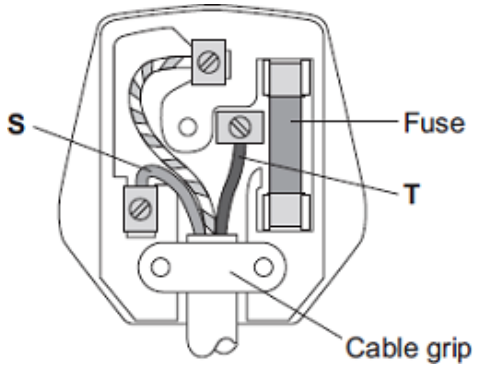
Q1. (a) The diagram shows the inside of a three-pin plug.



(i) What name is given to the wire labelled **S**?

Draw a ring around the correct answer.

earth **live** **neutral**

(1)

(ii) What is the colour of the insulation around the wire labelled **T**?

Draw a ring around the correct answer.

blue **brown** **green and yellow**

(1)

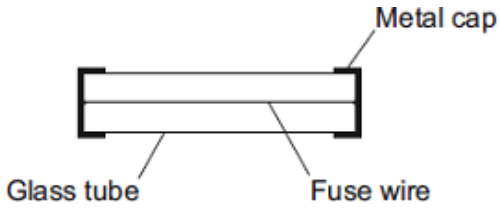
(b) The plug contains a 13 amp fuse.

(i) Which **one** of the following is the correct circuit symbol for a fuse?

Draw a ring around the correct answer.

(1)

(ii) The diagram shows the parts of the fuse.



What would happen if a current of 20 amps passed through the 13 amp fuse?

.....

.....

(1)

(c) Not all electrical appliances are earthed.

(i) Which **one** of the following appliances must be earthed?

Tick (✓) **one** box.

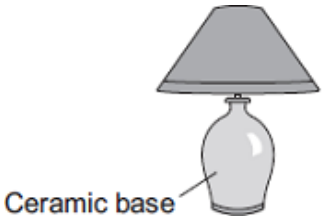
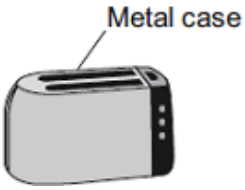
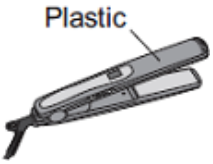


Table lamp ☐



Toaster ☐



Hair straighteners ☐

Give a reason for your answer.

.....

.....

(2)

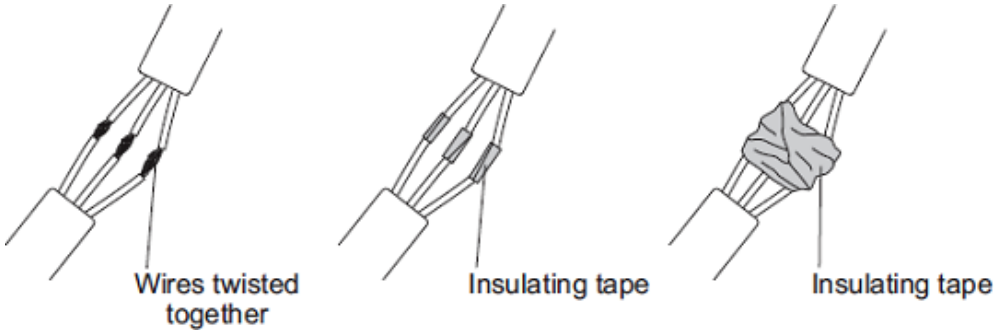
(ii) Earthing an appliance helps to protect a person against a possible risk.

What is the risk?

.....

(1)

(d) The diagrams show how two lengths of mains electrical cable were joined. The individual wires have been twisted together and covered with insulating tape. This is not a safe way to join the cables.



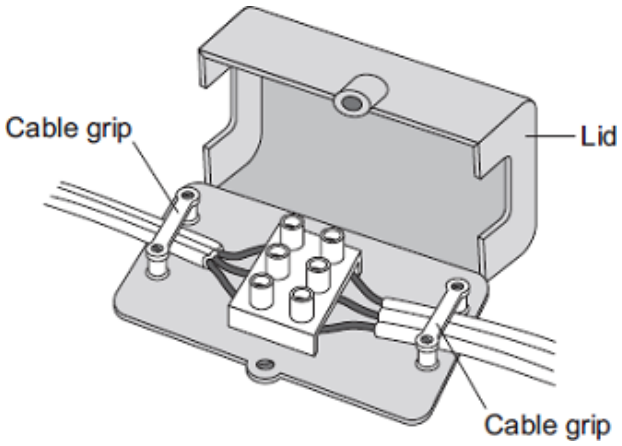
What is the possible risk from joining the two lengths of mains electrical cable in this way?

