2011 Physics

Intermediate 1

Finalised Marking Instructions

Physics – Marking Issues

The current in a resistor is 1·5 amperes when the potential difference across it is 7·5 volts. Calculate the resistance of the resistor.

	Answers	**Mark + Comment**	**Issue**
1.	$V=IR$ $7{\cdot}5=1{\cdot}5R$ $R=5{\cdot}0\ \Omega$	(½) (½) (1)	Ideal answer
2.	$5{\cdot}0\ \Omega$	(2) Correct answer	GMI 1
3.	5·0	(1½) Unit missing	GMI 2 (a)
4.	$4{\cdot}0\ \Omega$	(0) No evidence/wrong answer	GMI 1
5.	_____ Ω	(0) No final answer	GMI 1
6.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0\ \Omega$	(1½) Arithmetic error	GMI 7
7.	$R=\frac{V}{I}=4{\cdot}0\ \Omega$	(½) Formula only	GMI 4 and 1
8.	$R=\frac{V}{I}=$ _____Ω	(½) Formula only	GMI 4 and 1
9.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=$ _____Ω	(1) Formula + subs/No final answer	GMI 4 and 1
10.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0$	(1) Formula + substitution	GMI 2 (a) and 7
11.	$R=\frac{V}{I}=\frac{1{\cdot}5}{7{\cdot}5}=5{\cdot}0\ \Omega$	(½) Formula but wrong substitution	GMI 5
12.	$R=\frac{V}{I}=\frac{75}{1{\cdot}5}=5{\cdot}0\ \Omega$	(½) Formula but wrong substitution	GMI 5
13.	$R=\frac{I}{V}=\frac{7{\cdot}5}{1{\cdot}5}=5{\cdot}0\ \Omega$	(0) Wrong formula	GMI 5
14.	$V=IR\quad 7{\cdot}5=1{\cdot}5\times R\quad R=0{\cdot}2\ \Omega$	(1½) Arithmetic error	GMI 7
15.	$V=IR$ $R=\frac{I}{V}=\frac{1{\cdot}5}{7{\cdot}5}=0{\cdot}2\ \Omega$	(½) Formula only	GMI 20

SECTION A

1.	**A**	11.	**E**
2.	**B**	12.	**C**
3.	**E**	13.	**E**
4.	**C**	14.	**B**
5.	**C**	15.	**C**
6.	**D**	16.	**A**
7.	**B**	17.	**E**
8.	**B**	18.	**E**
9.	**D**	19.	**D**
10.	**B**	20.	**A**

SECTION B

Marks

21. A radio station transmits a signal at a frequency of 909 000 Hertz.

(a) State the speed of the radio signal in air.

300000000 metres per second no secs in physics	**1**

mps – ½ mark
no units – ½ mark
units but no value – 0 marks

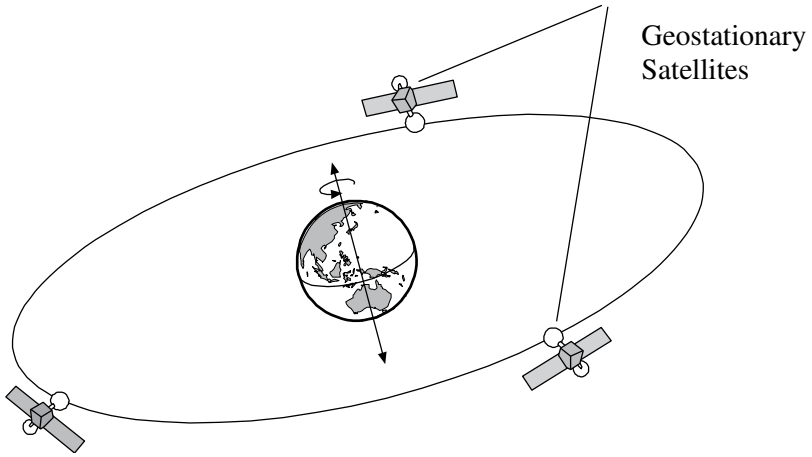
(b) A radio receiver picks up the signal.

Which part of the radio receiver selects a particular radio station?

tuner +/- rule applies	**1**

Marks

(c) Television signals from the Rugby World Cup in New Zealand are sent via geostationary satellites to Scotland.



(i) What is meant by a geostationary satellite?

(appears to) stay above the same point on the Earth's surface

or

24 hours for one orbit **1**

or

moves round the earth at a speed and a distance so it appears not to move

or

satellite is at a height of 36 000 km

moves in time with the Earth

<u>appears</u> to be stationary above the same point on the Earth

Wrong answers:
satellite does not move
stays in the same place
same speed as the Earth
orbits the Earth 24 hours a day

Marks

(ii) When live interviews take place, there is a delay between the interviewer in Scotland asking a question and the person hearing the question.

Explain why there is a delay.

