

PHYSICS



EXAM QUESTION PACK

P3.1 STATIC AND CHARGE

SCORE

/80

PERCENTAGE

%

STEMUP

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Gateway Physics A (9-1)

Static and charge

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **80**.
- The total number of marks may take into account some 'either/or' question choices.

1 This question is about static electricity.

Bruno sometimes gets an electrostatic shock when he gets out of his car.

(i) As he gets out of the car he moves across the car seat.

Bruno becomes negatively charged.

Complete the sentence.

The car seat becomes _____ charged because it loses _____.

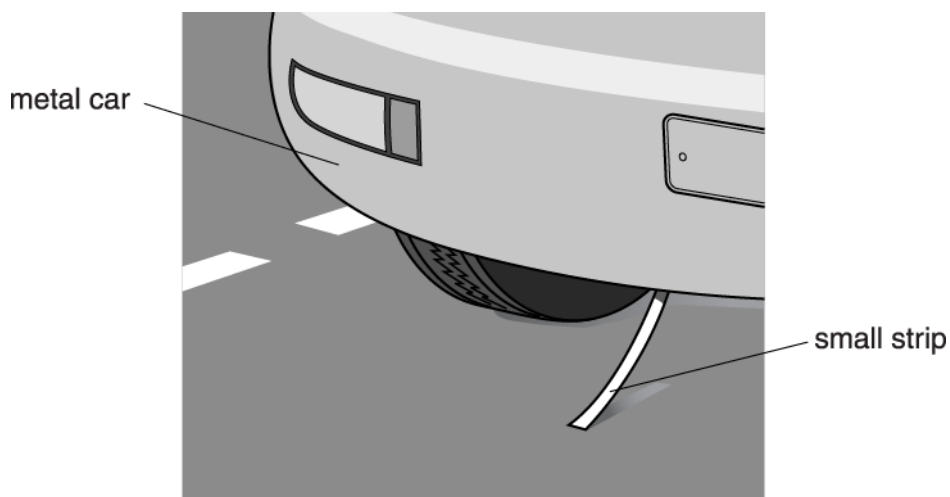
[1]

(ii) Bruno sprays the car seat with an antistatic spray.

Explain how this helps to reduce static electricity.

----- [1]

(iii) Bruno attaches a small strip to the back of his car.



This strip may reduce the chance of receiving an electrostatic shock but it is unreliable.

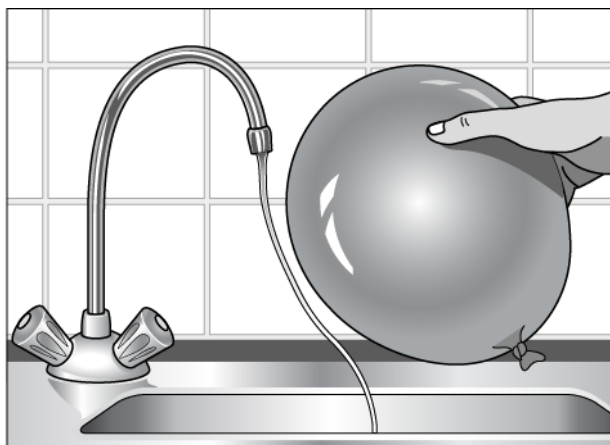
Explain why it is unreliable.

----- [1]

2 This question is about static electricity.

Bruno rubs a balloon on a piece of material.

He puts the balloon next to a water tap.



The stream of water bends towards the balloon.

Use ideas about static electricity to explain why.

[3]

George uses a model to explain resistance:

Current in a conductor is the flow of charge carriers calledneutrons.

The charge carriers collide with the atoms (ions) in the conductor.

This explains electrical resistance.

As the conductor gets hotter the resistance stays the same.

George has made **two** mistakes.

Describe the two mistakes he has made and write down the corrections.

----- [2]

4 Electrostatics can be useful or a nuisance.

Electrostatics can be useful for spray painting.

The way that different paint guns work can be described using diagrams and models.

Diagram of a normal paint gun

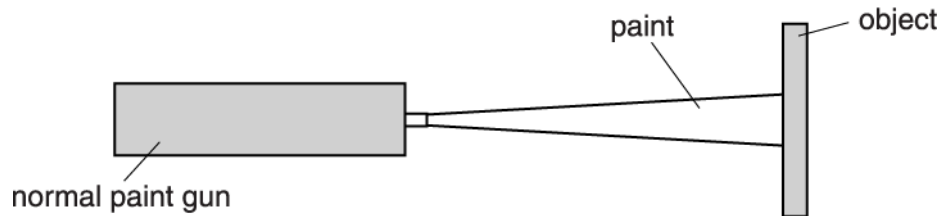
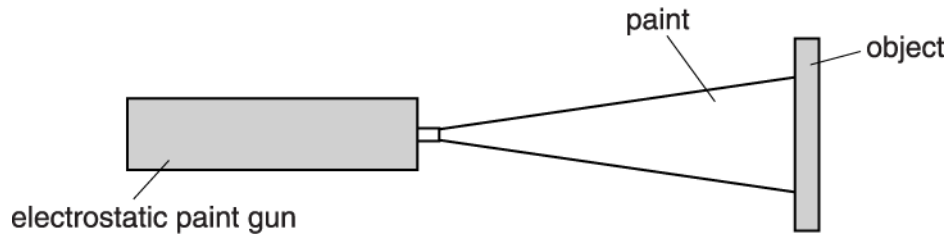


Diagram of an electrostatic paint gun

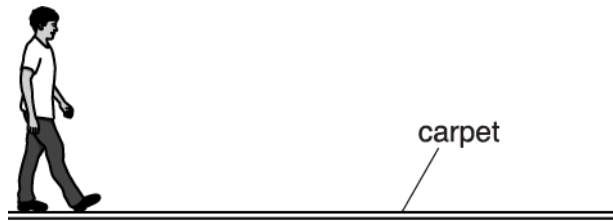


Use the diagrams to describe how and why the two paint guns work in different ways.

