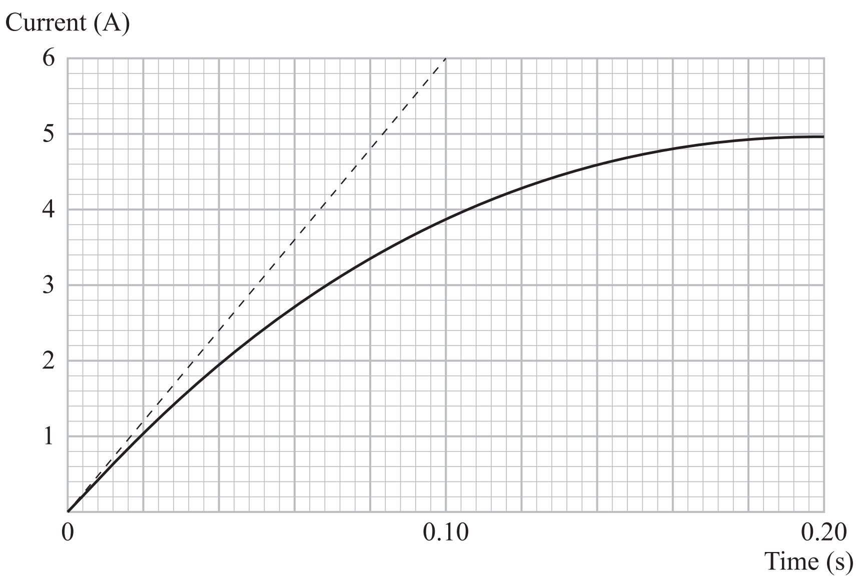
The induction coil has 50 turns in the primary coil and 8000 turns in the secondary coil. Both coils are wrapped around an iron core.



The primary coil of the induction coil can be modelled by a resistor in series with an ideal inductor as shown in the diagram below.



The following graph shows the current changing with time after the switch is closed (solid line).



ASSESSOR'S USE ONLY

(a) State the value of the voltage across the ideal inductor once current has reached a maximum value of 5.0 A.

(b) Explain why the current does not immediately reach maximum value as soon as the switch is closed.

(c) Immediately after the switch is closed, the back EMF across the ideal inductor is 12.0 V.

Using the dotted line on the graph on page 10, calculate the self-inductance of the ideal inductor.

MĀ TE KAIMĀKA ANAKE

(d) Me whai ngaohiko tino kaha kia puta ai he korakora.

Whakamāramahia mai he aha i puta ai he korakora whakawhiti te āputa o te puru kora ina huakina te panahiko.

ASSESSOR'S USE ONLY

(d) Sparks require a very high voltage to be produced.

Explain how it is possible for a spark to be produced across the gap in the spark plug when the switch is opened.

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATORU

He mea nui kia kaua e nui te wai i roto i ngā papa e whakamahia ana i roto i ngā whare.

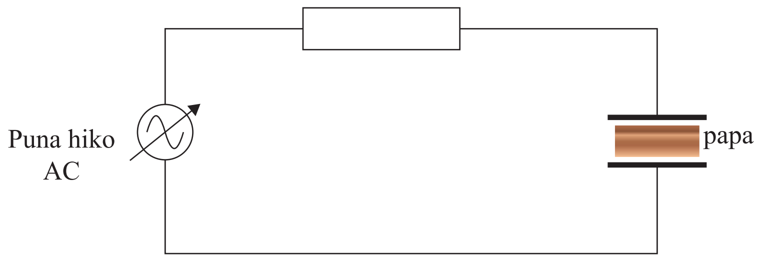
Ka whakamahia e Thomas he pūnga iahiko papana-whakarara, ko te papa te āraihiko, hei ine i te wai i roto i ngā papa.

He nui ake te aumou āraihiko o te wai i te papa.

Ko tētahi tikanga o te ine rahinga wai i te papa ko te whakamahi i te ara iahiko e whakaaturia ana i raro.

Ka tūhono a Thomas i te ara iahiko, ā, ka whakaritea ēnei inenga e whai ake:

Ngaohiko	= 12.0 V_{rms}
Auautanga	= 151 Hz
Parenga o te pare iahiko	= 50.0 Ω
Tauhohenga o te pūnga iahiko	= 23.5 Ω



(a) Tātaitia te mōrahi ngaohiko o te puna hiko AC.

(e) Tātaihia te iahiko rms i roto i te ara iahiko.

ASSESSOR'S USE ONLY

QUESTION THREE

It is important that the wood used in buildings does not have much water in it.