Look for
large distance (1)
takes long time to travel (1)

2

Sound/light travelling is wrong
but waves travelling is OK

Satellite does not have to be mentioned.

Marks

22. A "hands-free" system for a mobile phone has an earpiece and a microphone.

(a) State the useful energy change that takes place in the:

(i) earpiece;

electrical to sound

1 or 0

(ii) microphone.

sound to electrical

1 or 0

for (i) and (ii)
must show change (to, arrow, dash)

accept electric but not electricity

(b) State **one advantage** of using a mobile phone instead of a landline.

it can be used most places OR ease of travelling about with it OR can use outside OR no wires OR use almost anywhere. Any suitable suggestion but must be a Physics reason, eg home phone is broken is 0 marks
+/- rule applies

1

(c) Give **one** reason why it is difficult for a mobile phone to pick up signals in a steep-sided valley.

there is not a clear line of sight between the mobile phone and the transmitter/any suitable suggestion, eg too low down to pick up signals/signals don't bend down/valley blocks signals/signals don't get through obstacle

1

radio signals travel in straight lines 0 marks on its own
signals don't get picked up in hilly regions 0 marks – restates question
implication of time 0 marks
signals don't get through on its own 0 marks

Marks

23. A student investigates various types of communication devices including mobile phones and fax machines.

(a) What kind of communication is sent by fax?

documents OR written material OR drawn material/text/graphics/texts/words/ numbers/typing/data/paperwork/letters	**1**

wrong answers – codes/electrical waves or signals/text messages/mail/files/visual communication

(b) The student connects a telephone handset to an oscilloscope and whistles a steady note into the mouthpiece.

Figure 1 shows the pattern observed on the oscilloscope screen.

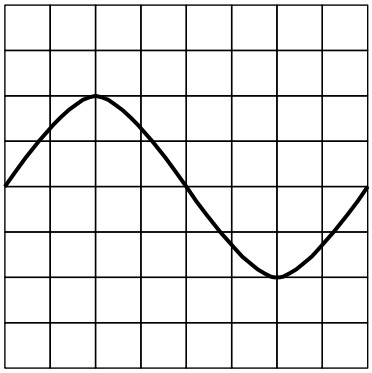


figure 1

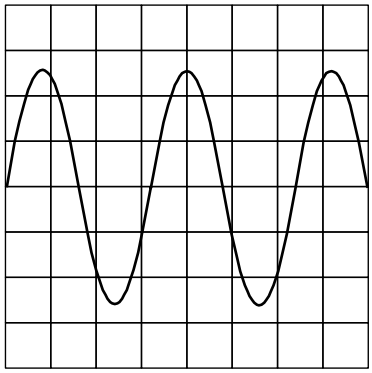


figure 2

(i) The student now whistles a note that is louder **and** at a higher frequency.

On figure 2 sketch the pattern that is now obtained.

The controls on the oscilloscope remain unchanged.

greater amplitude (1) majority of cycles must be greater **more than one complete wave (1)** **not centred is OK**	**2**

however if waves are drawn as straight lines cannot get second mark
if waves appear to go backwards in time cannot get second mark

(ii) What is the unit used to measure sound level?

decibel/bel/dB/DB	**1**

Marks

23. (continued)

(iii) Give **two** examples of noise pollution.

machinery OR aircraft OR traffic OR drills OR TV OR radio OR loud music etc (½) each

1

Other acceptable answers

people shouting
loud voices
construction sites low frequency hum dog barking
cars (plural)
fireworks
grass cutters/lawnmowers

Incorrect answers

airports
speakers
earthquakes
voices
car (singular)
emergency vehicles

+/- rule applies

Marks

24. A hairdresser uses a conical styler to produce curls in hair.

The rating plate for the styler is shown below.

BB 513 HD21X	
230 volts	50 hertz
1495 watts	

(a) Calculate the current in the styler when it is switched on
Remember to check page 2 of Marking Instructions (also GMI).

current = power/voltage

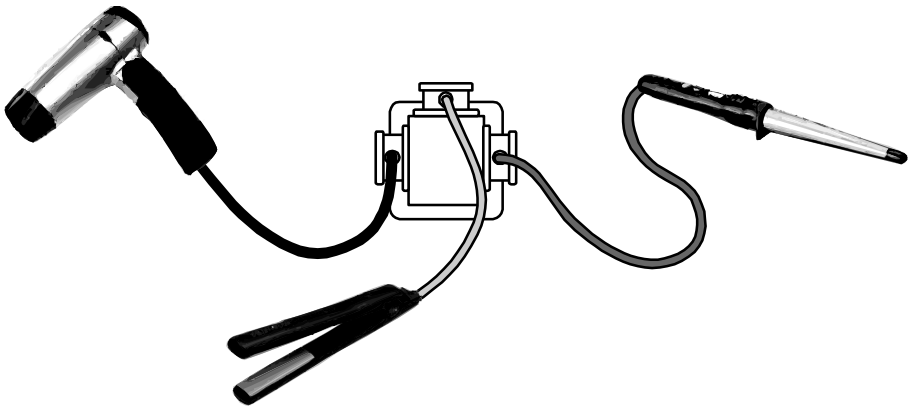
current = 1495/230

current = 6·5 amperes/amps/A/a **2**

(b) How many wires are in the flex?

