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, 2018

91526M Te whakaatu māramatanga ki ngā pūnaha hiko

2.00 i te ahiahi Rātū 20 Whiringa-ā-rangi 2018
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 2–19 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

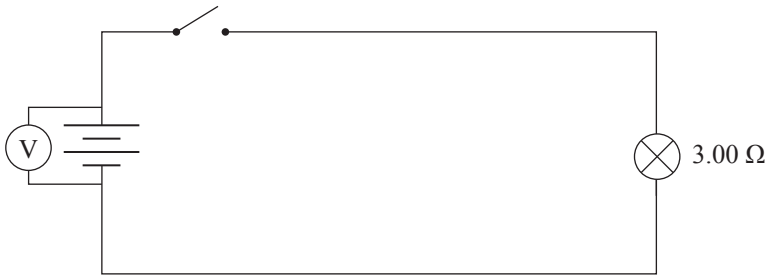
TAPEKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

MĀ TE KAIMĀKA ANAKE

Ka whakatūhia e Casey he pūhiko, he pana, me tētahi pūrama 3.00 Ω hei ara hātepe.



Ko te inenga o te ngaohiko pūhiko he 6.02 V ina huaki ana te pana. Engari, ka katia ana te pana, ka kite a Casey kua heke te ngaohiko pūhiko ki te 5.85 V.

(a) Whakamāramahia mai he aha i heke ai te ngaohiko pūhiko ina kati te pana.

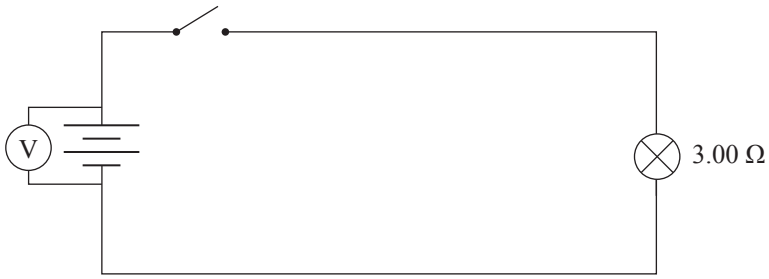
(b) Ko te ine a Casey i te iahiko e haere ana mā te ara iahiko he 1.89 A.

Tuhia te EMF, ka whakaatu i te parenga ā-roto o te pūhiko he tata ki te 0.09 Ω.

QUESTION ONE

ASSESSOR'S USE ONLY

Casey sets up a battery, a switch, and a 3.00 Ω light bulb in series.



The battery voltage is measured to be 6.02 V when the switch is open. However, when the switch is closed, Casey notices that the battery voltage drops to 5.85 V.

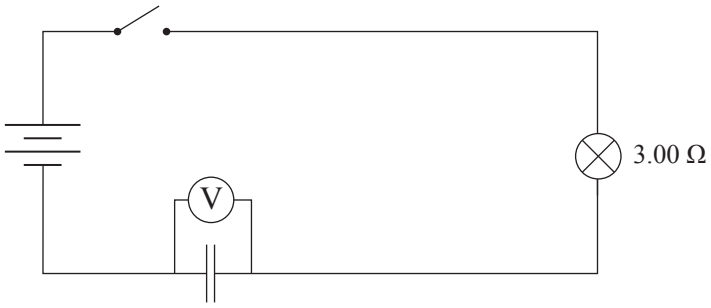
(a) Explain why the battery voltage is less when the switch is closed.

(b) Casey measures the current through the circuit to be 1.89 A.

