



Electricity

FREE Online Physics GCSE Course

physicswithkate.com

Name _____ Date _____

TIME ALLOWED

45 minutes

TOTAL MARKS

36 DOUBLE AWARD · **45** PHYSICS

YOU WILL NEED

a ruler, a pencil, a black or blue pen and a calculator

Instructions

- **Physics:** answer **all** questions.
- **Double Award (Science):** answer Questions 1–6. Skip Questions 7 and 8.
- Write your answers in the spaces provided, in black or blue ink. Draw diagrams in pencil.
- In calculations, show clearly how you work out your answer.

Information

- The marks for each question are shown in brackets.
- Physics is out of 45 marks. Double Award (Science) is out of 36 marks.
- Questions 7 and 8 (static electricity) are **Physics only**.

Your score

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total	%
Out of	2	4	10	6	7	7	4	5	36 / 45	100
Your mark										

Marking your test

The full mark scheme is at the back of this booklet. Try every question first, then mark your answers in a different colour.

1 Question 1

2 marks

Calculate the resistance of a filament lamp when the voltage across it is 4.5 V and the current in it is 51 mA.

Use the equation $R = \frac{V}{I}$

Resistance = _____ Ω
(2)

Total for this question: 2 marks

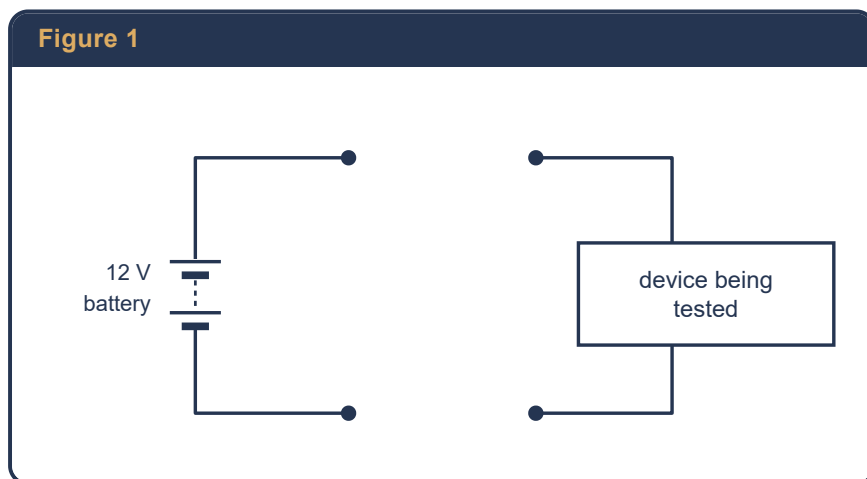
2 Question 2

4 marks

A technician investigates different electrical devices that are used in a car.

The technician connects a device to the 12 V car battery and measures the current in the circuit and the potential difference (voltage) across the device.

Figure 1 shows the car battery and the device that is being tested.