2 **1**

(c) The hairdresser connects a hairdryer, conical styler and hair straighteners to an adaptor as shown.



Why could this be dangerous?

too many appliances connected, this may result in too <u>high a current</u>/power (voltage is wrong) being drawn from the socket (1) OR

(which could result in) <u>overheating</u> of the wiring to the socket OR result in an electrical fire (1) **1**

24. (continued)

Answer must relate to the overloading of the circuit.

Ignore irrelevant physics but not wrong physics

eg too high voltage causes fire 0 marks
BUT too high current so electrocuted 1 mark

Incorrect responses (on their own)

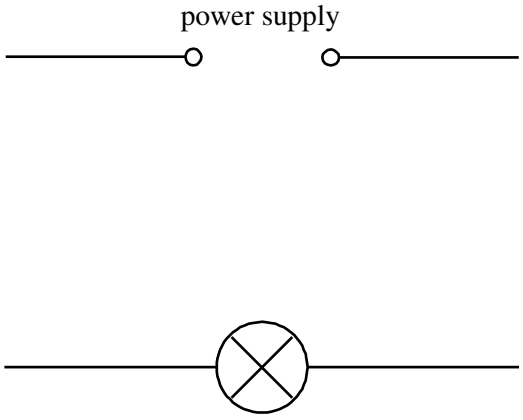
blow fuse
blow up
overload of electricity
electrocuted

Marks

25. A power supply, an ammeter and a voltmeter are used to investigate how the current in a lamp changes as the voltage across the lamp changes.

(a) Complete the circuit diagram, including the voltmeter and ammeter, to show how the voltage and current are measured.

ignore cells if connected correctly
switch in gap loose last mark
fuse in gap loose last mark
cells incorrectly in gap loose last mark

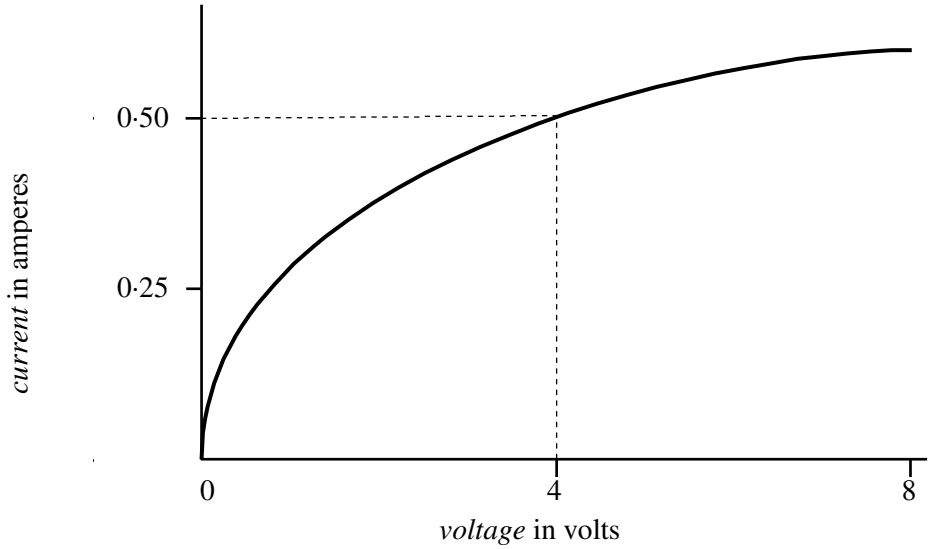


ammeter in series, ignore 2 ammeters in series **voltmeter in parallel, voltmeter across supply is OK** **complete circuit (1) each, ie no gaps**	**3**

Marks

25. (continued)

(b) The graph shows the results of the investigation.

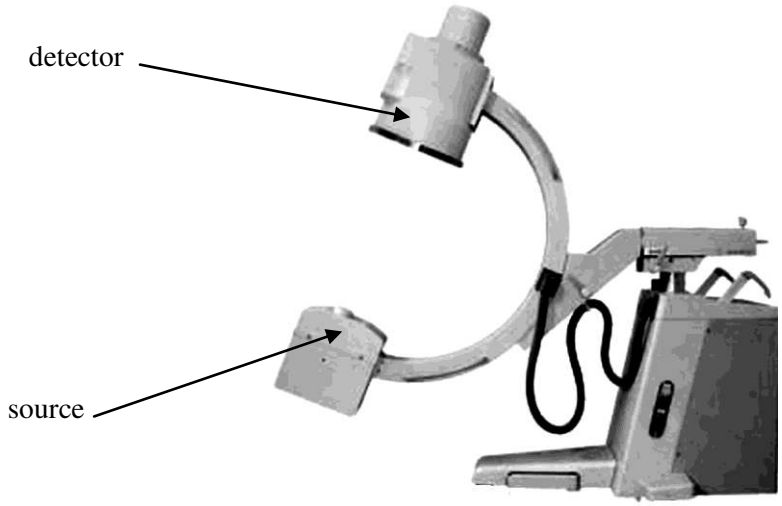


Calculate the resistance of the lamp when the voltage across it is 4 volts.