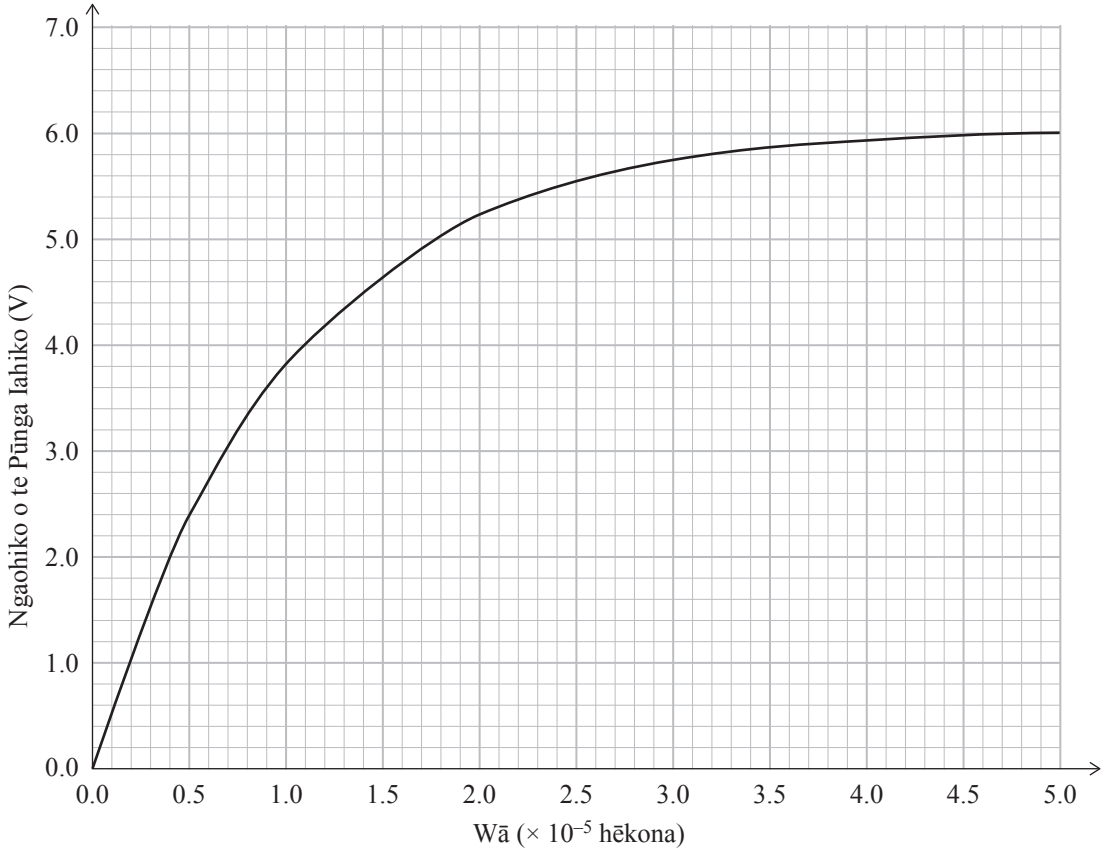
State the EMF, and show that the internal resistance of the battery is approximately 0.09 Ω.

Ka tāpirihia hātepetia e Casey he pūnga iahiko ki te pūhiko, ka kati i te pana. Ka inea e Casey te ngaohiko puta noa i te pūnga iahiko i te wā e whakahiko ana.