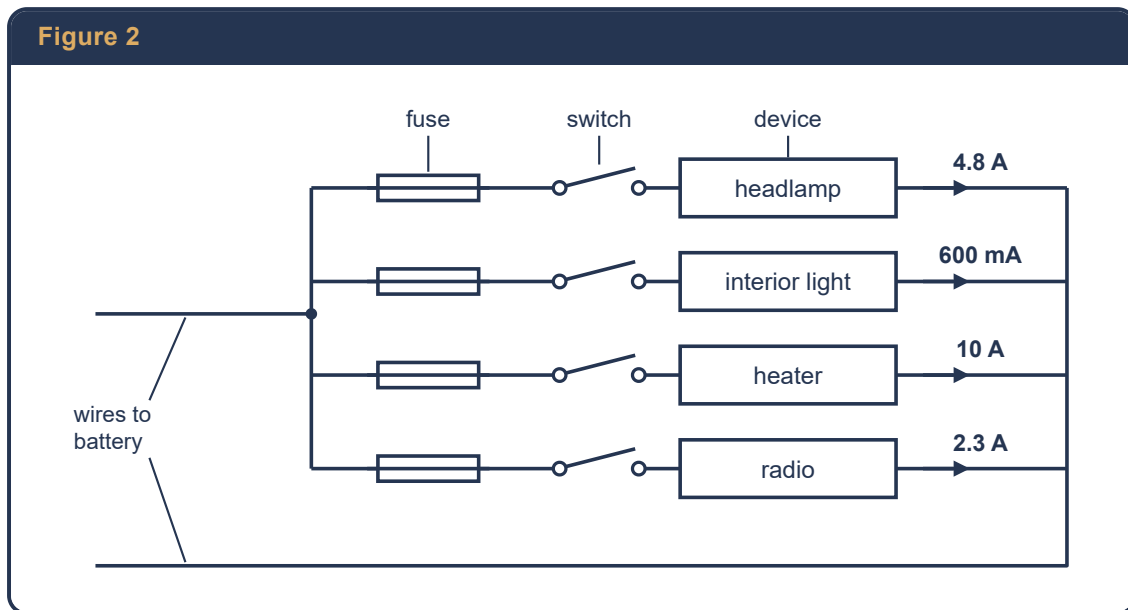


- (a) Draw on **Figure 1** to show how the circuit should be completed so that the current in the circuit and the voltage across the device can be measured.

(2)

- (b) The technician connects four devices to the car battery. Each device has its own switch and its own fuse.

Figure 2 shows how they are connected. The current in each device is shown next to it.



- (i) Calculate the current in the wires to the battery when all the devices are switched on.

Current = _____ A
(1)

- (ii) State how the overall resistance of the circuit changes when any one of the devices is switched off.

(1)

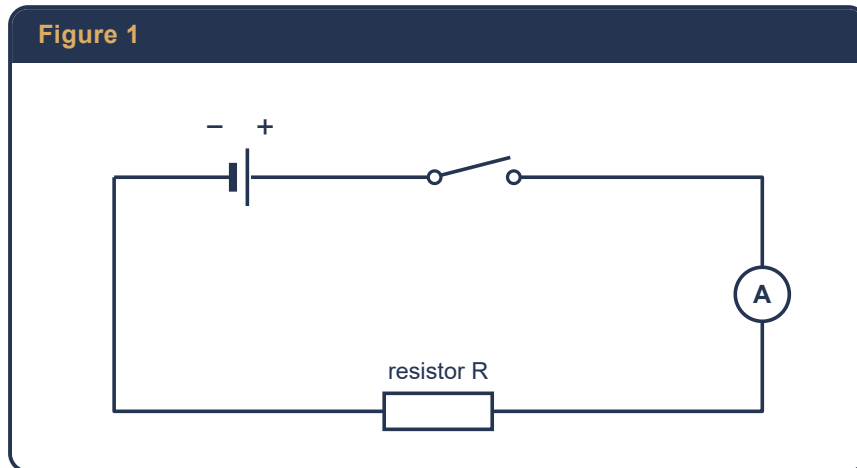
Total for this question: 4 marks

3 Question 3

10 marks

- (a) A student investigates resistors connected in parallel. Each resistor has the same resistance.

Figure 1 shows the circuit with one resistor, R.



- (i) Add to Figure 1:

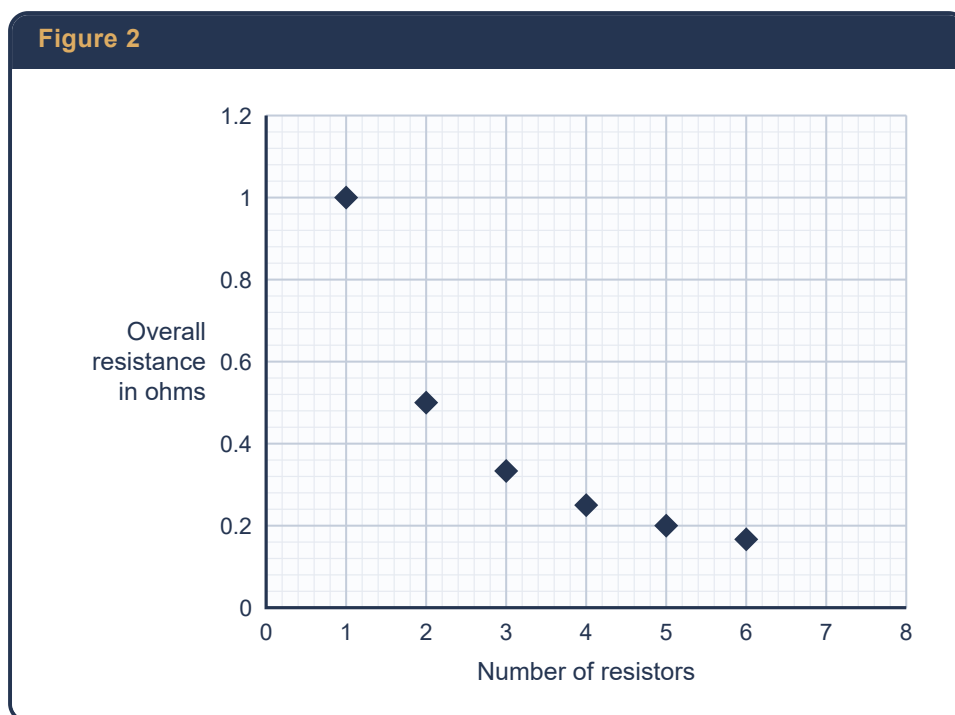
- a voltmeter to find the potential difference across resistor R
- another resistor in parallel with resistor R.