resistance = voltage/current/*R* = *V*/*C*	
resistance = 4/0·5	
resistance = 8 ohms	**2**

Marks

26. Different types of radiation are used in medical procedures. X-rays are used to detect broken bones. Gamma radiation is used to kill cancerous cells.



(a) (i) State **two** safety precautions needed when dealing with a source of gamma radiation.

don't handle OR keep distance OR wear gloves OR use tongs OR wear lead apron OR film badge OR screening OR wear goggles OR go out of room OR restrict length of time OR wash hands OR source must be stored safely and securely (½) each	**1**

Look for two different reasons, eg protective clothing and gloves is ½ only BUT goggles and gloves is 1 mark

(ii) State **one other** use of gamma radiation in medicine.

as a tracer OR sterilising surgical instruments OR gamma camera OR detection of cancer OR PET scans etc	**1**

incorrect responses

look inside body/destroying tumours/detecting illness/cleaning medical equipment/check passageways

(b) State **one** detector of x-rays.

<u>photographic</u> film OR fluoroscopy OR electronic methods OR telescope OR film badge	**1**

incorrect responses

X-ray machine/airport scanner/camera/broken bones

Marks

26. (continued)

(c) Ultraviolet radiation has advantages and disadvantages for health.

(i) State **one** advantage.

cure certain skin diseases OR SAD OR healthy growth OR make vitamin D OR promote cell growth OR jaundice treatment OR shows bacteria **1**

not tanning/not kills eczema (anything)

(ii) State **one** disadvantage.

can cause <u>skin</u> cancer OR burn the skin OR age the skin OR damage the skin OR sunburn OR wrinkles OR kills living cells OR damage eyes **1**

incorrect responses

causes skin disease OR damage body OR health problems

(d) Lasers have many applications in medicine and technology.

(i) State **one medical** use of lasers.

scalpel OR sealing blood vessels OR removing birth marks OR correcting vision OR removing tattoos OR bloodless surgery OR (laser) eye surgery OR correcting eyesight OR removing tumours OR heating tissue OR kill cells **1**

incorrect responses

eye treatment (too general) OR burning moles OR keyhole surgery

Marks

26. (continued)

(ii) State **one non-medical** use of lasers.

CD and DVD writers/players OR laser quest game	**1**

Other possible answers

cut through metal
bar code scanner
laser pointer
fibre optics
reading discs
laser shows
marking lines
calculate distance to the moon
security systems
builder's line
remove tattoos (but not for both medical and non-medical)
welding
gun sights
laser tagging
checking damage to pipes
cutting diamonds

incorrect responses

TV remote
light shows
measure distance
light gates
speed cameras
laser pen

Marks

27. Some chemicals fluoresce under certain conditions.

(a) What is meant by saying a chemical *fluoresces*?

the chemicals glow (when they absorb UV radiation) OR glow under ultraviolet light OR it glows OR (chemicals) light up OR absorbs light and makes a bright colour OR gives out light	**1**

incorrect response

changes colour when a light is put on it

(b) **Circle** (any indication) the type of radiation that will make these chemicals fluoresce.

radio **infrared** **ultraviolet** **microwave**

ultraviolet	**1**

(c) These chemicals are used on passports.

State **one** other use for these chemicals.

marking valuable items at home, banknotes/security markings/credit cards/ theatrical effects/driver's licence/money/secret messages/<u>detecting</u> blood splatter/ whiteners in washing powder	**1**

Incorrect responses

forensics (too general)/glowsticks/safety jackets/fingerprints

(d) At an airport, hand luggage is passed through a scanner that uses a different type of radiation.

Name this type of radiation.

X-rays/X radiation	**1**

Marks

28. While attending a fireworks display, a group of students decide to use a stopwatch to measure the time interval between seeing the flash of a firework exploding and hearing the bang.

(a) Why do the students see the flash before they hear the bang?

light (travels) faster than sound (or vice versa) **it takes <u>more</u> time for the sound to travel** **if candidate quotes values they must both be correct with correct units**	**1**

it takes time for the sound to travel – 0 marks

(b) The students calculate the speed of sound using this time interval and the distance they are from the point of explosion.

The time interval measured on the stopwatch is 0·7 seconds and the distance from the point of explosion is 210 metres.

Calculate the speed of sound.