.....

.....

(1)

(e) The diagram below shows a connecting box being used to join two lengths of electrical cable. This is a safe way to join the cables.



The cable grips are important parts of the connecting box.

Explain why.

.....

.....

.....

.....

(2)
(Total 10 marks)

Q2. (a) The diagram shows the information plate on an electric kettle. The kettle is plugged into the a.c. mains electricity supply.

230 V	**2760 W**
50 Hz	

Use the information from the plate to answer the following questions.

(i) What is the frequency of the a.c. mains electricity supply?

.....

(1)

(ii) What is the power of the electric kettle?

.....

(1)

(b) To boil the water in the kettle, 2400 coulombs of charge pass through the heating element in 200 seconds.

Calculate the current flowing through the heating element and give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

amps **volts** **watts**

.....

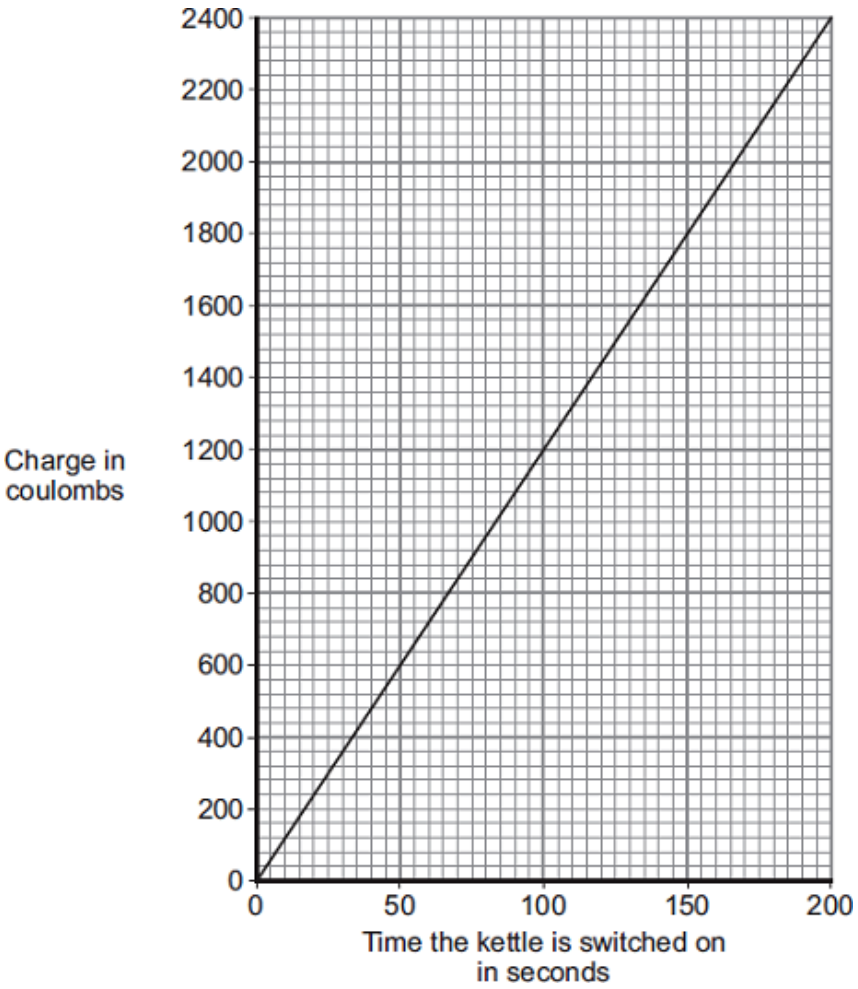
.....

.....

Current = ...

(3)

(c) The amount of charge passing through the heating element of an electric kettle depends on the time the kettle is switched on.



What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....

.....

(2)

(Total 7 marks)

Q3. A student did an experiment with two strips of polythene. She held the strips together at one end. She rubbed down one strip with a dry cloth. Then she rubbed down the other strip with the dry cloth. Still holding the top ends together, she held up the strips.