(2)

- (ii) State the measurements that the student must take to find the overall resistance of the resistors in parallel.

(2)

- (iii) The student investigates how the overall resistance of the circuit changes when more identical resistors are added in parallel with R. **Figure 2** shows the results.



State the resistance of a single resistor.

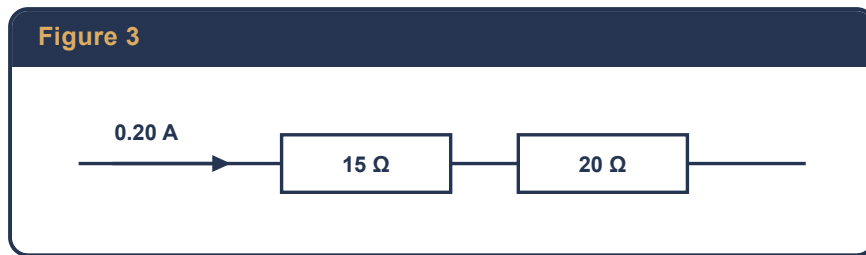
Resistance = _____ Ω
(1)

- (iv) Comment on the relationship between the overall resistance of the circuit and the number of resistors in parallel.

Use information from **Figure 2** to support your answer.

(3)

- (b) A different circuit is then set up with two resistors, as shown in **Figure 3**.



Calculate the potential difference across the 15 Ω resistor.

Potential difference = _____ V
(2)

Total for this question: 10 marks

4 Question 4

6 marks

- (a) Which of these symbols is used to represent a thermistor in an electrical circuit?

Tick (✓) **one** box.



(1)

- (b) A student investigates how the current in a lamp changes with the potential difference across it, and uses the results to calculate the resistance of the lamp. **Figure 1** shows the results.

Potential difference in V	Current in A	Resistance in Ω
1.0	0.09	11
2.0	0.14	14
3.0	0.18	17
4.0	0.22	18
5.0	0.26	
6.0	0.30	20

- (i) One value of resistance is missing from the table. Calculate the value of resistance that is missing.

Missing resistance = _____ Ω
(3)

- (ii) The student used a power supply that had fixed output voltage settings. Each of these outputs was a whole number of volts.

Describe how the student could add a component to the circuit that would give a continuously variable voltage across the lamp.

(2)

Total for this question: 6 marks

5 Question 5

7 marks

- (a) A resistor is connected to a power supply. The potential difference across the resistor is 6.0 V.

- (i) Which of these corresponds to a potential difference of 6.0 V?

Tick (✓) **one** box.

A 6.0 joules per ohm

☐

B 6.0 amps per coulomb

☐

C 6.0 joules per coulomb

☐

D 6.0 amps per ohm

☐

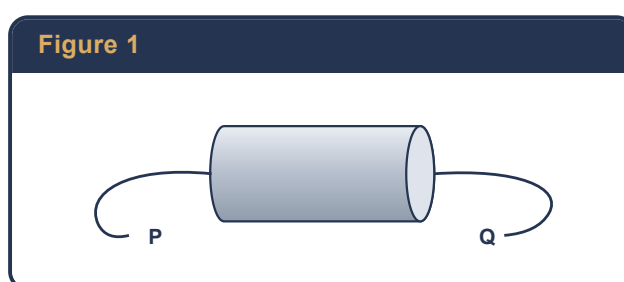
(1)

- (ii) The resistor stays connected for a period of time. The current in the resistor is 200 mA. A total charge of 42 C flows through the resistor.

Calculate, in minutes, the time taken for this amount of charge to flow through the resistor.