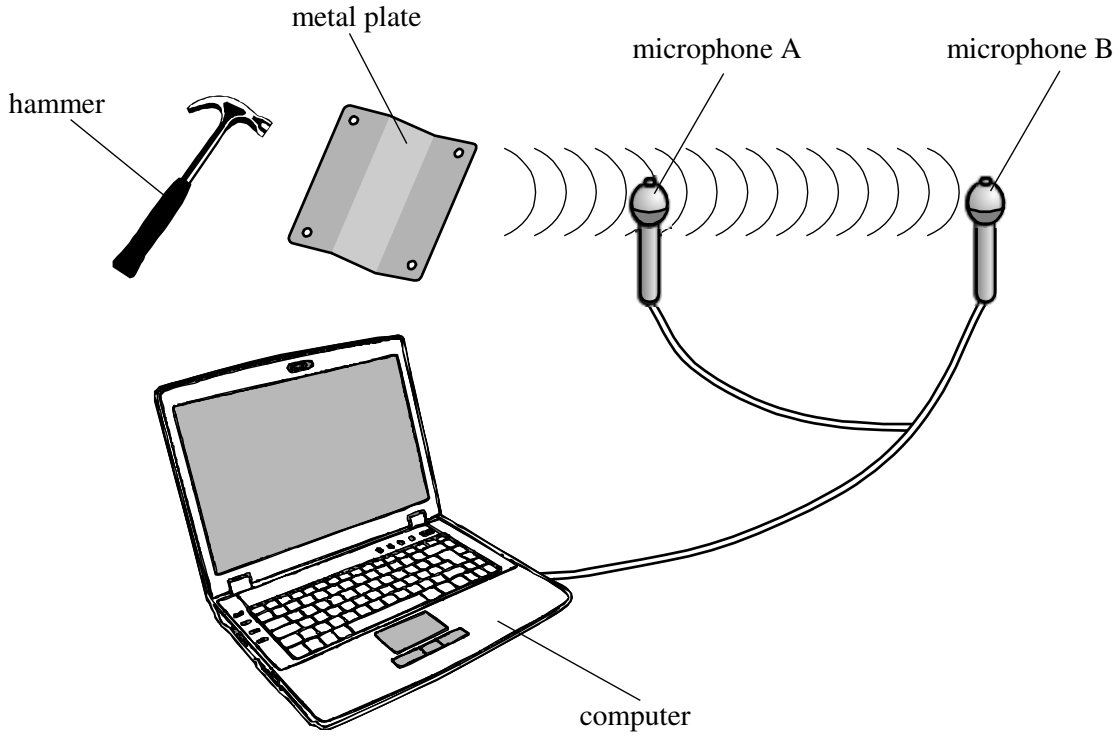
speed = distance/time **speed = 210/0·7** **speed = 300 metres per second**	**2**

Marks

29. A student sets up the apparatus shown to measure the speed of sound in air.

A sound is produced by striking a metal plate with a hammer. Timing starts when the sound reaches microphone A. Timing stops when the sound reaches microphone B.

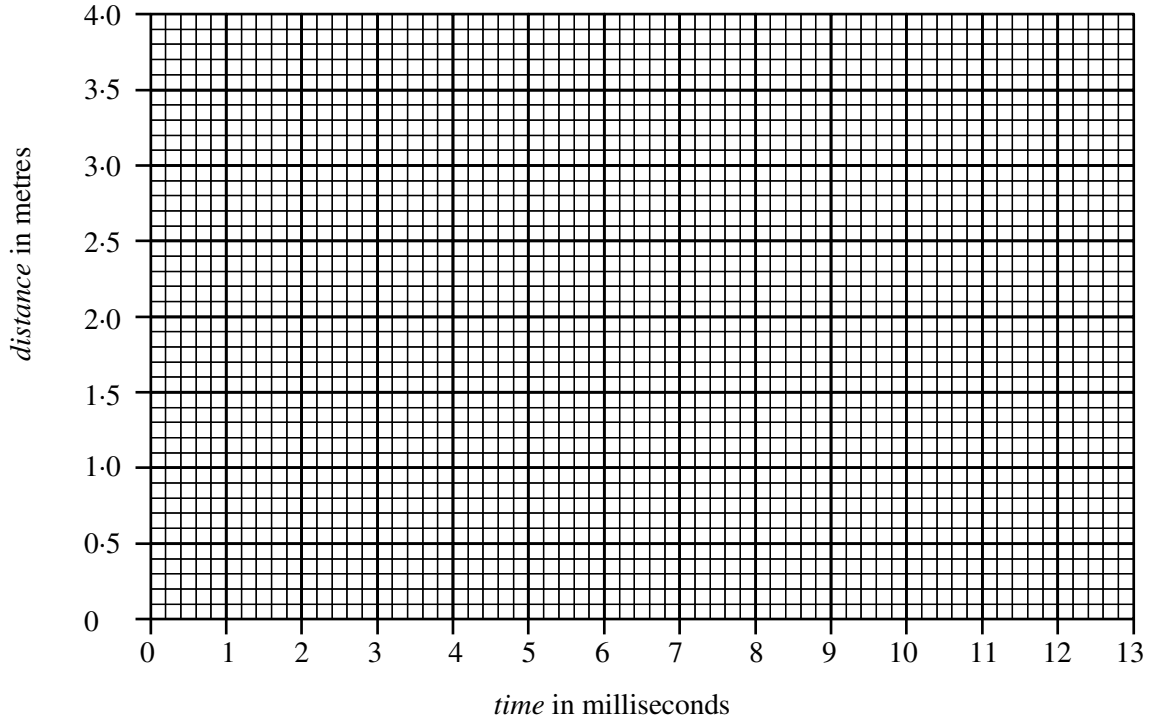
The student records times for different distances between the microphones.