MĀ TE KAIMĀKA ANAKE



Te Ngaohiko Pūnga Iahiko i te wā Whakahiko

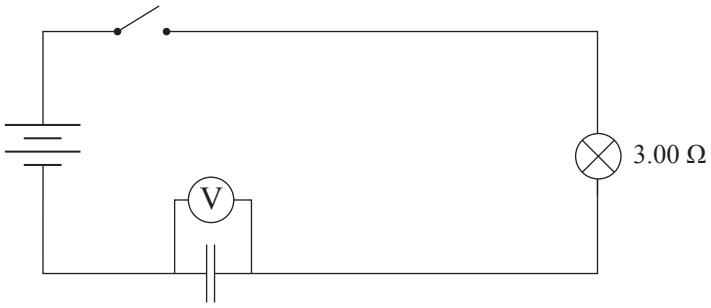


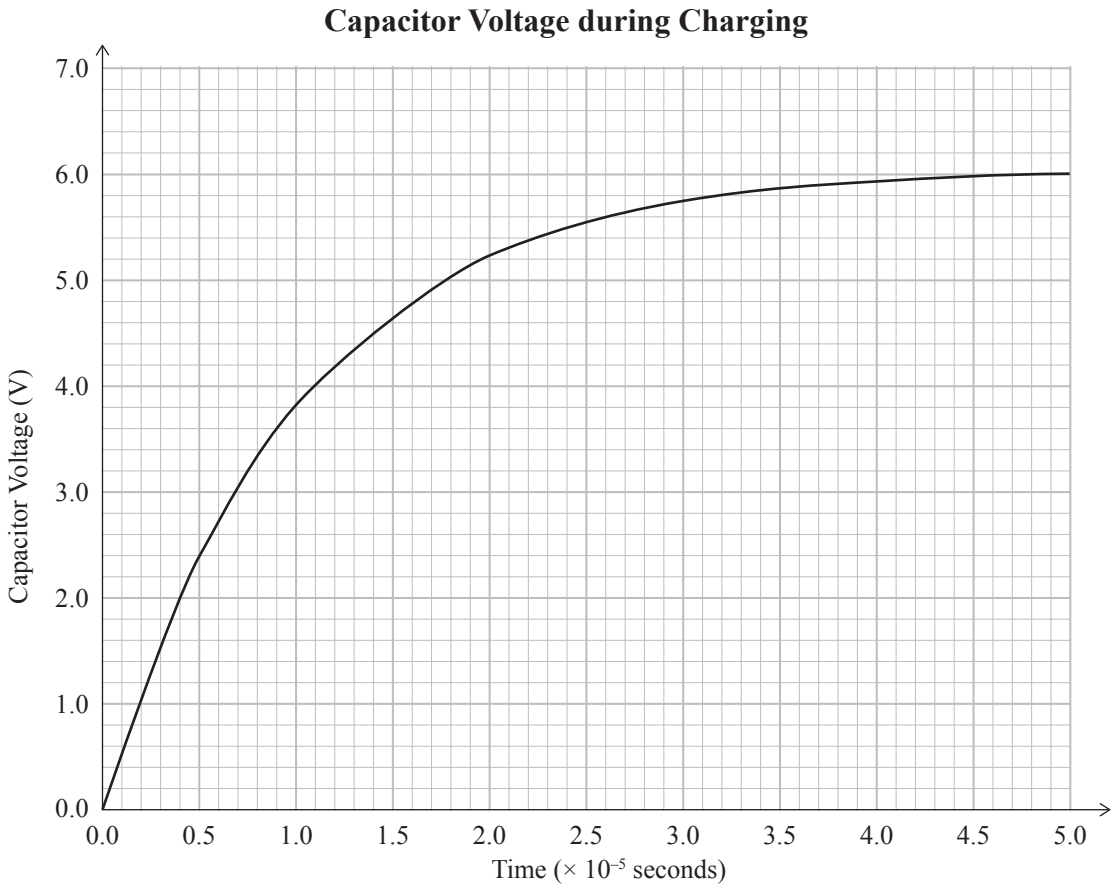
(c) Mā te whakamahi i ngā mōhiohio o te kauwhata, whakatauhia te āheipuringa[1] o te pūnga iahiko.

[1] kahapupuri hiko

ASSESSOR'S USE ONLY

Casey now adds a capacitor in series with the battery and closes the switch. Casey measures the voltage across the capacitor as it charges.





(c) Using information from the graph, determine the capacitance of the capacitor.

(d) Ka tukuna e Casey te pūnga iahiko, ka tangohia te pūrama, ā, ka tīmata anō ki te whakahiko i te pūnga iahiko. Ko te whakapae a Casey, mā te tango i te pūrama, ka iti ake te pūngao ka whakawhitia ki te rama me te wera, nō reira ka tere ake te whakahiko i te pūnga iahiko, ā, ka nui ake ngā pūngao pupuri ina oti te whakahiko.