Time = _____ minutes
(3)

- (b) **Figure 1** shows a cardboard tube with a wire coming out of each end.



There are two $10\ \Omega$ resistors inside the cardboard tube. A potential difference of 6.0 V is connected between P and Q. There is a current of 1.2 A in the wires.

Deduce how the resistors have been arranged inside the cardboard tube.

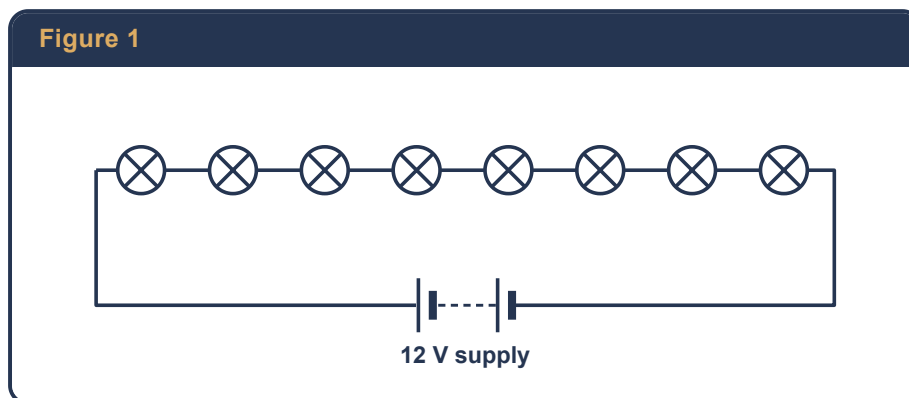
(3)

Total for this question: 7 marks

6 Question 6

7 marks

- (a) Figure 1 shows eight identical filament lamps connected in series to a 12 V power supply.



Calculate the potential difference across each lamp.

Potential difference = _____ V
(1)

- (b) This is a 6-mark extended answer. You will be marked on how well your answer is organised as well as on the physics.

Explain, with the aid of a circuit diagram, the method a student could use to investigate how the resistance of a single lamp changes with the potential difference across the lamp.

(6)

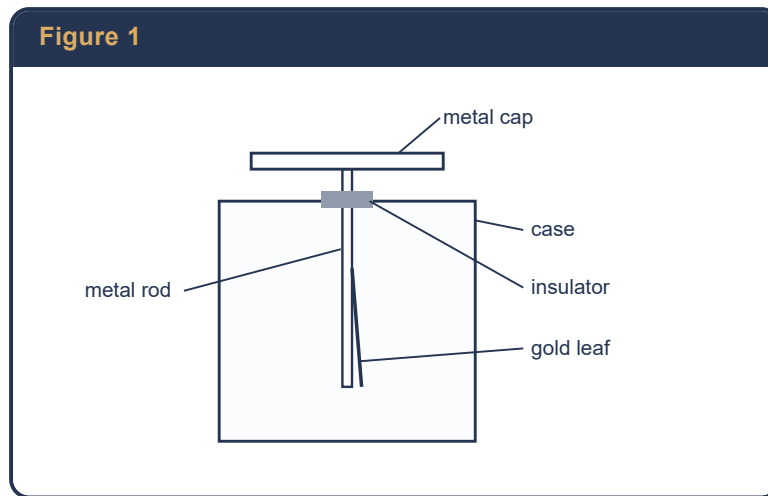
7 Question 7

Physics only

4 marks

(1)

(ii) Figure 1 shows a gold leaf electroscope that can be used to investigate static electricity.