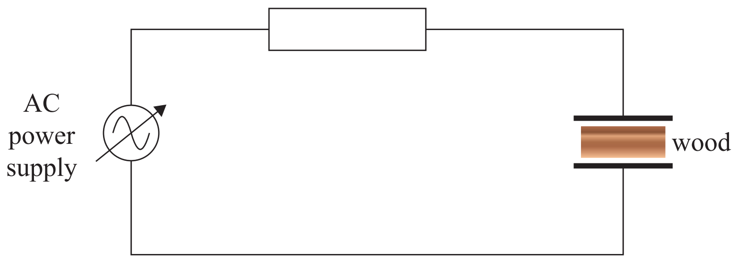
Thomas uses a parallel-plate capacitor, with the wood as the dielectric, to measure the water content of the wood.

Water has a higher dielectric constant than wood.

One way of measuring the water content in the wood is by using the circuit shown below.

Thomas connects the circuit, and makes the following measurements:

Supply voltage	= 12.0 V_{rms}
Frequency	= 151 Hz
Resistance of the resistor	= 50.0 Ω
Reactance of capacitor	= 23.5 Ω



(a) Calculate the peak voltage of the AC power supply.

(b) Calculate the rms current in the circuit.

MĀ TE KAIMĀKA ANAKE

(c) Whakamāramahia mai ka ahatia te iahiko ina whakakapia te papa i roto i te pūnga iahiko ki tētahi papa ōrite he nui ake te wai i roto.

(d) Ka tāpirihia hātepetia he pūpoapoa ki te pūnga iahiko me te parenga iahiko i roto i te ara iahiko. Ko te tauhohenga o te pūpoapoa he 35.7 Ω i te 151 Hz. Ko te tauhohenga o te pūnga iahiko he 23.5 Ω i te 151 Hz.

Ka whakatikahia e Thomas te auautanga kia eke te iahiko ki te mōrahitanga.

(i) Tātaihia te auau kōwaro.

(ii) Whakamāramahia te take i mōrahi ai te iahiko i te auau kōwaro.

(c) Explain what would happen to the circuit current when the wood in the capacitor is replaced by a similar piece of wood that contains more water.

ASSESSOR'S USE ONLY

(d) An inductor is added in series with the capacitor and resistor in the circuit. The reactance of the inductor is 35.7 Ω at 151 Hz. The reactance of the capacitor is 23.5 Ω at 151 Hz.

Thomas adjusts the frequency until the current is maximum.

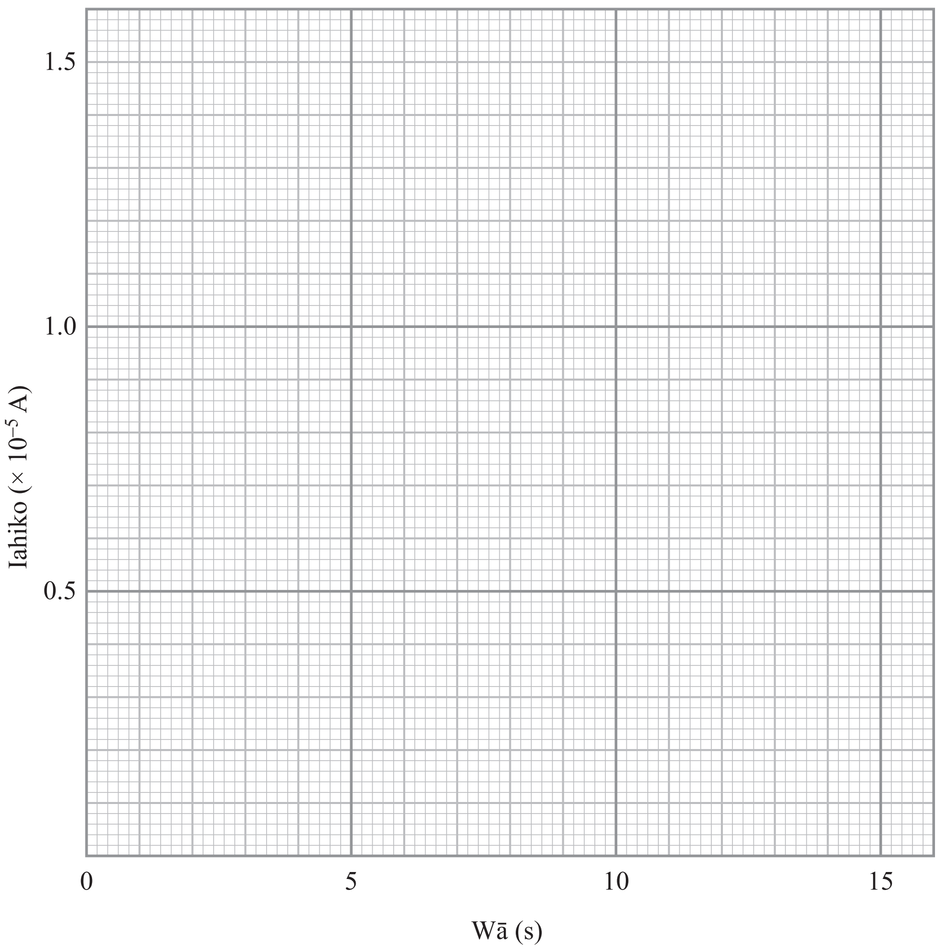
(i) Calculate the resonant frequency.