You may add more labels to the diagrams to help your description.

[3]

5 Patrick walks on a nylon carpet.



He becomes negatively charged.

Describe how Patrick has become **negatively** charged.

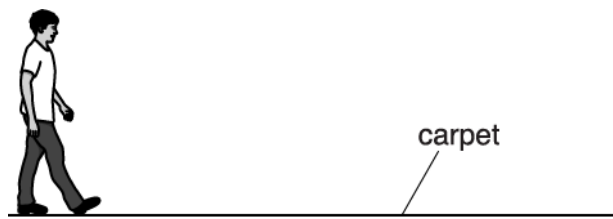
----- [2]

6 Electrostatic shocks can be a nuisance.

Describe how you can get electrostatic shocks.

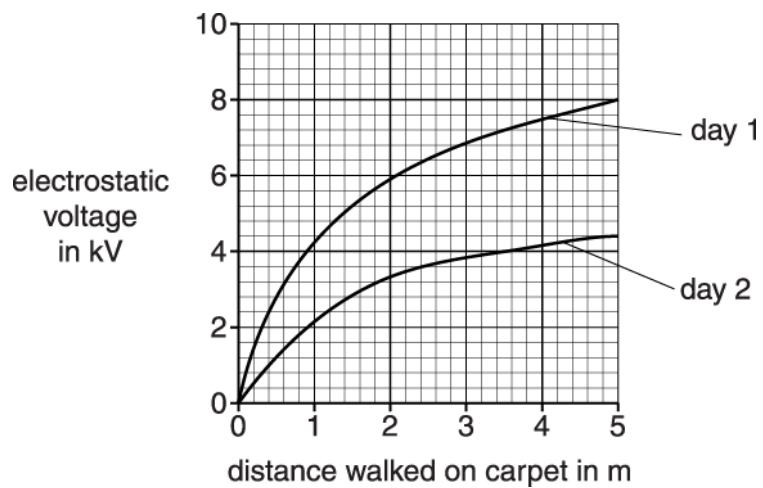
----- [2]

7 Patrick walks on a nylon carpet.



He becomes negatively charged.

His electrostatic voltage is measured when he walks on the carpet on different days.



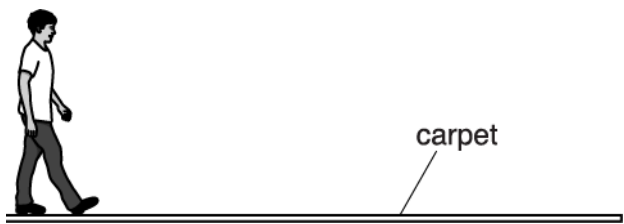
(i) Use the graph to explain what happens on day 1.

----- [2]

(ii) Suggest what is different on day 2.

----- [1]

8(a) Patrick walks on a nylon carpet.



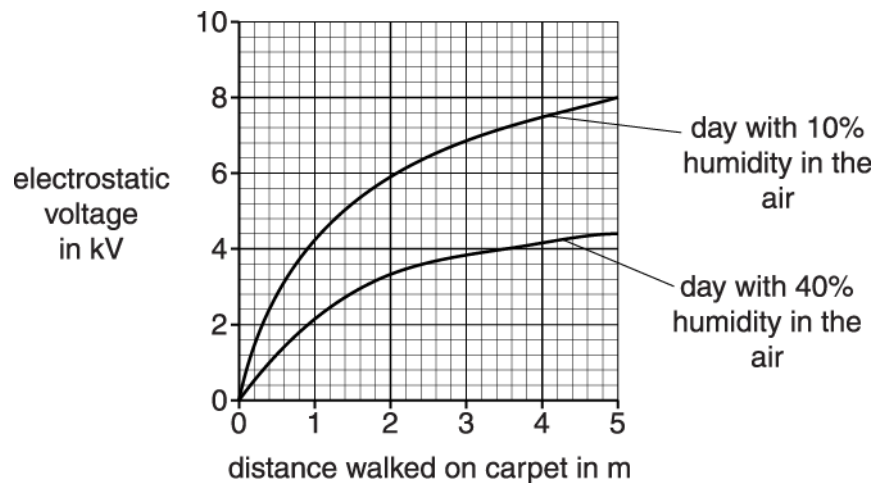
Patrick becomes charged.

Then he receives an electrostatic shock.

Describe how Patrick can become charged and suggest how he receives an electrostatic shock.

----- [2]

(b) Patrick's electrostatic voltage is measured when he walks on the carpet on different days.



(i) Use the graph to describe what happens as Patrick walks along the carpet.