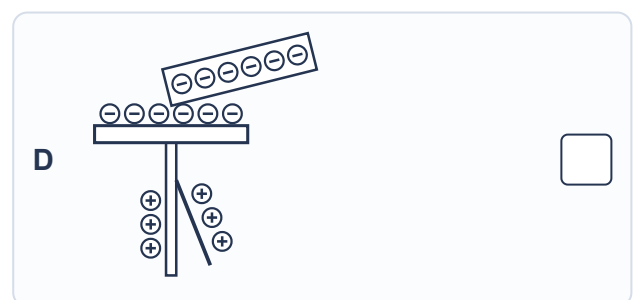
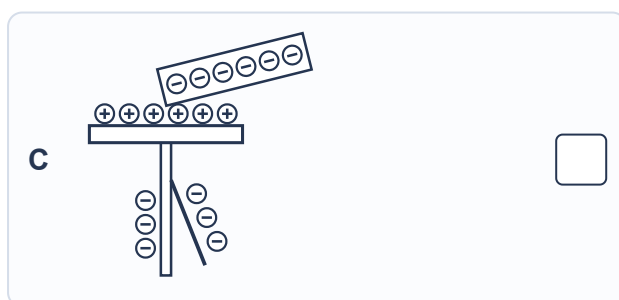
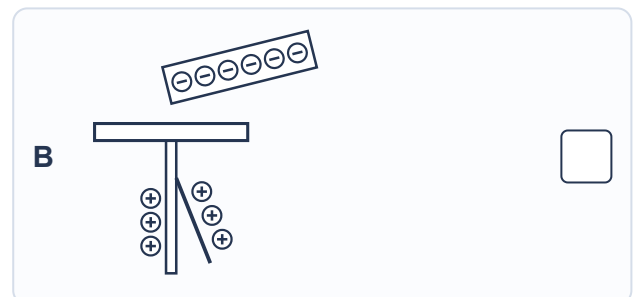
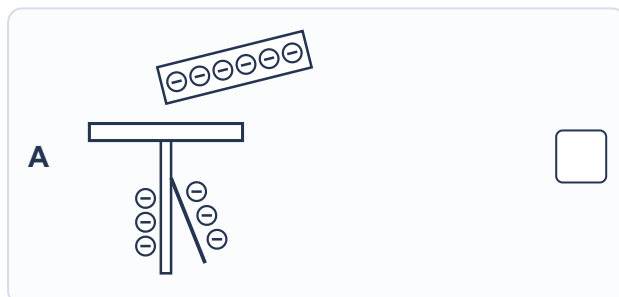


The electroscope has no overall charge. The gold leaf has a very small mass and can bend very easily.

The student brings a negatively charged plastic strip near to the cap of the electroscope. The gold leaf bends away from the metal rod.

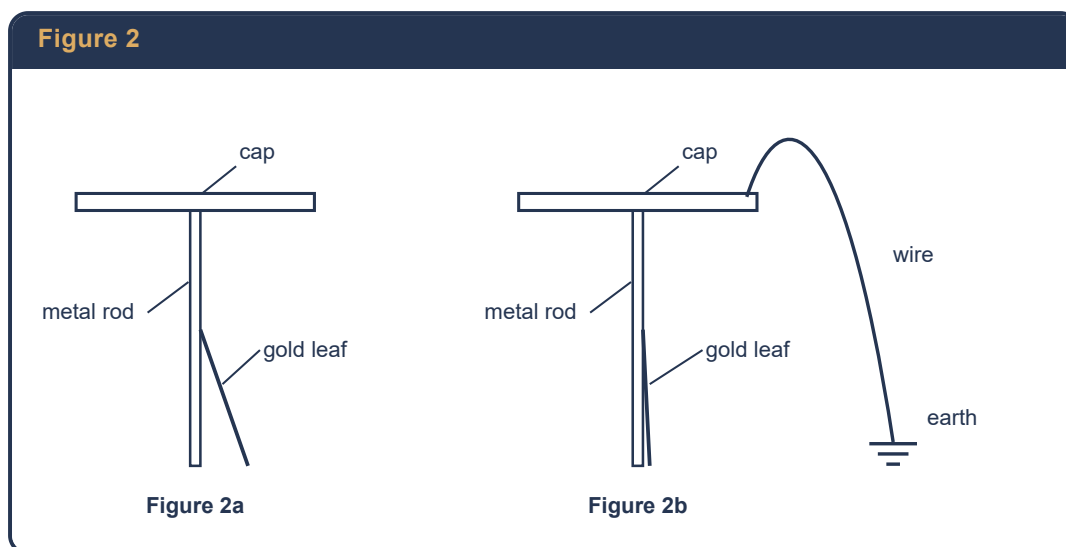
Which diagram shows how the electric charge is now distributed?

Tick (✓) **one** box.



(1)

- (b) **Figure 2a** shows another gold leaf electroscope that has been given an overall negative charge. A student connects its metal cap to earth with a piece of wire, as shown in **Figure 2b**.



Explain why the gold leaf has moved.

