

91173



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## Level 2 Physics 2022

### 91173 Demonstrate understanding of electricity and electromagnetism

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.

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

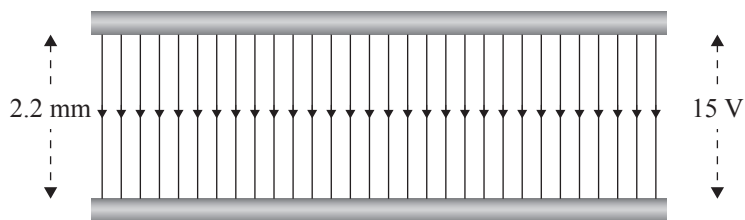
Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (XXXX). This area may be cut off when the booklet is marked.

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

### QUESTION ONE: ELECTRIC FIELDS

Two parallel plates are set up 2.2 mm apart with 15 V between them.



- (a) Show that the electric field strength between the plates is  $6.8 \times 10^3 \text{ V m}^{-1}$ .

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- (b) An electron at rest is released from the negative plate and accelerates towards the positive plate.

Calculate the maximum speed of the electron when it reaches the positive plate.

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- (c) A student states that increasing the distance between the plates while keeping the voltage the same, will mean that an electron released from rest at the negative plate is accelerating over a longer distance, and will therefore reach a higher speed than in part (b) when it reaches the positive plate.

- (i) Use physics principles to explain why this is incorrect.

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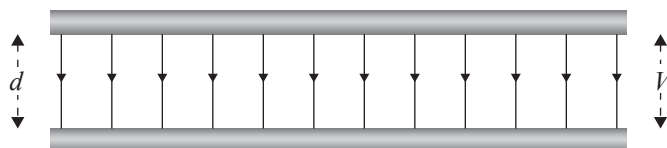
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- (ii) State one thing that could be done to increase the maximum speed of the electron.

- (d) The diagram below shows the electric field between a set of parallel plates  $d$  metres apart with  $V$  volts between them.



The distance between the plates is now doubled, and the voltage between them is halved.

- (i) State what happens to the strength of the electric field.

Your answer should include a number.

- (ii) Using the same scale, draw in the field lines on the diagram below to show the new electric field between the plates.



*If you need to redraw your response, use the diagram on page 8.*

## QUESTION TWO: CIRCUITS

A student finds some car headlamps that are labelled 12.0 V, 55.0 W.

- (a) Show the resistance of a single headlamp is  $2.62 \, \Omega$ .

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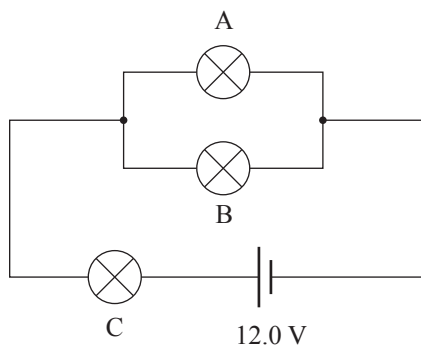
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Source: [www.wired.com/story/texas-instruments-headlights/](http://www.wired.com/story/texas-instruments-headlights/)

- (b) The student connects two of these headlamps (labelled A and B), and another lamp (C), which is used to light up the number plate in the circuit below. The resistance of lamp C is  $1.22 \, \Omega$ .



Calculate the total resistance of this circuit.

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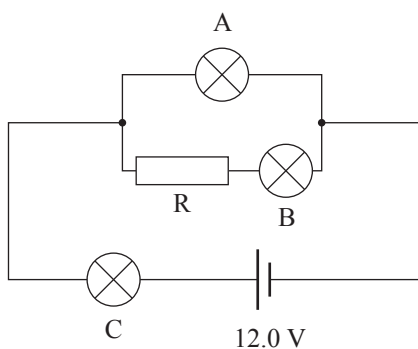


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The student connects a radio with resistance  $R$  to the circuit.



Source: [www.techinn.com/en/kenwood-kdc-bt450dab-car-radio/137796349/p](http://www.techinn.com/en/kenwood-kdc-bt450dab-car-radio/137796349/p)

- (c) Use physics principles to describe the effect adding the radio would have on the brightness of lamp A.

Assume the radio and lamps are all operating. Start by describing what effect adding the radio would have on the circuit resistance.

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- (d) Give at least three reasons why the circuit in part (c) would not be a good way to connect the 12 V headlamps in a car.