----- [2]

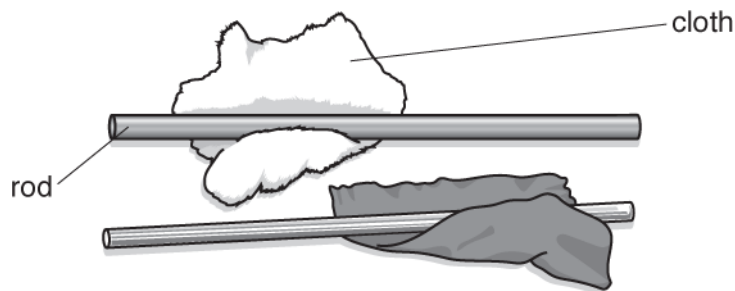
(ii) Use the graph to compare the data for the two days.

----- [1]

(iii) Draw a line on the graph to show what will happen to the electrostatic voltage when there is 20% humidity in the air. [1]

9 Carlos investigates static electricity.

He rubs rods with different cloths.



Carlos then uses the rods to pick up small pieces of paper.

Look at his results.

Rod material	Cloth material	Does it pick up paper?
plastic	nylon	yes
nylon	silk	yes
glass	artificial fur	yes
copper	steel wool	no

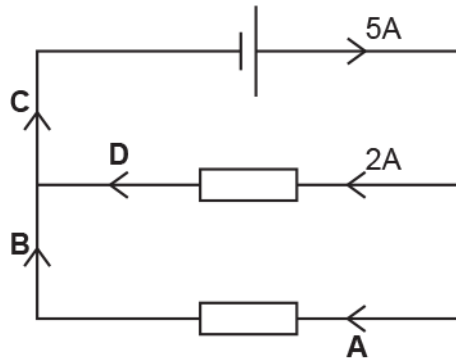
Explain his results and use these to describe why static electricity can be useful or a nuisance.



The quality of written communication will be assessed in your answer to this question.

61

10 This is a circuit.



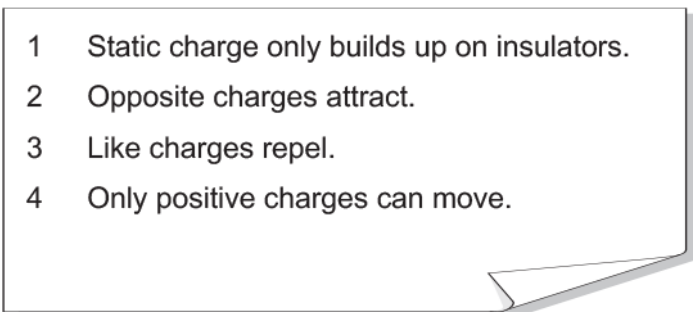
Which letter A, B, C or D shows the part of the circuit that carries a current of 2 A?

Your answer

[1]

- (i) A student has completed her homework on static electricity.

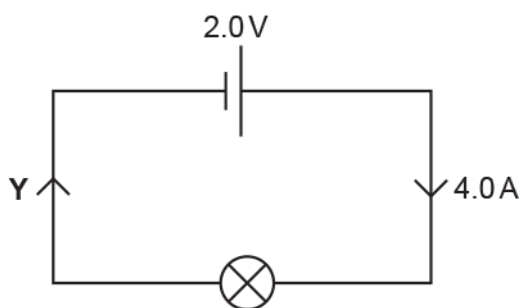
Look at her homework.



Identify the student's mistake and correct it.

----- [2]

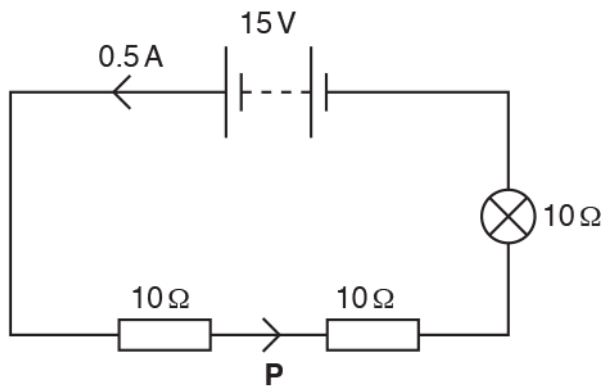
- (ii) When charges move, a current flows.



Write down the current flowing at point Y in the circuit.

Answer = ... A [1]

12 What is the current at point **P** in the circuit?



- A 0.5 A
- B 7.5 A
- C 15.0 A
- D 20.5 A

Your answer

[1]

13(a)

- (i) Write down the conditions needed for charge to flow through a conductor.

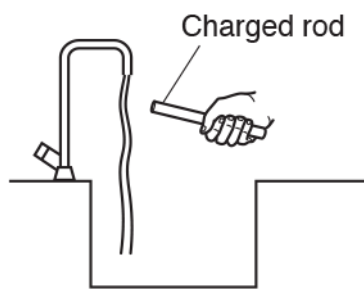
----- [2]

- (ii) Calculate the charge that flows past a point in a circuit with a 5.0 A current for five minutes.

Answer = ... C [4]

(b) This question is about electrostatic charges.

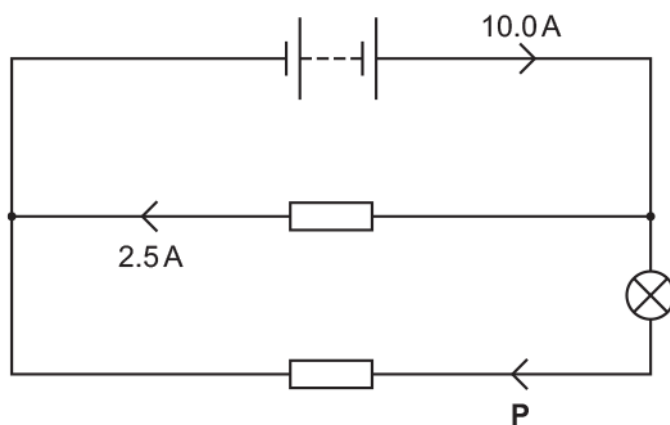
A charged rod is brought towards a gentle stream of water from a tap.