(a) (i) What movement would you expect to see?

.....

.....

(1)

(ii) Why do the strips move in this way?

.....

(2)

(b) Complete the **four** spaces in the passage.

Each strip has a negative charge. The cloth is left with a.....

charge. This is because particles called ..... have been transferred

from the ..... to the ..... .

(4)

(c) The student tried the experiment using two strips of aluminium. The strips did not move.

Complete **each** of the sentences.

(i) Materials, such as aluminium, which electricity will pass through easily, are

called ..... .

(1)

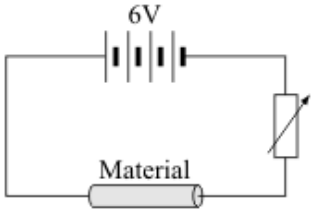
(ii) Materials, such as polythene which electricity will **not** pass through easily, are

called ..... .

(1)

(Total 9 marks)

Q4. (a) The diagram shows the circuit used to investigate the resistance of a material. The diagram is incomplete; the ammeter and voltmeter are missing.



(i) Draw the symbols for the ammeter and voltmeter on the diagram in the correct places.

(2)

(ii) How can the current through the material be changed?

.....

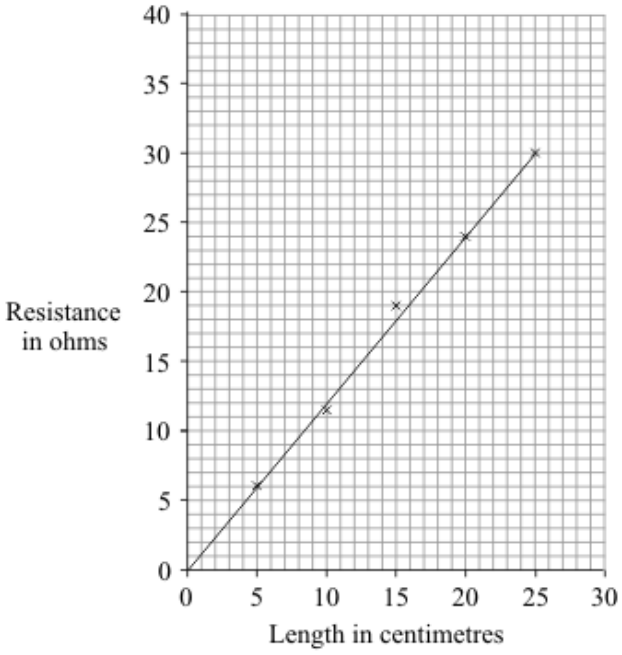
.....

(1)

(b) The material, called conducting putty, is rolled into cylinders of different lengths but with equal thicknesses.

Graph 1 shows how the resistance changes with length.

Graph 1



(i) Why has the data been shown as a line graph rather than a bar chart?

.....

.....

(1)

(ii) The current through a 30 cm length of conducting putty was 0.15 A.

Use **Graph 1** to find the resistance of a 30 cm length of conducting putty.

Resistance = ... ohms

(1)

(iii) Use your answer to (b)(ii) and the equation in the box to calculate the potential difference across a 30 cm length of conducting putty.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

.....

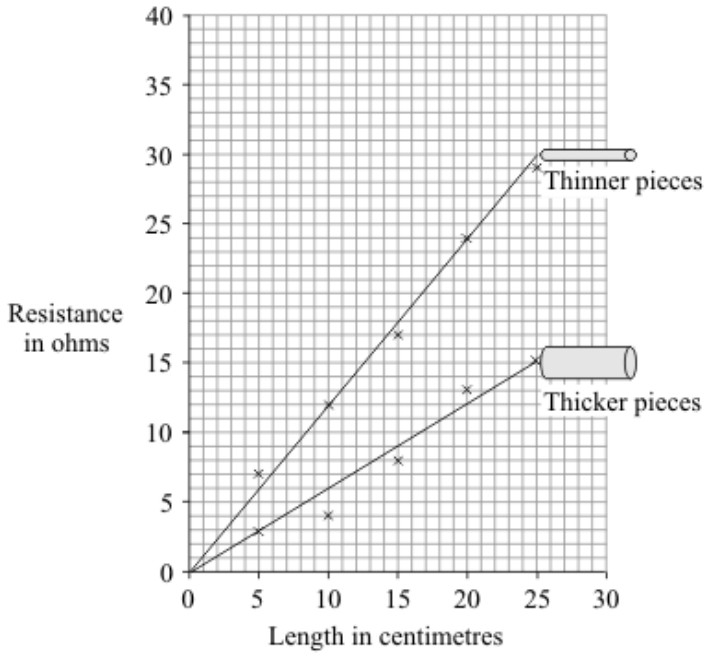
.....