Distance between microphones in metres	*Time for the sound to travel between the two microphones* in milliseconds
0·8	2·5
1·6	5·0
2·4	7·5
3·2	10·0
4·0	12·5

29. (continued)

(a) Using the data in the table, plot a **line graph** on the grid provided.



Must be a line graph (bar chart = 0 marks)

Correct plotting of points (1) allow 1 point incorrect, centre of point should be within the box **2**

If points are incorrect second mark is still available.

Candidate can get both marks even if points are indistinct as long as graph line is correct gradient and position.

Line does not need to be projected forward or back.

Best fitting line (1) Line must be passably straight, not multiple lines

(b) Why is this method of measuring the speed of sound in air more accurate than a method that uses a stopwatch?

reaction time (of the person will not cause an error in the value) OR too short a time for humans **1**

incorrect responses

humans are not as quick because it is done by computer
humans have to wait to hear sound
difficult to operate stopwatch
too quick

human error

too quick a time

Marks

30. An unmanned spacecraft is on a mission to Mars.

The engines of the spacecraft are turned off once it has travelled far into space.

(a) The spacecraft now travels at a constant speed.

Explain why this happens.

the forces are balanced OR no friction/air resistance/drag OR no forces acting against it	**1**

incorrect responses
equal forces
because the engine is switched off
no atmosphere

no gravity is irrelevant with correct physics

The table below gives some information on the planets.

Planet	*Gravitational pull in* newtons per kilogram
Earth	10
Mars	4
Jupiter	26
Saturn	11

Marks

30. (continued)

(b) The spacecraft has a mass of 900 kg.

(i) What is the weight of the spacecraft on Earth?

weight = mass × 10 **weight = 900 × 10** **weight = 9000 newtons/N/n**	***W = mg*** ***W* = 900 X 4 Max ½**	**weight = mass X 4** **0 marks**

2

(ii) Complete the following sentence by **circling** the correct word or phrase.

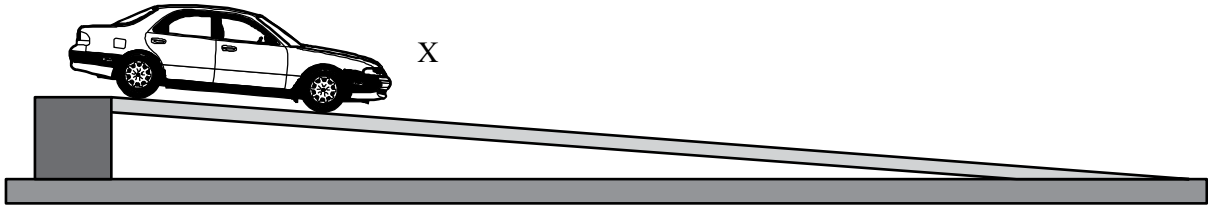
The mass of the spacecraft on Mars is { the same as its mass on Earth. / zero. / different from its mass on Earth. }

the same as its mass on Earth

1

31. A student measures the average speed of a car travelling down the full length of a ramp.

The car, of length 0·15 metres, is released at point X.



Describe a method for measuring the average speed of the car.

Your description should include:

Additional equipment the student would require.
The measurements the student would make.
How the student would calculate the average speed of the car.

(distance) – (measuring) tape OR trundle wheel OR metre stick (½) **(time) – stopwatch/clock (½)** **length of slope from X to bottom, time to travel measured distance (1)** **average speed = distance measured/time to travel distance (1)**	**3**

answers to be in correct box

(distance) – (measuring) tape OR trundle wheel OR metre stick (½) OR ruler **(time) – stopwatch/clock (½)**

length of slope (from X to bottom) (½) , time to travel measured distance (½) **must specify what distance and what time**