(ii) Explain why the current is maximum at the resonant frequency.

MĀ TE KAIMĀKA ANAKE

HE HOAHOA TĀPIRI

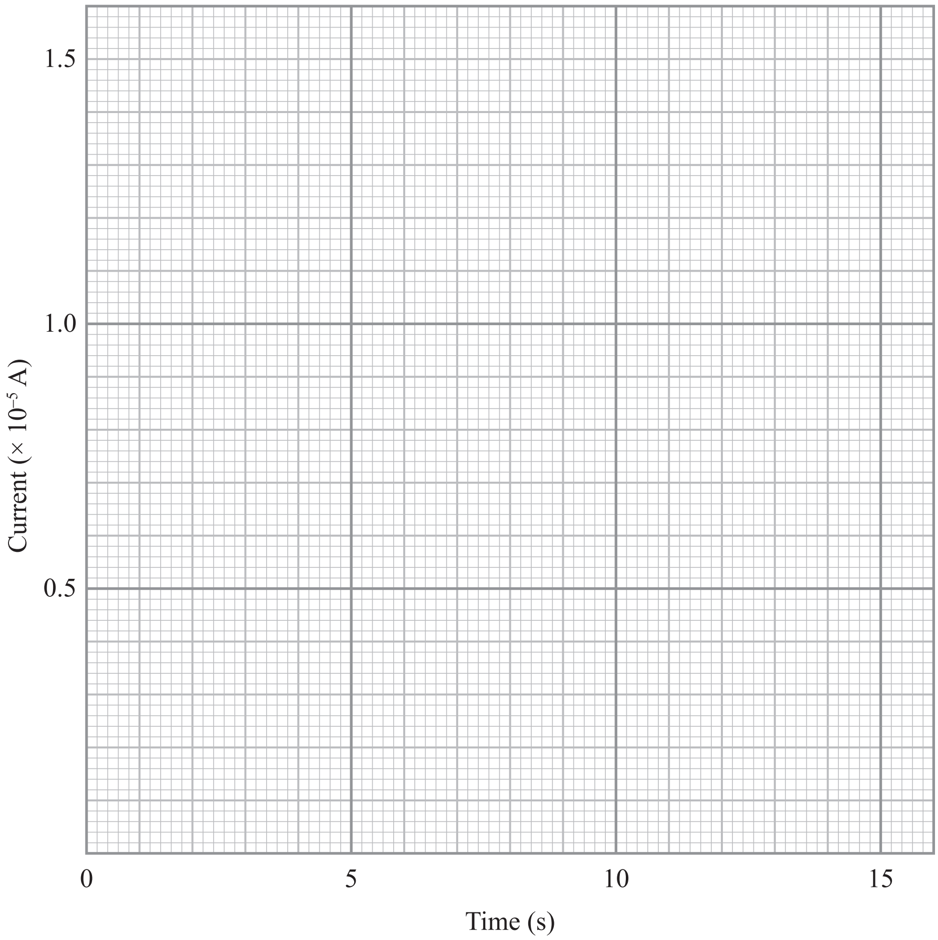
Ki te hiahia koe ki te tātuhi anō i tō kauwhata mai i te Tūmahi Tuatahi (c)(i), tātuhia ki te tukutuku o raro. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



SPARE DIAGRAMS

ASSESSOR'S USE ONLY

If you need to redraw your graph for Question One (c)(i), draw it on the grid below. Make sure it is clear which answer you want marked.



He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

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 3 Physics, 2017

91526 Demonstrate understanding of electrical systems

2.00 p.m. Monday 20 November 2017
Credits: Six

91526M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of electrical systems.	Demonstrate in-depth understanding of electrical systems.	Demonstrate comprehensive understanding of electrical systems.

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 Booklet L3–PHYSR.

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

Numerical answers should be given with an SI unit, to an appropriate number of significant figures.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–21 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.