Potential difference = ... volts

(2)

(c) A second set of data was obtained using thicker pieces of conducting putty. Both sets of results are shown in **Graph 2.**

Graph 2



(i) What is the relationship between the resistance and the thickness of the conducting putty?

.....

.....

(1)

(ii) Name **one** error that may have reduced the accuracy of the results.

.....

(1)

(iii) How could the reliability of the data have been improved?

.....

.....

(1)

(Total 10 marks)

Q5. The process of nuclear fusion results in the release of energy.

(a) (i) Describe the process of nuclear fusion.

.....

.....

.....

.....

(2)

(ii) Where does nuclear fusion happen naturally?

.....

(1)

(b) For many years, scientists have tried to produce a controlled nuclear fusion reaction that lasts long enough to be useful. However, the experimental fusion reactors use more energy than they produce.

(i) From the information given, suggest **one** reason why nuclear fusion reactors are not used to produce energy in a nuclear power station.

.....

.....

(1)

(ii) Suggest **one** reason why scientists continue to try to develop a practical nuclear fusion reactor.

.....

.....

(1)

(c) In 1989, two scientists claimed in a daily newspaper that they had produced nuclear fusion reactions in normal laboratory conditions. The process became known as ‘cold fusion’. Other scientists thought that the evidence produced to support ‘cold fusion’was unreliable.

(i) Suggest **one** reason why other scientists thought that the evidence to support ‘cold fusion’ was unreliable.

.....

.....

(1)

(ii) In 2007, the results of a new ‘cold fusion’ research project were published in a respected scientific journal. This journal includes scientists such as Albert Einstein amongst its past authors.

Suggest why people may be more likely to believe an article published in a respected scientific journal than one published in a daily newspaper.

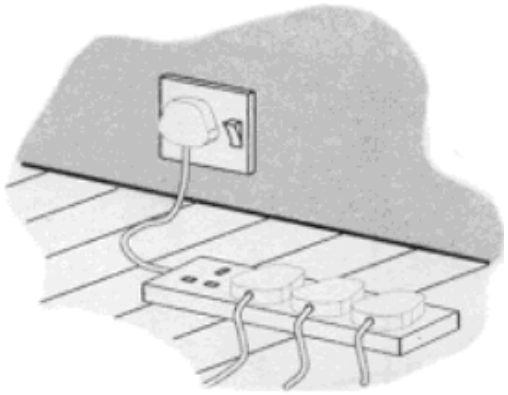
.....

.....

.....

(1)
(Total 7 marks)

Q6. (a) An adaptor can be used to connect up to four appliances in parallel to one 230 V mains socket. The adaptor is fitted with a 13 A fuse. The table gives a list of appliances and the current they draw from a mains socket.



Appliance	**Current**
computer	1 A
hairdryer	4 A
heater	8 A
iron	6 A
television	2 A

(i) What current will flow to the adaptor when the television, computer and hairdryer are plugged into the adaptor?

.....

Current = ... A

(1)

(ii) Write down the equation which links current, electrical power and voltage.

.....

(1)

(iii) Calculate the electrical power used when the television, computer and hairdryer are plugged into the adaptor. Show clearly how you work out your answer and give the unit.

.....

.....

.....

Electrical power = ...

(2)

(iv) What would happen to the fuse if the heater is also plugged into the adaptor?

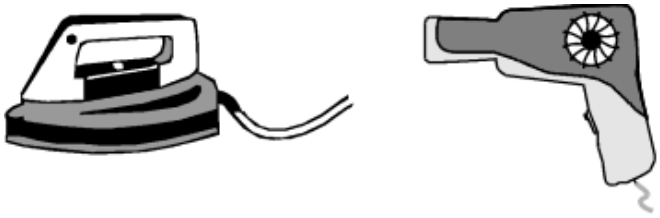
Give a reason for your answer.

.....

.....

(2)

(b) The diagram shows **two** of the appliances.



