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, 2014

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

2.00 i te ahiahi Rātū 18 Whiringa-ā-rangi 2014
Whiwhinga: Ono

Paetae	Kaiaka	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 te (ngā) whārangi kei muri i te pukapuka nei, ka āta tohu ai i ngā tau pātai.

Tirohia mehemea kei roto nei ngā whārangi 2–19 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

MĀ TE KAIMĀKA ANAKE

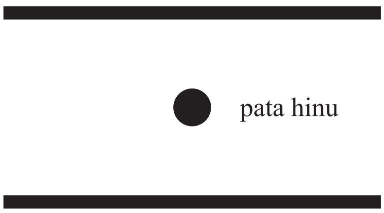
PĀTAI TUATAHI: TE WHAKAMĀTAU PATA HINU A MILLIKAN

Te whana[1] kei te irahiko:	-1.6×10^{-19} C
Te papatipu o te irahiko:	9.11×10^{-31} kg
Te whana kei te iraoho:	$+1.6 \times 10^{-19}$ C
Te papatipu o te iraoho:	1.67×10^{-27} kg

I te tau 1909 i whakahaerehia e Robert Millikan tētahi whakamātau hei whakatau i te rahi o te whana kei tētahi irahiko. I utaina e ia he whana ki tētahi pata hinu tino iti, ā, ka inea me pēhea te kaha o tētahi whaitua hiko ka hoatu kia kore ai te pata hinu e taka.

Kei te mahi a Janet i tētahi whakamātau ōrite. Kei a ia tētahi pata hinu hihiko e puri whakapahohotia ana ki tētahi whaitua hiko, kia mānu ai.

He whana tōraro more tō te pata hinu o te 24×10^{-10} C, ā, ka raua atu ki tētahi whaitua hiko kaha ōrite o te 610 N C^{-1} e ahu poutū ana. Ka "mānu" te pata hinu (ka puritia tāiritia[2]) i waenga i ngā pereti. (Ko te whakapae he tino iti noa te pānga o te hau ki te mānutanga.)



(a) Whakaingoatia ngā tōpana (me ngā ahunga) ka pā ki te pata hinu i te wā e tāiri ana i waenga i ngā pereti.

(b) Tātaihia te papatipu o te pata hinu. (Whakamahia $g = 9.8$ N kg^{-1}, ā, $F = mg$.)

[1] hihiko
[2] tārewatia

QUESTION ONE: MILLIKAN'S OIL DROP EXPERIMENT

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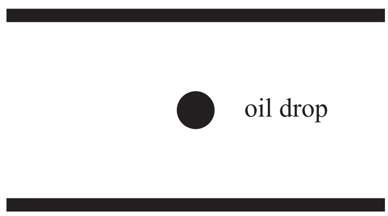
Charge on electron: -1.6×10^{-19} C
Mass of electron: 9.11×10^{-31} kg
Charge on proton: $+1.6 \times 10^{-19}$ C
Mass of proton: 1.67×10^{-27} kg

In 1909 Robert Millikan performed an experiment to determine the size of the charge on an electron. He put a charge on a tiny drop of oil, and measured how strong an applied electric field had to be in order to stop the oil drop from falling.

Janet is doing a similar experiment. She has an electrically charged oil drop held stationary in an electric field, so that it floats.

The oil drop has a net negative charge of 24×10^{-10} C, and is placed in a uniform electric field of strength 610 N C^{-1} directed vertically. The oil drop " floats" (is held suspended) between the plates. (Assume any buoyancy effect of air to be negligible.)



(a) Name the forces (including directions) acting on the oil drop while it is suspended between the plates.

(b) Calculate the mass of the oil drop. (Use $g = 9.8$ N kg^{-1} and $F = mg$.)

MĀ TE KAIMĀKA ANAKE

(c) Whakamāramahia mai ka aha taua pata hinu hihiko mēnā ka whakatatahia atu ngā pereti tētahi ki tētahi.

Ko te whakapae ka ōrite tonu te whana kei te pata hinu, ā, kāore e rerekē te ngaohiko puta noa i ngā pereti.

(d) Ka raua tētahi irahiko wātea me tētahi iraoho wātea ki ngā whaitua hiko ōrite pū (he ōrite te kaha o te whaitua hiko).

Whakatauritea:

- te kaha o te **tōpana hiko** ki ia korakora
- te whakatere o ia korakora (ka taea e koe te waiho atu te tō ā-papa ka whakamahi kē i $a = \frac{F}{m}$).

Hōmai he pūtake hei parahau i ō whakatauritenga.