Explain how the charged rod affects the stream of water.

[3]

14 Look at the circuit diagram.



What is the current at point **P** in the circuit?

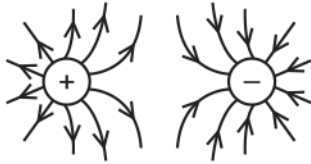
- A 2.5 A
- B 5.0 A
- C 7.5 A
- D 10.0 A

Your answer

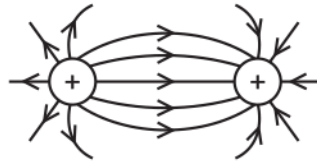
[1]

15 Look at the field line diagrams for positive and negative charges.

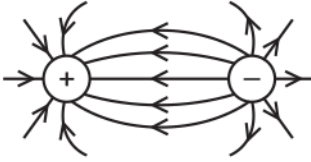
A



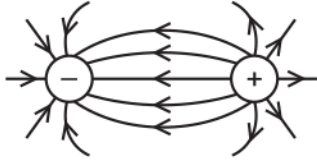
B



C



D



Which field line diagram is correct?

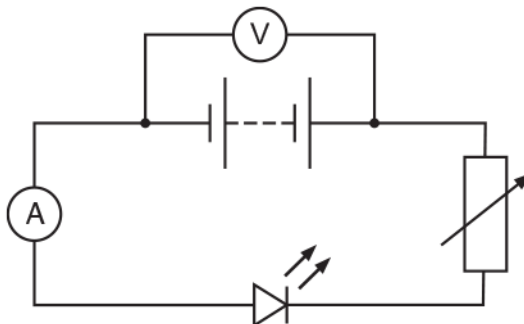
Your answer

[1]

16(a) A student investigates the electrical characteristics of a light emitting diode (LED).

The student builds a circuit to investigate how the current through an LED and the potential difference across it vary when the LED lights up.

Look at the circuit diagram.



(i) The student has made **two** errors connecting the circuit.

Identify the errors.

1 _____

2 _____

[2]

(ii) What is the purpose of the component  in the circuit?

_____ [1]

(b) The student then connects the circuit correctly. He measures the current through the LED as 0.03 A when the potential difference across it is 3.0 V.

(i) Calculate the resistance of the LED.

Use the equation: potential difference = current $\times$ resistance

Resistance = ... Ω [3]

(ii) Calculate the charge which flows when this LED operates for 2.5 minutes.

Charge = ... C [4]

(iii) Calculate the energy transferred when this LED operates for 2.5 minutes.

Use the equation: energy transferred = charge $\times$ potential difference

Energy transferred = ... J [2]

17 Static electricity can be produced when two materials are rubbed together.

Which two types of material could cause static electricity to be produced?

- A Two insulators
- B Two conductors
- C One insulator and one conductor
- D A metal and a non-metal

Your answer

[1]

18 What conditions are needed for charge to flow?

- A A source of potential difference and two lamps.
- B A complete circuit and two lamps.
- C A complete circuit and a source of potential difference.
- D A complete circuit and a source of resistance.

Your answer

[1]

19 Calculate the **charge** that flows when a current of 2.5 A flows for 30 seconds.

Charge = ... C [3]

20(a) A student investigates static electricity using a plastic ruler.

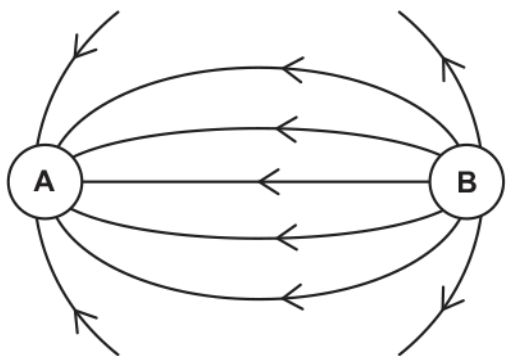
(i) Explain in terms of electrons why the plastic ruler is not normally charged.

----- [2]

(ii) Explain in terms of electrons why the ruler becomes charged when the student rubs it with a cloth.

----- [2]

(b) The diagram shows the electric field between two charges, A and B.



(i) State the charges of A and B.

Use the diagram to explain your answer.

----- [3]

(ii) Describe **one** similarity between the electric field line diagram and a magnetic field line diagram.

----- [1]

21 Calculate the charge flow when a current of 20 mA flows for 2000 s.

Use the equation: charge flow = current $\times$ time

- A 40 C
- B 100 C
- C 40 000 C
- D 100 000 C

Your answer

[1]

22(a) A student investigates static electricity using a plastic ruler.