Iron Hairdryer

(i) For safety reasons, it is important that the iron has an earth wire connected to its outer metal case. Explain why.

.....

.....

.....

.....

(2)

(ii) The hairdryer does not have an earth wire. It is safe to use because it is double *insulated.* Explain what the term *double insulated* means.

.....

.....

.....

.....

(2)

(Total 10 marks)

Q7. The picture shows an electric bicycle. The bicycle is usually powered using a combination of the rider pedalling and an electric motor.

(a) A 36 volt battery powers the electric motor. The battery is made using individual 1.2 volt cells.

(i) Explain how a 36 volt battery can be produced using individual 1.2 volt cells.

To gain full marks, you must include a calculation in your answer.

.....

.....

.....

.....

(2)

(ii) The battery supplies a direct current (d.c.).

What is a *direct current (d.c.)*?

.....

.....

(1)

(iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Use the equation in the box to calculate the maximum charge that the battery stores.

charge = current × time

Show clearly how you work out your answer and give the unit.

.....

.....

Charge stored = ...

(3)

(b) When powered only by the electric motor, the bicycle can carry a 90 kg rider at a maximum speed of 6 m/s. Under these conditions, the maximum distance that the bicycle can cover before the battery needs recharging is 32 km.

The bicycle has a mass of 30 kg.

(i) Use the equation in the box to calculate the maximum kinetic energy of the bicycle **and** rider when the rider is not pedalling.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2)

(ii) The bicycle can be fitted with panniers (bags) to carry a small amount of luggage.

What effect would fitting panniers and carrying luggage have on the distance the bicycle can cover before the battery needs recharging?

.....

Give a reason for your answer.

.....

.....

(2)

(Total 10 marks)

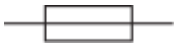
M1. (a) (i) neutral

1

(ii) brown

1

(b) (i) centre symbol ringed



accept any correct indication

1

(ii) fuse (wire) melts

accept fuse blows
accept fuse breaks / snaps
accept burns out appliance doesn't work is insufficient
overheat is insufficient
*do **not** accept blows up*

1

(c) (i) Toaster

1

(only one with) a metal case / outside

reason only scores if toaster chosen
accept it is metal
accept outside / case / metal conducts (electricity)
*do **not** accept it conducts electricity*

1

(ii) electric shock / electrocution

*do **not** accept explosion*

1

(d) overheating of cables **or** fire

it refers to the electric cable
accept short circuit / sparking
overheating of tape is insufficient
do not accept electrocution / shock

1

(e) stop cable(s) being pulled loose / free

accept wire(s) for cable(s)
accept to hold cables in place

1

and so breaking the circuit **or** and shorting (one wire to another) **or** and causing a fire risk / sparking

accept appliance / plug would not work

1

[10]

M2. (a) (i) 50 (Hz)

1

(ii) 2760 (W)

1

(b) 12

*allow **1** mark for correct substitution, ie 2400/200*

or

*allow **1** mark for 2760/230 provided no subsequent step shown*

2

amps

1

(c) the charge is <u>directly</u> proportional to the time switched on for

*accept for **1** mark the longer time (to boil), the greater amount of charge*

***or** positive correlation*

***or** they are proportional*

2

[7]

M3. (a) (i) (bottom **or** other ends) move apart or repel

accept they move apart

1

(ii) have <u>same</u> charge

accept both have negative charge
(from part (b) do not credit both have positive charge

same **or** like charges repel

not just opposite charges attract

2

(b) positive

1

electrons

1

cloth

1

polythene

accept strips

1

(c) (i) conductors

accept metals

1

(ii) insulators

accept non-conductors/poor conductors do not credit non-metals

1

[9]

M4. (a) (i) ammeter symbol correct and drawn in series

accept

*do **not** accept lower case a*

1

voltmeter symbol correct and drawn in parallel with the material

*do **not** accept* 

1

(ii) adjust / use the variable resistor

accept change the resistance

or change the number of cells

accept battery for cell
accept change the p.d / accept change the voltage
accept increase / decrease for change

1

(b) (i) data is <u>continuous</u> (variable)

1

(ii) 36 (Ω)

correct answer only

1

(iii) 5.4 or their (b)(ii) × 0.15

*allow **1** mark for correct substitution*

2

(c) (i) the thick<u>er</u> the putty the low<u>er</u> the resistance

answer must be comparative

accept the converse

1

(ii) any **one** from:

- measuring length incorrectly
  accept may be different length
- measuring current incorrectly
  *do **not** accept different currents*
- measuring voltage incorrectly
  *do **not** accept different voltage*
- ammeter / voltmeter incorrectly calibrated
- thickness of putty not uniform
- meter has a zero error
  accept any sensible source of error eg putty at different temperatures
  *do **not** accept human error without an explanation*
  *do **not** accept pieces of putty not the same unless qualified*
  *do **not** accept amount of putty not same*
  *do **not** accept systematic / random error*

1

(iii) repeat readings
accept check results again
accept do experiment again
accept do it again
accept compare own results with other groups
*do **not** accept take more readings*

1

[10]

M5. (a) (i) (two) nuclei (of light elements) join
accept hydrogen atoms for nuclei

1

forming a larger / heavier nucleus / one
accept comparative term equivalent to larger
accept forms a helium (nucleus / atom) this mark only scores if fusion is in terms of hydrogen atoms

1

(ii) stars
accept a named star
e.g. the Sun
accept nebula
mention of planets negates answer

1

(b) (i) any **one** from:

- (currently) only experimental
- reaction does not last long enough
- use more energy than they produce
  allow difficult to control
  *do **not** allow inefficient on its own*

1

(ii) any **one** from:

- will give another source of energy
- unlimited fuel supplies / energy
  accept unlimited hydrogen
- would not produce any radioactive waste
  accept less radioactive waste
  accept nuclear for radioactive
  *do **not** accept toxic waste*
- want to show that it can be done
  accept any sensible suggestion
  *do **not** accept answers only in terms of fossil fuels or carbon dioxide*

1

(c) (i) any **one** from:

- repeating did not produce the same results / data
  accept could not be repeated
  accept has not been repeated
- experiments were not / may not be reproducible
- data / experiments were not valid
  *do **not** accept answers in terms of scientists being biased*

1

(ii) any **one** from:

- cannot trust journalists
  bias is insufficient on its own
- newspaper journalist may not have a science background
- newspaper may publish what people want to read
- newspaper may simplify ideas
- people believe / trust the scientists writing the journal
- people have heard of the scientists writing in the journal
- scientists writing in the journal are famous
- journal only publishes the work of respected / famous scientists
- data is checked by other scientists before published in the journal
  accept any sensible suggestion, these are examples they do not constitute a full list

1

[7]

M6. (a) (i) 7

1

(ii) (electrical) power = voltage x current

accept P = V × I (correct standard symbol)
accept watts = volts x amps
accept a correct rearrangement

accept 

if subsequent use of  *is correct*

1

(iii) 1610
or their (a)(i) × 230

*1.61 kW = **2** marks*
*do **not** accept 7 × 240*

2

watts

accept watt
accept W
accept .J/s

(iv) melts

accept burns out
accept blows
accept breaks
*do **not** accept stops working*
*do **not** accept burns*

2

current greater than 13(A)
or current exceeds fuse rating **or** current 15(A)

*do **not** accept too much current*
unless qualified

(b) (i) if live wire touches case

accept if case becomes live
accept metal for case

2

current flows to earth **or** ground
or fuse melts **or** stops iron becoming live

accept electricity flows to earth
*do **not** accept - you will get a shock*
*accept with <u>no earth</u> (wire) you would or could get a shock for **1**mark*

(ii) (outer) case is made of insulator

accept outside is plastic
*accept outside is not made of metal **or** conductor*

cable is (also) insulated

accept wires for cable
*do **not** accept it has two layers of insulation without explanation*
*do **not** credit answers in terms of heat*

2

[10]

M7. (a) (i) (connect) 30 (cells)

1

in series

1

(ii) current always flows in the same direction
or
current only flows one way

1

(iii) 36 000

*allow **1** mark for correctly converting 2 hours to 7200 seconds*
*answers 10 or 600 score **1** mark*

2

coulombs / C

*do **not** accept c*

1

(b) (i) 2160

*allow **1** mark for correct substitution, ie ½ × 120 × 6^2*
*answers of 1620 or 540 score **1** mark*

2

(ii) reduce it

1

any **one** from:

- draws a larger current (from battery)
- motor draws greater power (from battery)
  accept energy per second for power
  accept more energy needed to move the bicycle
- greater resistance force (to motion) / air resistance / drag / friction
  accept less streamlined
  more mass to carry is insufficient

1

[10]