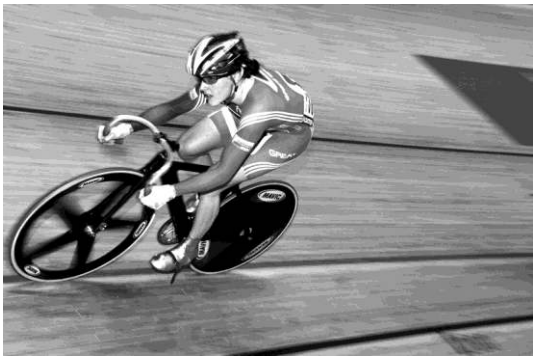
Speed = distance/time If box 2 is blank candidate can only get this mark for being specific about distance and time, eg **(average speed) = distance measured/time to travel distance**

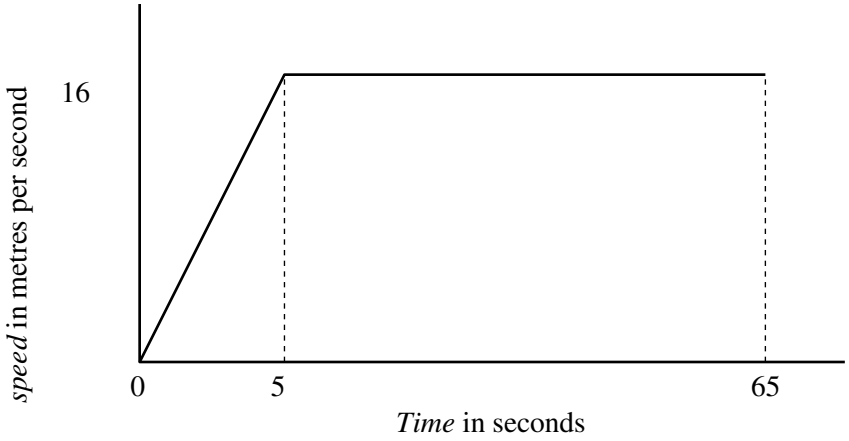
Be aware that some students will try to describe doing this experiment using a light gate. This at first glance is not valid as it would be used to work out an instantaneous speed – however – it is possible to calculate the average speed.

Box 1 as above plus light gate attached to a timer/computer, etc (any 2 of 3 items ½ each)
Boxes 2 and 3 then need to be carefully checked to see if the method works.

Marks

32. The graph below shows the speed of a cyclist during a 1000 metre sprint race.





(a) State the maximum speed of the cyclist during the race.

16 metres per second no unit ½ mark	**1**

(b) Calculate the average speed of the cyclist during the race.

Give your answer to 2 decimal places.

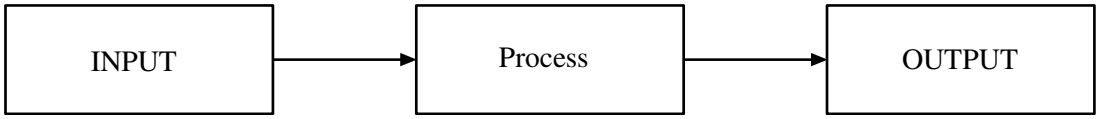
average speed = distance travelled/time taken **average speed = 1000/65** **average speed = 15·38 metres per second**	**2**

15
15.4
15.38
15.385 are all OK

Marks

33. (a) An electronic system can be represented by a block diagram as shown.

Complete the block diagram by filling in the missing labels.

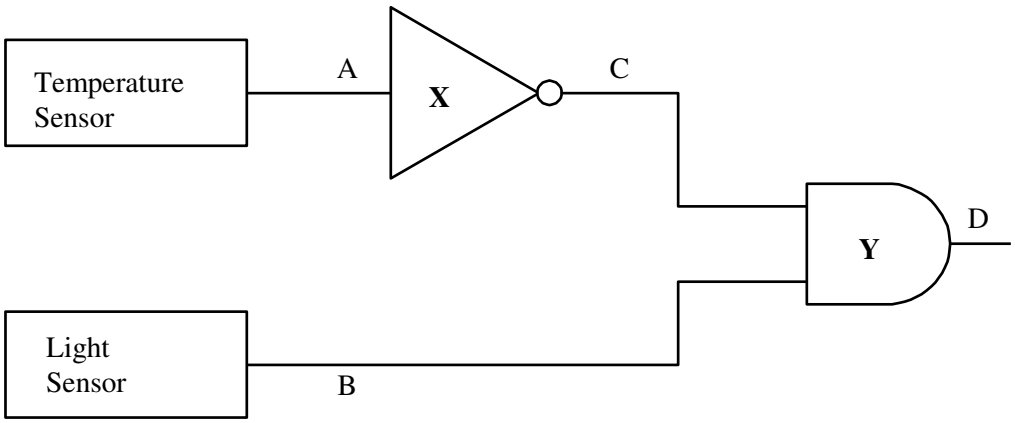


(½) each	**1**

(b) A circuit is set up to open a window in a greenhouse when the daytime temperature inside becomes too warm.

The diagram shows part of the circuit.