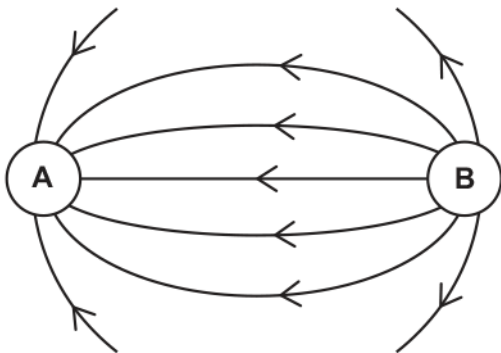
(i) Explain in terms of electrons why the plastic ruler is not normally charged.

[2]

(ii) Explain in terms of electrons why the ruler becomes charged when the student rubs it with a cloth.

[2]

(b) The diagram shows the electric field between two charges, A and B.



(i) State the charges of A and B.

Use the diagram to explain your answer.

[3]

(ii) Describe **one** similarity between the electric field line diagram and a magnetic field line diagram.

[2]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	(The car seat becomes) positive(ly) / + (charged because it loses) electron(s) [1]	1	both required for one mark not positive electrons Examiner's Comments Mostly correct with the seat becoming positively charged because it loses electrons. Occasionally one of neutrons, protons or charges was substituted instead of electrons.
		ii	(idea that) antistatic sprays are made of a conducting (polymer) material / contains a substance that is a good conductor [1] Car seat (now) conducts [1]	1	ignore charge cannot build up allow enables charge to move / leak to earth [1] Examiner's Comments Few candidates mentioned conduction. Most thought that the spray stopped the flow of electrons or reduced friction forces, etc. Others thought it neutralised charge. Good answers referred to it providing a conducting layer' [1].
		iii	(idea that the strip provides earthing but as the car moves) the strip is not always in contact with the road [1]	1	allow (idea that) the car is already earthed because there is graphite in the tyres so this additional earthing does not make a difference [1] ignore strip breaks / gets damaged / falls off Examiner's Comments About a third of answers correctly referred to the strip losing contact with the ground (because of uneven ground or the wind lifting it up). Some just thought it would break or it was not thick enough to carry electrons away.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
2			any three from the balloon is an insulator [1] balloon is charged/ gains or loses electrons [1] opposite charges attract [1] water is attracted [1]	3	ignore water bends allow the idea that the balloon and water (closest to the balloon) are oppositely charged [2] ignore pulling allow higher level answers about induction Examiner's Comments This question was about electrostatics. Most scored at least one mark (usually for attraction) but very few, even amongst higher ability candidates scored 3 marks
			Total	3	
3			(charge carriers are) not neutrons they are electrons [1] (resistance does not stay the same) it changes / increases [1]	2	allow mistakes indicated on the text not resistance decreases Examiner's Comments It was encouraging to see that most could recognise the faults in the description of current as flow of neutrons, and that resistance was not independent of temperature. The most common incorrect correction was stating that resistance decreases with increasing temperature.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4			any three from spread of (paint) spray less for normal paint gun / spread of (paint) spray more for electrostatic paint gun [1] (idea that) paint (droplets) in normal paint gun uncharged [1] (idea that) paint droplets in electrostatic gun have the same charge [1] (idea that) like charged (paint) particles repel (so spreading the paint further) [1] (idea that) object is charged (oppositely to paint) [1] (idea that) in electrostatic gun paint droplets are attracted to object [1]	3	allow marking points from labels on the diagrams allow (paint) spray identified as spreading once it leaves the paint gun [1] Examiner's Comments This question on Spray painting was accessible by most candidates who often scored at least [1] mark. The best answers included a detailed description of how the electrostatic paint spreads more, due to the like charged paint particles repelling. Weaker candidates often simply described the attraction between the paint and the object
			Total	3	
5			he gains negative charge (from the carpet) (1) but he gains electrons (from the carpet) (2)	2	Any mention of positive electrons [0] Any mention of moving positive charge [0] if no other marks scored allow idea that there is a transfer of electrons (1) Examiner's Comments There were some (but fewer) references to 'positive electrons' [1] this year. Most answers clearly stated the movement of electrons from the carpet to Patrick [2].
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6			become charged / loses or gains electrons [1] (then) become earthed / charge or electrons transferred to make object neutral [1]	2	allow examples of becoming charged e.g. (insulating) materials rubbing together / taking sweater off / walking on carpet [1] allow when touching something that is earthed [1] BUT allow touching charged object causes current to flow to earth [2] Examiner's Comments The explanation of electron movement and earthing was poorly described by most candidates. Very few achieved [2] marks.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7		i	(electrostatic) voltage increases with distance / AW [1] (idea of) voltage related to charge / electrons [1] the increase in (electrostatic) voltage is faster at the start / increases slower at the end / the increase is not linear [1]	2	allow the (electrostatic) voltage increases as more electrons are transferred (1) Eg. the (electrostatic) voltage increases with distance as he gains more (negative) charge or electrons [2] allow there is a steeper gradient at the start (1) allow trend shown with data from the graph: e.g. (electrostatic) voltage rises from 0 to 6kV in 2 metres but by only 2 in the next 3 metres [2] <u>Examiner's Comments</u> This question asked candidates to interpret and make conclusions from a graph of electrostatic voltage. Some answers failed to mention distance at all. Most though described the voltage increasing with distance [1] with rather fewer describing the reduced build up at higher distances or voltage. Also included were many part a) type answers talking about friction or transfer of electrons.