MĀ TE KAIMĀKA ANAKE

Whakamahia te whakaaro ahupūngao hei matapaki i ia āhuatanga o te whakapae a Casey.

Me matapaki e koe, me ngā whakamārama:

- mēnā ka tere ake te whakahiko o te pūnga hiko ināianei tēnā i mua
- mēnā ka iti ake te pūngao ka whakawhitia ki te rama me te wera i te wā o te whakahiko i te kore o te pūrama
- mēnā ka nui ake te pūngao ka puritia ki te pūnga iahiko kua whakahiko katoatia.

ASSESSOR'S USE ONLY

(d) Casey discharges the capacitor, removes the light bulb, and begins to charge the capacitor again. Casey predicts that, by removing the light bulb, less energy will be converted to light and heat, and so the capacitor will charge more quickly, and have more stored energy once fully charged.

Use physical reasoning to discuss each aspect of Casey's prediction.

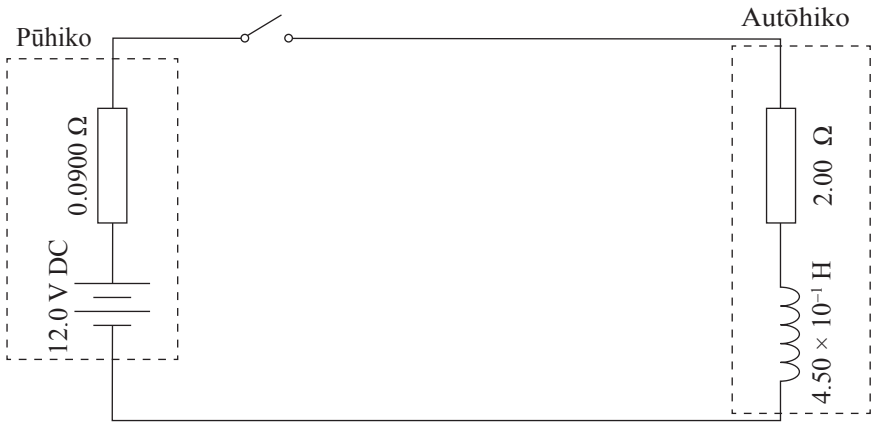
You should discuss, with explanations:

- whether the capacitor will charge more quickly than before
- whether less energy will be converted to light and heat during the charging process without the light bulb
- whether more energy will be stored in the fully charged capacitor.

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

Kei te whakamahia e Casey tētahi autōhiko he whai whāpoapoa o te 4.50×10^{-1} H me te parenga o te 2.00 Ω. Ka honoa e Casey ki tētahi pūhiko 12.0 V DC me tētahi parenga ā-roto o te 0.0900 Ω.



(a) Whakatauhia te iahiko e haere ana mā te autōhiko i ētahi meneti i muri mai i te katinga o te pana.

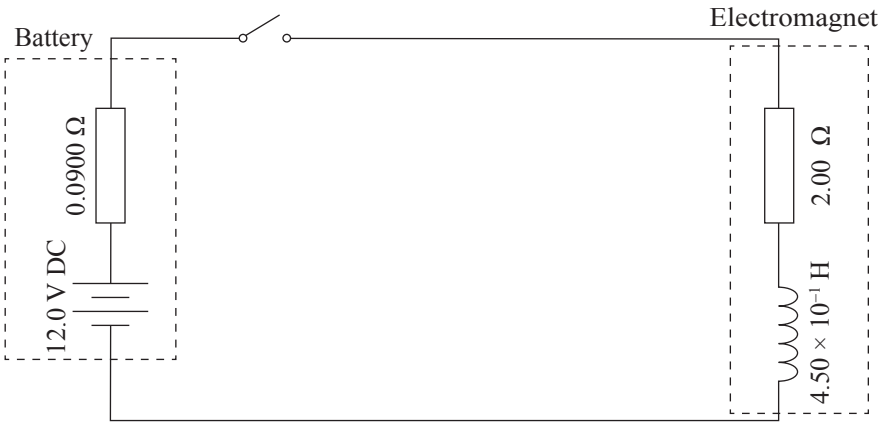
(b) Ka huakina e Casey te pana, ā, ka peke atu he kora nui i ngā pito o te pana huaki.