(2)

Total for this question: 4 marks

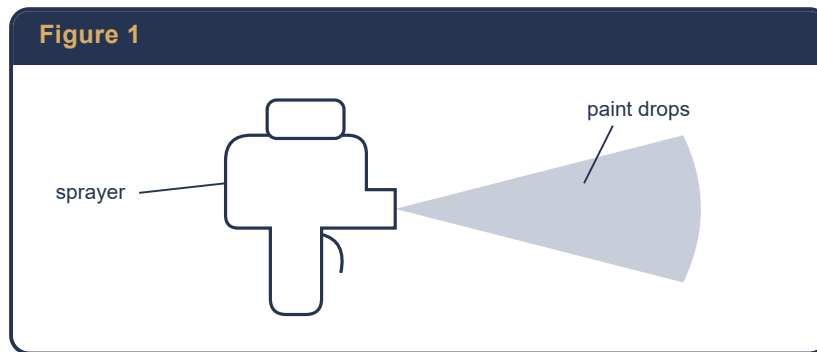
8 Question 8

Physics only

5 marks

Physics only.

Figure 1 shows a paint sprayer. Some paint sprayers give the paint drops a positive charge as they leave the sprayer.



(a) The paint drops have a positive charge because the sprayer

Tick (✓) **one** box.

A removes electrons from the paint drops

☐

B adds electrons to the paint drops

☐

C removes protons from the paint drops

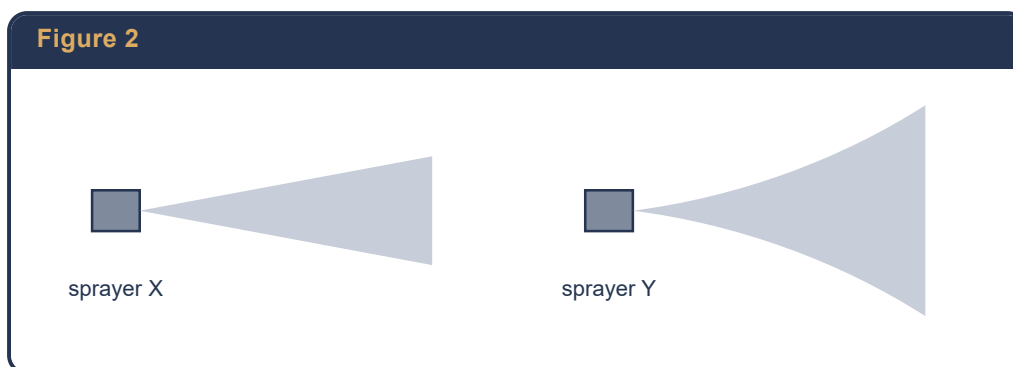
☐

D adds protons to the paint drops

☐

(1)

- (b) **Figure 2** shows the spray pattern from two different paint sprayers. Sprayer X does not charge the paint drops. Sprayer Y gives the paint drops a positive charge.



Explain how charging the paint drops changes the shape of the spray pattern.

(2)

- (c) Sprayer Y is used in a factory to paint a metal object. The object hangs by a metal wire that is connected to earth.

Explain why a metal wire is used to connect the object to earth.

(2)

Total for this question: 5 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

Electricity · Topic Test

[1] in the Mark column means one mark for that line.

accept / allow notes (gold) are other answers that also score.

reject / do not accept notes (red) are answers that do not.

1 Question 1 — mark scheme

Spec 2.13

2 marks

PART	ANSWER	MARK
	substitution: $R = \frac{4.5}{51 \times 10^{-3}}$ or $\frac{4.5}{0.051}$	1
	<i>0.088(2) or 8.8(2) or 0.88(2) or 0.09 seen scores 1 mark (a power-of-ten slip in the mA)</i>	
	evaluation: 88 (Ω)	1
	<i>accept 88.2 Ω</i>	
	<i>accept 0.088 kΩ or 0.09 kΩ for 2 marks</i>	
	<i>award full marks for the correct answer without working</i>	

Total: 2 marks

2 Question 2 — mark scheme

Spec 2.9, 2.17

4 marks

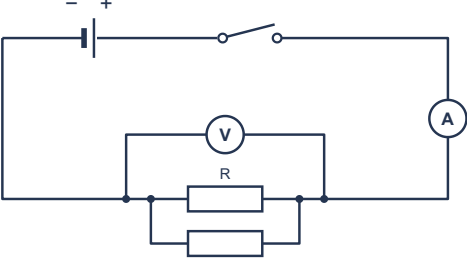
PART	ANSWER	MARK
(a)	voltmeter connected in parallel with the device	1
	<i>accept voltmeter connected in parallel with the battery</i>	
	ammeter connected in series with the device	1
	<i>the ammeter may be in the top or bottom wire, inside or outside the voltmeter connections</i>	
(b)(i)	17.7 (A)	1
	<i>4.8 + 0.6 + 10 + 2.3: 600 mA = 0.6 A</i>	
(b)(ii)	(the overall resistance) increases	1
	<i>the battery p.d. stays 12 V but the total current falls, so $R = V \div I$ is bigger</i>	