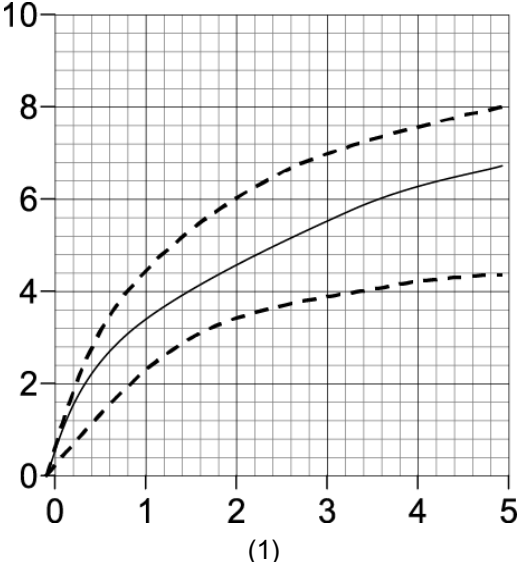
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	more moisture in air / surroundings / clothing / shoes / carpet [1] idea of more conductive air / surroundings / clothing / shoes / carpet [1] less friction / rubbing [1]	1	Eg. Wet day / wet shoes [1] allow idea of less insulated [1] allow more charge has leaked away (to earth) [1] allow bare feet / use of anti-static spray [1] allow idea that feet are picked up or feet are not dragged along the carpet (1) ignore speed of walking [1] <u>Examiner's Comments</u> Some candidates gave insufficient or incorrect detail to score. Some simply described the difference in the pattern to day 1 – eg 'it's a lower voltage'. The concept of 'wet' was rare with the majority of responses correctly explaining it in terms of 'less friction' or wearing less insulating shoes.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a		any one from gains charge from the carpet (1) idea of friction (between carpet and feet (1) the carpet is an insulator or his shoes are an insulator (1) he gains electrons / he loses electrons (1) any one from he touches another person (1) he touches something metal (1) (idea that) he is earthed (1) (idea that) he is discharged (1)	2	NOT Positive electrons Ignore ions Examiner's Comments ??This context about charging while walking across a nylon carpet is familiar. Many scored one mark for the idea of friction leading to charging but as in 2014 the explanation of electron movement and most candidates poorly described earthing.
	b	i	electrostatic voltage or charge increases (with distance) AW (1) (idea of) voltage related to charge / electrons [1] but the increase in electrostatic voltage is faster at the start / increases slower at the end / the increase is not linear (2)	2	eg. the electrostatic voltage increases (with distance) as he gains (negative) charge or electrons [2] allow there is a steeper gradient at the start (1) allow trend shown with data from the graph: e.g. electrostatic voltage rises to 6kV in 2 metres but by only 2 in the next 3 metres [2] Examiner's Comments Most scored one mark for the simple relationship shown in the graph but very few achieved two marks and were not able to describe how the rate of charging with distance reduced.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	(idea that) greater voltage (gained) when there is less humidity / ORA Or idea that increase is more when there is less humidity / ORA (1)	1	answer needs to be comparative with reference to humidity allow more charge leaks away on a humid day (1) <u>Examiner's Comments</u> Most could correctly use the graph to compare charging on days with differing levels of humidity [1].
		iii	curved line starting a (0,0) with similar shape to those on graph but between the two lines (1)	1	allow any curved line starting at (0,0) and between the two lines on graph e.g.  (1) BUT any line that touches either of the two original lines after the start scores (0) <u>Examiner's Comments</u> It was very pleasing that nearly all candidates could interpolate the data to sketch the line for an intermediate level of humidity.

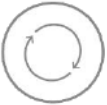
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	6	
9			Level 3: (5–6 marks) Detailed explanation of results AND useful and nuisance given. Quality of written communication does not impede communication of science at this level. Level 2: (3–4 marks) Simple explanation of results AND useful and nuisance given. Quality of written communication partly impedes communication of science at this level. Level 1: (1–2 marks) Simple description of results OR useful OR nuisance given. Quality of written communication impedes the communication of science at this level Level 0: (0 marks) Insufficient or irrelevant science. Not worthy of credit.	6	This question is targeted up to grade C Indicative scientific points may include (but are not limited to) the following: explanation of results • insulating materials rubbed together attract paper / conducting materials do not attract paper • unlike charges attract / the rod is a different charge to the paper for them to attract • electrons are transferred for attraction / no electrons are transferred for copper and steel wool • electrons are negative description of results • some rubbed materials attract paper / some rubbed materials do not attract paper • non metals attract paper / metals do not attract the paper useful static electricity • dusting • removing soot in chimneys • spray painting • crop spraying • defibrillators / restarting the heart nuisance static electricity • electrostatic shock • clothes cling • dust on TV screen
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10			D ✓	1 (AO2.1)	<u>Examiner's Comments</u> About two-thirds of the candidates got this question correct: the commonest wrong answer here was A, presumably looking at the symmetry in the bottom part of the diagram.
			Total	1	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
11	Error: only positive charges can move ✓ Correction: negative charges/electrons can move ✓	2 (AO3.2a) (AO1.2)	ALLOW indication on the student's notebook Examiner's Comments  A number of candidates provided the correct answer (that it is electrons that move) but did not identify that mistake in the student's homework (i.e. only positive charges can move). The two most common ways that candidates identified the student's mistake were: by putting a cross next to it on the homework sheet, or by writing that statement 4 was wrong in their answer. Over a third of candidates omitted to identify the student's mistake in their answer (see Exemplar 1 below). Candidates were instructed to do this in the stem of the question and identifying the error was the marking point for the first mark.  AfL Underlining the command words can ensure that candidates answer the question that is being asked. In this example both 'identify' and 'correct' needed to be answered for both marks. Relying on the reader to assume that what the mistake is from the answer provided is testing the reader's knowledge and understanding not that of the candidate. Exemplar 1 Identify the student's mistake and correct it. ☒ Negative charges can move as well ✓ [2] Exemplar 2