Whakamāramahia mai he pēhea te whakaputa a te pōkai i tētahi ngaohiko nui rawa ina huaki ana te pana.

QUESTION TWO

ASSESSOR'S USE ONLY

Casey is using an electromagnet that has an inductance of 4.50×10^{-1} H and a resistance of 2.00 Ω. Casey connects it to a 12.0 V DC battery with an internal resistance of 0.0900 Ω.



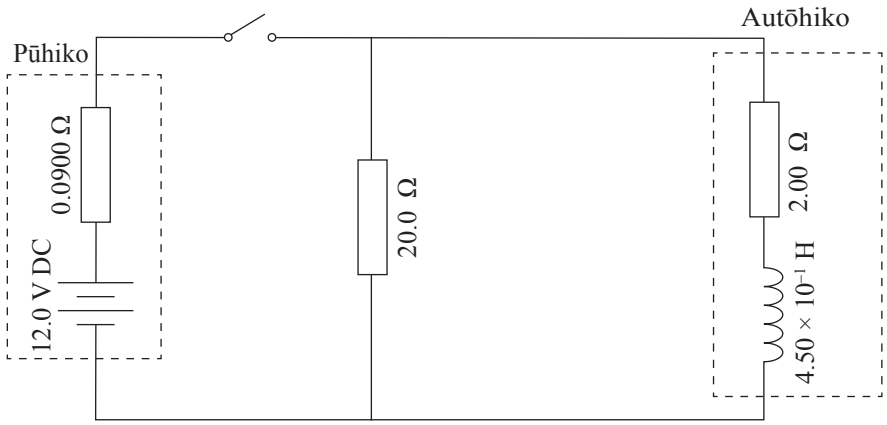
(a) Determine the current through the electromagnet a few minutes after the switch is closed.

(b) Casey opens the switch and a large spark jumps across the terminals of the open switch.

Explain how the coil can produce such a high voltage when the switch is opened.

(c) Kia kaua rawa he korakora tūkino, ka whakatakoto whakararatia e Casey tētahi parenga iahiko 20.0 Ω ki te taha o te autōhiko.

MĀ TE KAIMĀKA ANAKE

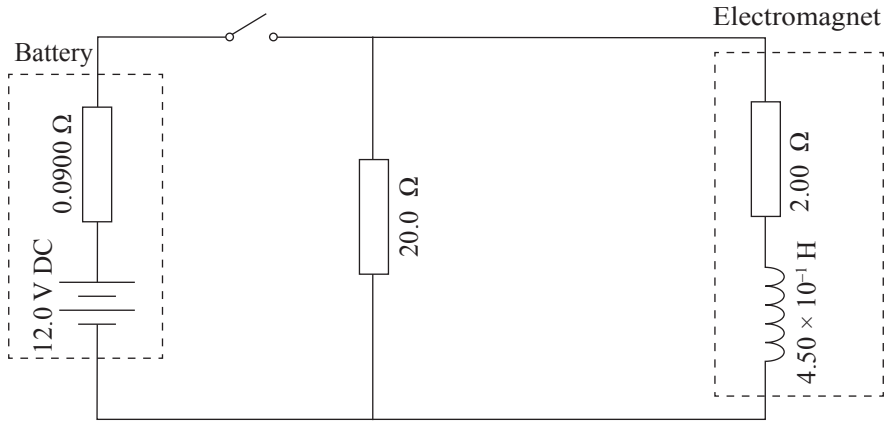


I tētahi wā, i muri tata mai i te katinga o te pana, ka eke te iahiko e piki haere ana mai i te pūhiko ki te 2.00 A , ā, ko te EMF o muri he 9.00 V e whakaputahia ana puta noa i te pūpoapoa.