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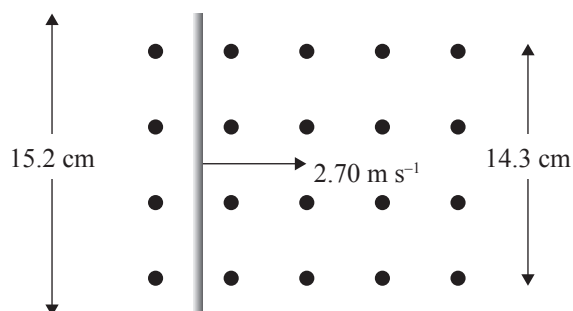
### QUESTION THREE: MAGNETIC FIELDS

A wire is pushed through a magnetic field at a constant speed of  $2.70 \text{ m s}^{-1}$ .

Length of the wire =  $15.2 \text{ cm}$

Magnetic field strength =  $1.2 \text{ mT}$

Width of the magnetic field =  $14.3 \text{ cm}$



*If you need to redraw your response, use the diagram on page 8.*

(a) Clearly mark the positive end of the wire on the diagram above.

(b) Calculate the voltage induced in the wire.

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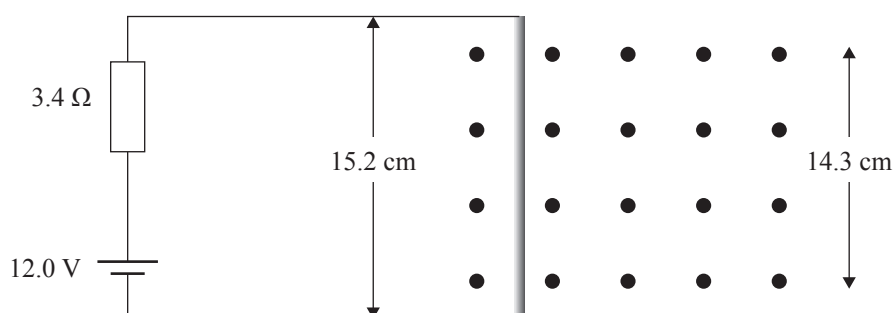
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(c) The wire is now stationary and connected to a circuit that contains a  $3.40 \Omega$  resistor and a  $12.0 \text{ V}$  battery.



(i) Calculate the magnetic force on the wire.

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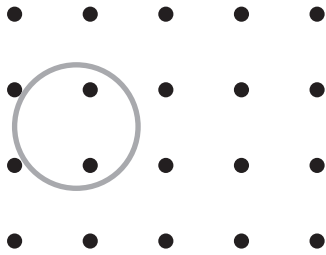
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- (ii) State the direction of the magnetic force on the wire as either:

**Up page (↑)**    **Down page (↓)**    **Left (←)**    **Right (→)**

**Out of the page    Into the page    No force**

- (d) An electron cutting the magnetic field experiences a force that makes it follow a circular path.



*If you need to redraw  
your response, use the  
diagram on page 8.*



Source: <http://boomeria.org/physicslectures/secondsemester/nuclear/nuclear1/nuclear1.html>

The electron is travelling from the left into the field.

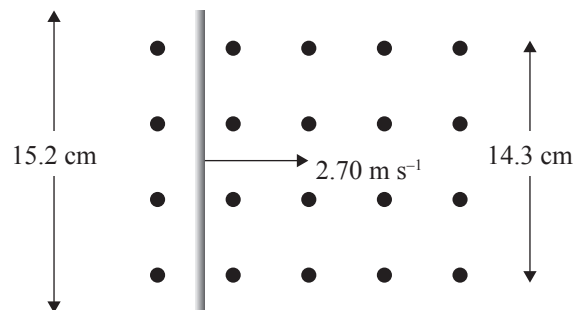
- (i) Clearly mark on the diagram above the direction the electron moves around the circle.
- (ii) Use physics principles to explain why there is a force on the electron as it cuts the magnetic field.

## SPARE DIAGRAMS

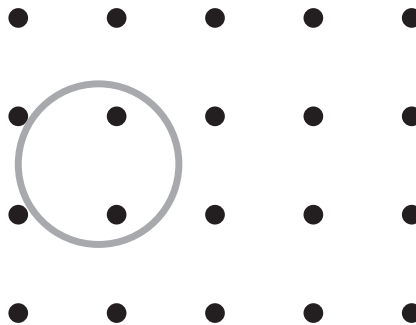
If you need to redraw your response to Question One (d)(ii), use the diagram below. Make sure it is clear which answer you want marked.



If you need to redraw your response to Question Three (a), use the diagram below. Make sure it is clear which answer you want marked.



If you need to redraw your response to Question Three (d)(i), use the diagram below. Make sure it is clear which answer you want marked.





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

QUESTION  
NUMBER

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