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					Identify the student's mistake and correct it. not only positive charges have the ability to move ✓ a negative charge is able to move ✓ [2]
		ii	4A ✓	1 (AO1.2)	Examiner's Comments Half of all candidates did know that the current must be the same both sides of the bulb. The most common misconception was attempts to calculate and answer using the data on the circuit diagram.
			Total	3	
12			A ✓	1 (AO2.1)	Examiner's Comments About 80% of candidates gave the correct answer A. Common incorrect answers were randomly selected from the other distractors.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13	a	i	potential difference ✓ closed or complete circuit ✓	2 (AO2 × 1.1)	IGNORE ions / charge ALLOW voltage ALLOW higher level answers eg. must have delocalised electrons / electrons that are free to move <u>Examiner's Comments</u> Only about 10% here gained both marks. Delocalised electrons was a common correct answer for 1 mark. Less often seen were a potential difference [1] and a complete circuit [1].
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1500 (C) award 4 marks $Q = It$ ✓ $t = 5 \times 60 = 300$ (s) ✓ $Q = 5 \times 300$ ✓ $Q = 1500$ (C) ✓	4 (AO1.1) (AO2.1) (AO2.1) (AO2.1)	<u>Examiner's Comments</u> This was reasonably well answered and about two thirds of candidates gained 3 marks for 1500. Some forgot to convert minutes to seconds but were credited some reward for their working.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		Rod attracts water ✓ • Opposite charges attract ✓ • water has both + and – charges / idea of polarisation / AW ✓	3 (AO3 × 1.2)	IGNORE positive electrons / movement of protons / ions for this answer. ALLOW Water bends or moves towards rod OR for candidates that have misinterpreted the diagram as repulsion of water then ALLOW Rod repels water / water bends or moves away from rod ✓ • Like charges repel ✓ • water has both + and – charges / idea of polarisation / AW ✓ <u>Examiner's Comments</u> The diagram was interpreted differently by candidates. Some thought it attracted (ideal scenario) and others thought it repelled. However marks were made available for both lines of thought as both interpretations were valid from the diagram. It gave a full range of marks and discriminated well with about 10% gaining full marks by including the idea of polarisation. The ideas of repulsion of water and opposite charges repelling were credited 2 marks.
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14			C ✓	1 (AO1.1)	<u>Examiner's Comments</u> A number of candidates chose A, assuming that the current was the same in each resistor, or B, assuming that the 10.0 A was equally shared. Candidates should be encouraged to read all of the question without guessing what the question is asking. Many candidates helpfully wrote tables to the right comparing currents and potential differences in series and parallel circuits. Some candidates helpfully wrote $10 - 2.5$ and in some cases, this was added to the diagram. It is helpful in these types of question to underline quantities as the question is read.
			Total	1	
15			D ✓	1 (AO1.1)	<u>Examiner's Comments</u> This was generally well answered. Candidates who did not gain the correct answer often chose C indicating that the direction of the electric field was not fully understood.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
16	a	i	LED / cells connected the wrong way around OR ✓ Voltmeter is across the battery/cells OR voltmeter should be across the LED ✓	2 (AO2x3 .2a)	ALLOW diode IGNORE voltmeter in wrong place <u>Examiner's Comments</u> The majority of the candidates gained at least one mark. Vague answers such as "voltmeter is in the wrong place" did not gain credit. Higher ability candidates stated for one of the errors that the LED (or cells) were connected the wrong way around or the LED (or cells) needed to be reversed. For the other error, it was expected that the candidates would indicate that the voltmeter was not measuring the potential difference across just the LED, but across the battery. Candidates gained a mark for this error by suggesting connecting the voltmeter across the LED. Incorrect answers given by many candidates included the ammeter being in the wrong place or the variable resistor being in the wrong place. Often candidates incorrectly suggested that the order of the components mattered.
		ii	Any one from: Control/change/alter the current (in the circuit) ✓ Control/change/alter the potential difference/voltage (across the LED) ✓	1 (AO1.2)	DO NOT ALLOW to vary the resistance <u>Examiner's Comments</u> A large number of candidates answered this question by stating that the component was a variable resistor or to vary the resistance of the circuit. Few candidates answered the question in term of the purpose of the variable resistor was to vary the potential difference across the LED or vary the current through the LED (by varying the resistance in the circuit).