Tōpana hiko:

Whakatere:

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(c) Explain what the same charged oil drop would do if the plates were brought closer together.

Assume the charge on the oil drop remains the same, and the voltage across the plates remains unchanged.

(d) A free electron and a free proton are placed in identical electrical fields (same electric field strength).

Compare:

- the strength of the **electric force** on each particle
- the acceleration of each particle (you may neglect gravity and use $a = \frac{F}{m}$).

Give reasons to justify your comparisons.

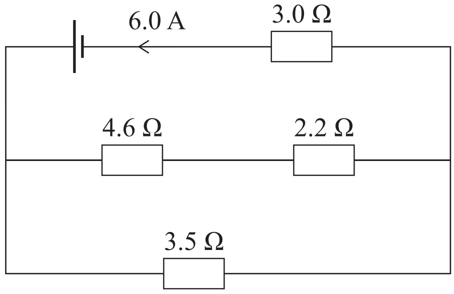
Electric force:

Acceleration:

MĀ TE KAIMĀKA ANAKE

PĀTAI TUARUA: NGĀ PARENGA IAHIKO KEI TĒTAHI ARA IAHIKO DC

Kei te tūhurahura a Sandra i ngā ara iahiko kei roto i te taiwhanga pūtaiao. Ka honoa e ia ētahi parenga iahiko kia pāhekoheko ai. Ko te iahiko mai i te putunga he 6.0 A.



(a) Tātaitia te parenga whaihua o te ara iahiko.

(b) Tātaihia te rahi o te ngaohiko e whakawhiti ana i te parenga iahiko 3.5 Ω.

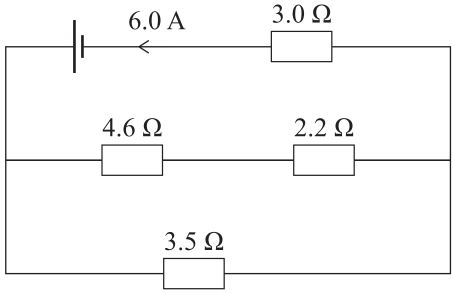
(c) Whakapuakina tō whakautu ki te Pātai Tuarua (b) ki te maha tika o ngā mati whai tikanga[3].

Homai tētahi pūtake mō tō kōwhiringa o ngā mati whai tikanga.

[3] mati tāpua

QUESTION TWO: RESISTORS IN A DC CIRCUIT

Sandra is investigating electrical circuits in the lab. She connects various resistors in combination. The current drawn from the supply is 6.0 A.



(a) Calculate the effective resistance of the circuit.

(b) Calculate the size of the voltage across the 3.5 Ω resistor.

(c) Express your answer to Question Two (b) to the correct number of significant figures.

Give a reason for your choice of significant figures.

(d) Whakamāramahia mai ko tēhea te parenga iahiko ka huri i te pūngao nui rawa i te hēkona ki te wera, ko te parenga iahiko 4.6 Ω, ko tō te 2.2 Ω rānei.

MĀ TE KAIMĀKA ANAKE

(d) Explain which resistor, the 4.6 Ω or the 2.2 Ω resistor, would convert the greater amount of energy per second into heat.

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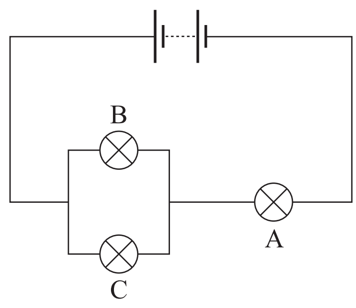
MĀ TE KAIMĀKA ANAKE

PĀTAI TUATORU: NGĀ RAMA ME NGĀ PARENGA IAHIKO KEI TĒTAHI ARA IAHIKO DC

Ka tūhono a Stephen i ngā rama ōrite pū, e ai ki te hoahoa i raro.

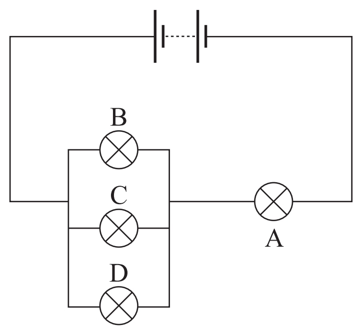


(a) Ka pahū te Rama B.

Tuhia mai ka ahatia te tīahoaho[4] o te rama A.

(b) Ka whakakapihia e Stephen te rama B ki tētahi mea hou.