Me whakaatu ko te iahiko e haere ana mā te autōhiko i tēnei wā he 1.41 A.

(c) To prevent damaging sparks, Casey places a 20.0 Ω resistor in parallel with the electromagnet.

ASSESSOR'S USE ONLY



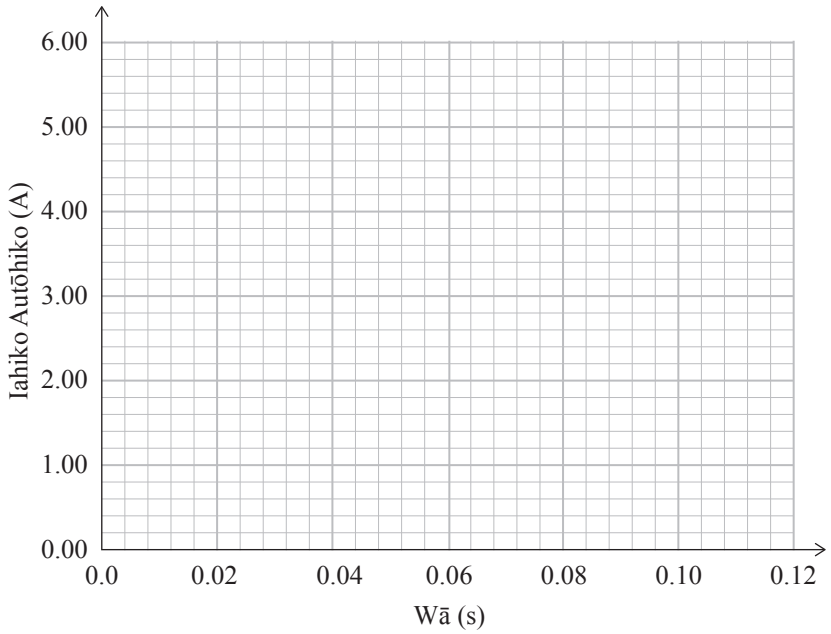
At one point, shortly after the switch is closed, the rising current drawn from the battery has reached 2.00 A and a back EMF of 9.00 V has been induced across the inductor.

Show that the current through the electromagnet at this time is 1.41 A.

(d) I muri i tētahi wā, he 5.72 A te ōrite o te rere o te iahiko i te pōkai.

Kua huakina te pana ināianei.

(i) Tuhia te kauwhata o te iahiko ki te wā mō te autōhiko ina neke ana te iahiko ki te kore.



(ii) Whakamāramahia mai he pēhea te pare a te parenga 20 Ω i ngā kora ngaohiko teitei i kite a Casey i mua ake.