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 100 (Ω) award 3 marks Resistance = potential difference $\div$ current / $R = V \div I$ ✓ $R = 3.0 \div 0.03$ ✓ $R = 100 (\Omega)$ ✓	3 (AO1.2) (AO2.1) (AO2.1)	<u>Examiner's Comments</u> The majority of the candidates were able to rearrange the given equation and substitute into the rearranged equation the correct values to give an answer of 100 Ω. A very small minority of candidates used 0.3 A rather than 0.03 A. Candidates often underline the quantities in the question, which was good practice.
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4.5 (C) award 4 marks Charge flow = current $\times$ time / $Q = I \times t$ ✓ $t = 2.5$ minutes = 150 seconds ✓ $Q = 0.03 \times 150$ ✓ $Q = 4.5$ (C) ✓	4 (AO1.2) (AO1.2) (AO2.1) (AO2.1)	ALLOW 3 marks for an answer of 0.075 (C) (time not converted to seconds) ✓✓✓ <u>Examiner's Comments</u> In this question, higher ability candidates who did not obtain the correct answer, but showed their working, could still gain marks from their working. In this case, the equation for charge flow needed to be recalled and the time of 2.5 minutes needs to be changed to 150 seconds, before the answer could be calculated.
		iii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 13.5 (J) award 2 marks $E = 4.5 \times 3.0$ ✓ $E = 13.5$ (J) ✓	2 (AO2.1) (AO2.1)	ECF from (ii) ALLOW 14(J) <u>Examiner's Comments</u> Most candidates were able to multiply their answer to (ii) by 3.0 to gain the correct answer.
			Total	12	
17			A ✓	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18			C ✓	1 (AO1.1)	<u>Examiner's Comments</u> The term 'source' was not clearly understood by some candidates. In this context a 'source of potential difference' is 'something which will give a voltage that pushes the flow of charge around the circuit.'
			Total	1	
19			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 75 (C) award 3 marks Charge flow = current × time / $Q = It$ ✓ $Q = 2.5 \times 30$ ✓ $Q = 75$ (C) ✓	3 (AO1.2) (AO2.1) (AO2.1)	Mp1 can be assumed if correct substitution follows No ECF from incorrect equation <u>Examiner's Comments</u> Although the concept of electrical charge is difficult for many GCSE candidates, and they were required to recall the equation the majority of candidates were credited with full marks here.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
20	a	i	(Ruler has) equal numbers of protons and electrons / ORA ✓ So (effects of positive charges and negative charges) cancel out / AW / ORA ✓	2 (AO2 x 1.1)	ALLOW equal numbers of positive and negative charges/opposite charges / ORA ALLOW ruler has not lost/gained electrons / ORA ALLOW ruler is/atoms are neutral unless there is a loss/gain of electrons / ORA ALLOW if the ruler had been charged, movement of electrons (to/from the air) would discharge it ALLOW overall/net charge is zero/neutral / ORA IGNORE just charge is neutral
		ii	Electrons are transferred (from/to the ruler or from/to the cloth) / ORA ✓ And any one from: Charges are no longer equal / AW ✓ Different numbers of protons and electrons / AW ✓ Effects no longer cancel out / AW ✓	2 (AO2 x 1.1)	ALLOW electrons are lost/gained DO NOT ALLOW protons/positive charges move ALLOW ruler becomes negative/positive with correct movement of electrons ✓✓
	b	i	They must be opposite/unlike charges / one is positive and one is negative / one is a proton and one is an electron ✓ And any two from: They are being attracted ✓ The arrows show a force on the positive (charge)/(charge) B ✓ Forces/field (lines) go from positive to negative ✓ (Charge) A is negative AND (charge) B is positive ✓	3 (AO3 x 1.2)	ALLOW A is positive and B is negative for this mark only ALLOW forces/field (lines) go from B to A ALLOW maximum of 1 mark if described as opposite poles / positive and negative poles

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Any one from: North and South (poles) (replace positive and negative charges) ✓ The arrows/field lines go from North to South (as opposed to positive to negative) ✓ They have similar shape field (patterns) ✓ Closeness of field lines represents strength of field (in each case) ✓ Opposite <u>poles</u> (and opposite charges) attract ✓ Both show direction of field (lines)/forces ✓	1 (AO1.1)	
			Total	8	
21			A	1 (AO2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
22	a	i	(Ruler has) equal numbers of protons and electrons / ORA ✓ So (effects of positive charges and negative charges) cancel out / AW / ORA ✓	2 (AO2 x 1.1)	ALLOW equal numbers of positive and negative charges/opposite charges / ORA ALLOW ruler has not lost/gained electrons / ORA ALLOW ruler is / atoms are neutral unless they lose/gain electrons / ORA ALLOW if the ruler had been charged, movement of electrons (to/from the air) would discharge it ALLOW overall/net charge is zero/neutral / ORA IGNORE just charge is neutral
		ii	Electrons are transferred (from/to the ruler or from/to the cloth) / ORA ✓ And any one from: Charges are no longer equal / AW ✓ Different numbers of protons and electrons / AW ✓ Effects no longer cancel out / AW ✓	2 (AO2 x 1.1)	ALLOW electrons are lost/gained DO NOT ALLOW protons/positive charges move ALLOW ruler becomes negative/positive with correct movement of electrons ✓✓
	b	i	They must be opposite/unlike charges / one is positive and one is negative / one is a proton and one is an electron ✓ And any two from: They are being attracted ✓ The arrows show a force on the positive (charge)/(charge) B ✓ Forces / field (lines) go from positive to negative ✓ (Charge) A is negative AND (charge) B is positive ✓	3 (AO3 x 1.2)	ALLOW A is positive and B is negative for this mark only ALLOW forces / field (lines) go from B to A ALLOW maximum of 1 mark if described as positive and negative poles

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Any one from: North and South (poles) (replace positive and negative charges) ✓ The arrows/field lines go from North to South (as opposed to positive to negative) ✓ They have similar shape field (patterns) ✓ Closeness of field lines represents strength of field (in each case) ✓ Opposite <u>poles</u> (and opposite charges) attract ✓ Both show direction of field (lines) / forces ✓	1 (AO1.1)	
			Total	8	