Whakamāramahia ka ahatia te ngaohiko e whakawhiti ana i te rama B me te ngaohiko e whakawhiti ana i te rama A mēnā ka tāpirihia whakararahia tētahi rama ōrite pū, D, e ai ki te hoahoa i raro.



[4] pīataata

QUESTION THREE: LAMPS AND RESISTORS IN A DC CIRCUIT

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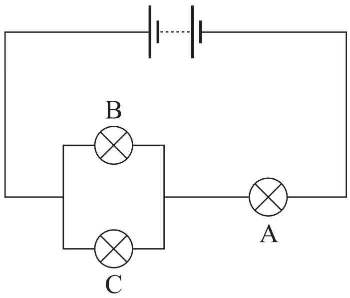
Stephen connects identical lamps, as shown in the diagram below.

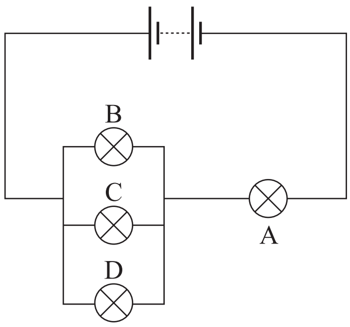


(a) Lamp B blows.

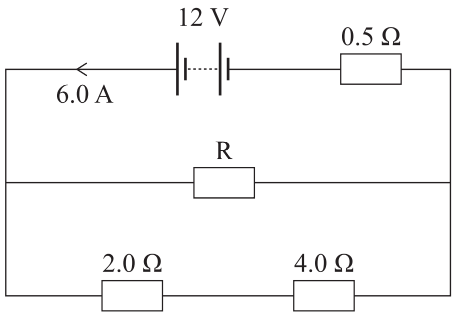
State what happens to the brightness of lamp A.

(b) Stephen replaces lamp B with a new one.

Explain what would happen to the voltage across lamp B and the voltage across lamp A if another identical lamp, D, was added in parallel, as shown in the diagram below.



Kātahi ka heria e Stephen ētahi parenga iahiko ka tūhonoa katoatia atu, e ai ki te hoahoa i raro.



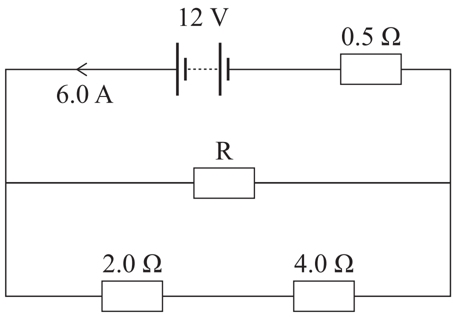
(c) Tātaihia te ngaohiko e whakawhiti ana i te parenga iahiko 0.5 Ω.

(d) Tātaihia te parenga o te parenga iahiko R.

Tīmatahia tō whakautu mā te tātai i te ngaohiko e whakawhiti ana i ia peka.

Stephen then takes a selection of resistors and connects them as shown in the diagram below.

ASSESSOR'S USE ONLY



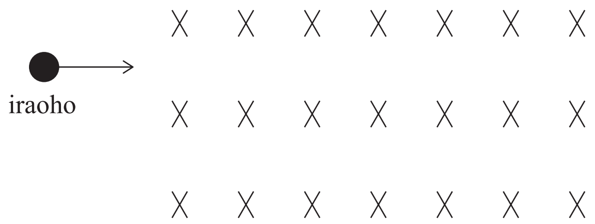
(c) Calculate the voltage across the 0.5 Ω resistor.

(d) Calculate the resistance of resistor R.

Begin your answer by calculating the voltage across each branch.

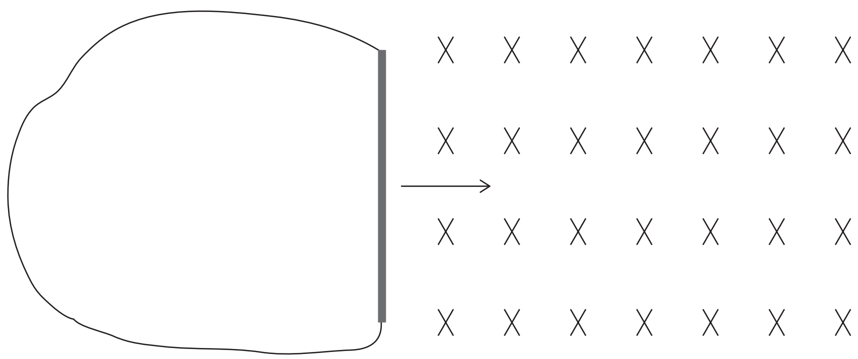
PĀTAI TUAWHĀ: AUTŌ Ā-HIKO

Ka whakawhitihia koki hāngaitia e tētahi iraoho he $+1.6 \times 10^{-19}$ C te whana tētahi whaitua autō he 0.65 T te kaha. Ko te tere aumou o te iraoho (i roto i te whaitua autō) he 4.8×10^{3} m s^{-1}.