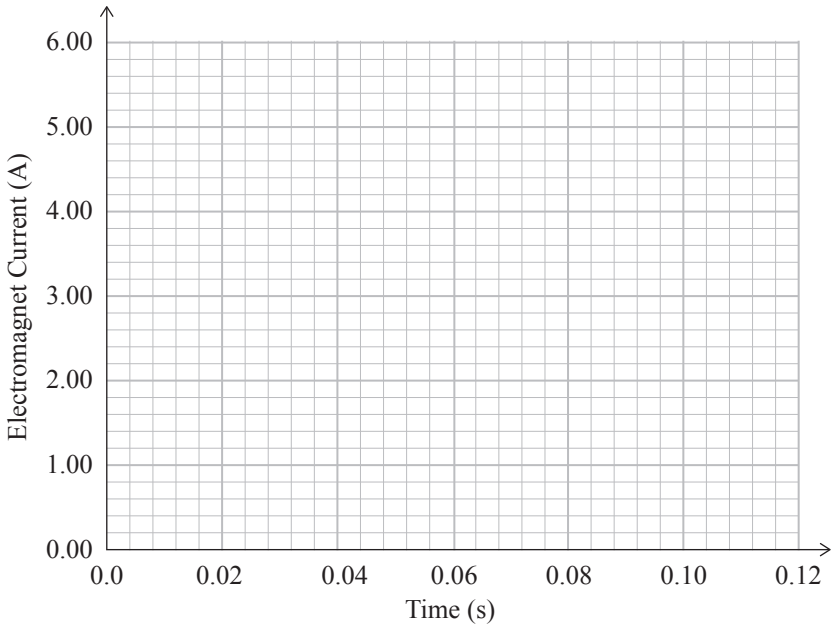
MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

(d) After many more minutes, the current through the coil is a steady 5.72 A.

The switch is now opened.

(i) Plot the graph of current versus time for the electromagnet as the current falls to zero.



(ii) Explain how the presence of the 20 Ω resistor protects against the high voltage sparks that Casey witnessed earlier.

TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

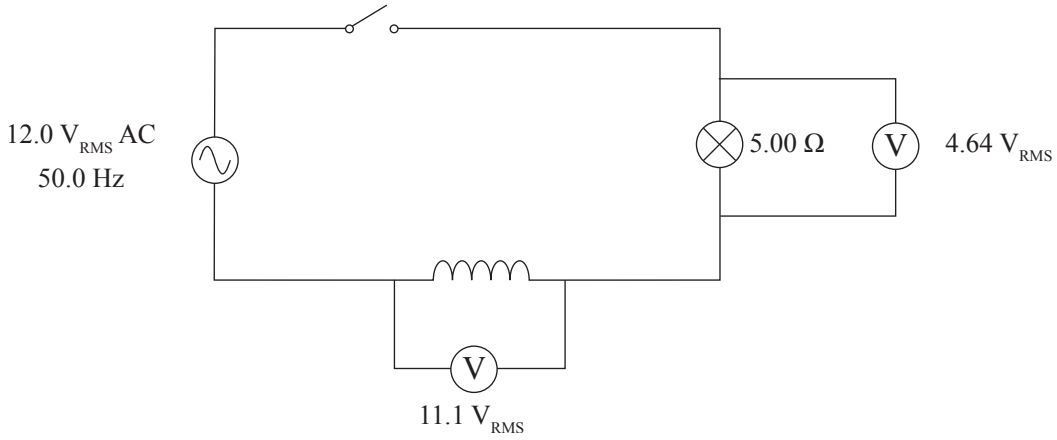
Kei te whakamātautau a Casey ki te waihanga i ngā pūpoapoa me ngā pūnga iahiko.

Hei waihanga i tētahi pūnga iahiko, ka raua e Casey he rapa whāiti i waenga i ngā papana konumohe 1.20 m^2 te whāiti, kātahi ka whakakōpētia ngā papana. He aumou āraihiko tō te rapa o te 8.90, ā, ka whakakōpeketia ki tētahi mātotoru o te 1.00×10^{-4} m.

(a) Me whakaatu ko te āheipuringa o te pūnga iahiko a Casey he 9.45×10^{-7} F.

Hei hanga i tētahi pūpoapoa, e hia rau ngā huringa a Casey o te waea konukura āraihiko ki tētahi matira rino. Kei te hiahia a Casey ki te whakamātautau i te whāpoapoa.

Ka hono ia i te ara iahiko, e whakaaturia ana i raro. Ko te ngaohiko puta noa i te rama ka inea he 4.64 V_{RMS}, ā, puta noa i te pūpoapoa he 11.1 V_{RMS}.



(b) Me whakaatu ko te whāpoapoa o te pūpoapoa a Casey he 3.81×10^{-2} H.