Temperature sensor when warm gives logic 0.
Temperature sensor when cold gives logic 1.



Light sensor in darkness gives logic 0.
Light sensor in light gives logic 1.

33. (continued)

(i) Name logic gate **X**.

NOT/inverter	**1**

(ii) Name logic gate **Y**.

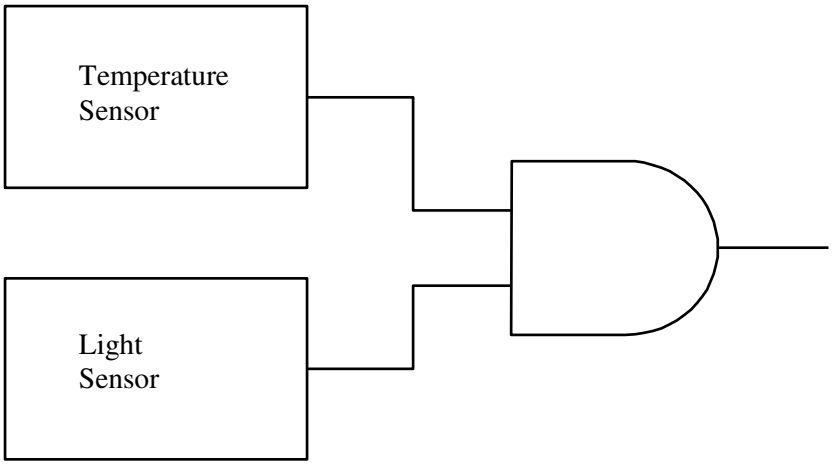
AND	**1**

(c) Complete the table below to show the logic levels at C and D.

A	B	C	D
0	0	1	0
0	1	1	1
1	0	0	0
1	1	0	0

(1) each column correct	**2**

(d) Gate X is removed from the circuit as shown.



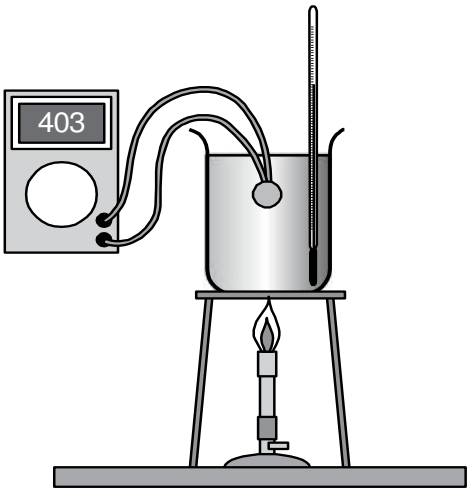
Describe how the circuit will now operate.

open window when cold (1) **during daylight (1) either order**	**2**

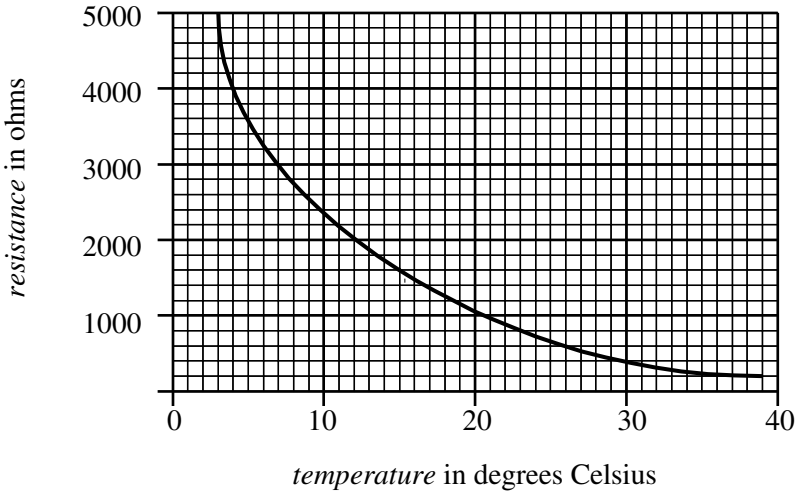
Both temp sensor and light sensor have to give 1 for circuit to work – 0 marks. General statement 0 marks

Marks

34. A student investigates how the resistance of a thermistor changes with temperature.



The student notes the resistance of the thermistor at different temperatures.
The graph of the student's results is shown below.



(a) What is the resistance of the thermistor at 15 degrees Celsius?

1600 ohms (no unit – ½ mark)	**1**

+/- 50 ohms tolerance

Marks

34. (continued)

(b) The current in the thermistor at 15 degrees Celsius is 6·0 milliamperes.

(i) When the temperature is 10 degrees Celsius will the current now be **bigger**, **smaller** or **the same**?

smaller	**1**

(ii) Explain your answer to part (i).

the resistance (of the thermistor) is greater (therefore the current in the circuit) is smaller)	**1**

(i) and (ii) are independent marks

[END OF MARKING INSTRUCTIONS]