(a) Tātaihia te rahi o te tōpana autō kei te iraoho i te wā kei roto i te whaitua.

Ka nekehia tētahi matira kawenga hiko e honoa ana ngā pito e tētahi waea e ai ki te whakaaturanga i raro, mā tētahi whaitua autō e ahu atu ana ki te whārangi. E tohu ana te pere i te ahunga o te neke o te matira.



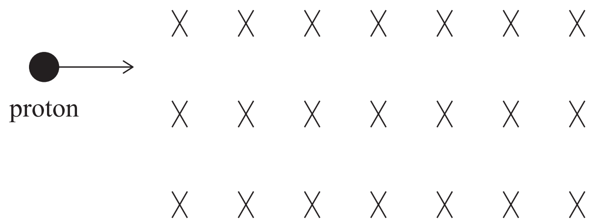
(b) Tātuhia ki te hoahoa tētahi pere hei whakaatu i te ahunga o te iahiko poapoa (iahiko māori) huri noa i te koropewa i puta nā te matira me te waea.

(c) Whakamāramahia te take ka puta he iahiko poapoa kei roto i te matira me te waea nā te nekehanga o te matira mā te whaitua autō.

ASSESSOR'S USE ONLY

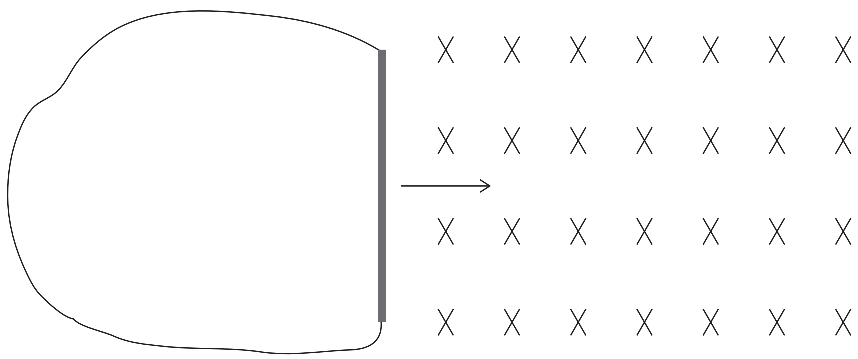
QUESTION FOUR: ELECTROMAGNETISM

A proton of charge $+1.6 \times 10^{-19}$ C moves at right angles across a magnetic field of strength 0.65 T. The constant speed of the proton (in the magnetic field) is 4.8×10^{3} m s^{-1}.



(a) Calculate the size of the magnetic force on the proton while it is in the field.

A piece of conducting rod whose ends are connected by a wire as shown, is moved through a magnetic field that is directed into the page. The direction in which the rod is moved is indicated by an arrow.



(b) On the diagram draw an arrow to show the direction of the induced current (conventional current) around the loop formed by the rod and wire.

(c) Explain why there will be an induced current in the rod and wire due to movement of the rod across the magnetic field.

(d) I te āhuatanga i runga ake, ko te roa o te matira he 0.40 m, ā, ko te kaha o te whaitua autō he 0.85 T. Ka nekehia te matira ki te 4.6 m s^{-1} te tere mā te whaitua. Ko te parenga tōpū o te matira me te waea he 0.68 Ω.

Mā te tātai i te ngaohiko ka whakaputaina, tātaihia te rahi o te tōpana me pā ki te matira kia neke haere tonu ki te tere aumou mā te whaitua autō.

MĀ TE KAIMĀKA ANAKE

(d) In the situation above, the length of the rod is 0.40 m and the magnetic field strength is 0.85 T. The rod is moved with a speed of 4.6 m s^{-1} through the field. The combined resistance of the rod and wire is 0.68 Ω.

By calculating the voltage induced, calculate the size of the force that must be applied to the rod to keep it moving at a steady speed through the magnetic field.

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

TAU PĀTAI

MĀ TE KAIMĀKA ANAKE

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

QUESTION NUMBER

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English translation of the wording on the front cover

Level 2 Physics, 2014

91173 Demonstrate understanding of electricity and electromagnetism

2.00 pm Tuesday 18 November 2014
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–PHYSMR.

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 – 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.