MĀ TE KAIMĀKA ANAKE

Ka tāpirihia mai e Casey te pūnga iahiko 9.45×10^{-7} F hei hanga i tētahi iahiko hātepe LCR. Ka tino paku te mura o te pūrama. Ka huria e Casey te putunga hiko AC ki te auau mōrahi kua whakaritea mō te 4.00×10^{2} Hz.

(c) Tātaihia te haukotinga (impedance) hou o te ara iahiko.

(d) (i) Tātaihia te auau kōwaro mō te ara iahiko ka whakataurite i tēnei ki te auau mōrahi kua whakaritea mō te putunga hiko.

(ii) Whakaahuahia mai ka pēhea te whakarerekē ā-ringa a Casey i te pūpoapoa me te pūnga iahiko hei whakapiki ake i te iahiko e haere ana mā te pūrama mā te whakamahi i tēnei putunga hiko.

QUESTION THREE

ASSESSOR'S USE ONLY

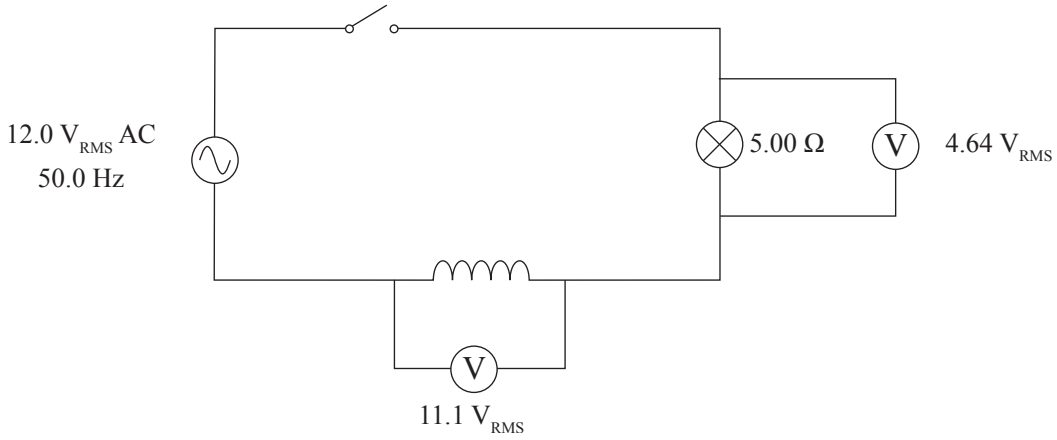
Casey is experimenting with building inductors and capacitors.

To make a capacitor, Casey places a thin layer of rubber between two 1.20 m^2 aluminium plates, and then squeezes the sheets together. The rubber has a dielectric constant of 8.90 and is compressed to a thickness of 1.00×10^{-4} m.

(a) Show that the capacitance of Casey's capacitor is 9.45×10^{-7} F.

To make an inductor, Casey winds several hundred turns of insulated copper wire around an iron rod. Casey wants to test its inductance.

Casey connects the circuit shown below. The voltage across the lamp is measured to be 4.64 V_{RMS}, and across the inductor to be 11.1 V_{RMS}.



(b) Show that the inductance of Casey's inductor is 3.81×10^{-2} H.

ASSESSOR'S USE ONLY

Casey adds in the 9.45×10^{-7} F capacitor to create an LCR series circuit. The light bulb barely glows. Casey switches the AC power supply to its maximum frequency setting of 4.00×10^{2} Hz.

(c) Determine the new impedance of the circuit.

(d) (i) Calculate the resonant frequency for the circuit and compare this with the maximum frequency setting of the power supply.

(ii) Describe how Casey could physically alter the inductor and capacitor to increase the current through the light bulb using this power supply.

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, 2018

91526 Demonstrate understanding of electrical systems

2.00 p.m. Tuesday 20 November 2018
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 2–19 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.