Total: 4 marks

3 Question 3 — mark scheme

Spec 2.9, 2.13, 2.20

10 marks

PART	ANSWER	MARK
(a)(i)	voltmeter in parallel across resistor R	1
		
	second resistor in parallel with R	1
(a)(ii)	potential difference (across the resistors in parallel) accept voltmeter reading	1
	current (in the circuit) accept ammeter reading then overall resistance = potential difference ÷ current	1
(a)(iii)	1 Ω accept one ohm	1
(a)(iv)	the (overall) resistance decreases as the number of resistors (in parallel) increases	1
	the relationship is non-linear accept decreases at a decreasing rate allow "the relationship is inversely proportional" for the first 2 marks	1
	any two relevant values from the graph e.g. 2 resistors give 0.5 Ω and 4 resistors give 0.25 Ω	1
(b)	recall and substitution: $V = 0.20 \times 15$	1
	evaluation: 3 (V) allow 7 (V) for 1 mark (using 15 + 20) award full marks for the correct answer without working	1

Total: 10 marks

4

Question 4 — mark scheme

Spec 2.9, 2.10, 2.11, 2.13

6 marks

PART	ANSWER	MARK
(a)	D	1
	 A is a diode, B is a light-dependent resistor (LDR), C is a motor	
(b)(i)	recall and substitution into $V = I \times R$: $5.0 = 0.26 \times R$ accept substitution and rearrangement in either order	1
	rearrangement: $R = \frac{5.0}{0.26}$ 5.0 ÷ 0.26 scores 2 marks	1
	evaluation: 19 (Ω) accept answers that round to 19 Ω, e.g. 19.23 accept the answer written in the table award full marks for the correct answer without working	1
(b)(ii)	add a variable resistor accept rheostat marks may come from a circuit diagram	1
	in series (with the lamp / power supply) accept between / before / after for "in series" the second mark depends on the first	1
	or add a potential divider (1) across the power supply (1) accept potentiometer ignore replacing the power supply / using fixed resistor(s) / an LDR / a thermistor	

Total: 6 marks

5

Question 5 — mark scheme

Spec 2.15, 2.20, 2.21

7 marks

PART	ANSWER	MARK
(a)(i)	C 6.0 joules per coulomb 1 volt is 1 joule per coulomb	1
(a)(ii)	recall and substitution: $42 = 0.200 \times t$ charge = current × time, $Q = I \times t$ accept substitution and rearrangement in either order	1
	rearrangement: $t = 42 \div 0.200 = 210$ s 2.1 or 3.5 to any power of ten scores 2 marks	1

evaluation: 3.5 (minutes)

1

accept 3 minutes 30 seconds

award full marks for the correct answer without working

(b) relevant calculation: R (between P and Q) = $6.0 \div 1.2 = 5 \Omega$

1

allow alternative arguments, e.g. if the resistors were in series: $I = 6 \div 20 = 0.3 \text{ A}$, or the p.d. would be $1.2 \times 20 = 24 \text{ V}$

reasoning: this is less than a single 10Ω resistor / less than two in series (20Ω)

1

accept the current is more than 0.3 A

conclusion: the resistors must be connected in parallel

1

Total: 7 marks

6 Question 6 — mark scheme

Spec 2.9, 2.20

7 marks

PART	ANSWER	MARK
(a)	1.5 (V) accept $12 \div 8$, $3/2$ or $1\frac{1}{2}$	1
(b) Mark the answer as a whole, using a 'best-fit' approach to the levels. The indicative content below is not a checklist: other relevant, correct physics also counts.		
0	No rewardable material.	0
L1	Some relevant physics, but some of it is inaccurate, and the method lacks detail. The explanation is not in a logical order and has big gaps.	1–2
L2	Mostly relevant physics, with some inaccuracies. The method is not fully detailed. The explanation has a mostly clear, logical structure with minor steps missing.	3–4
L3	Accurate, relevant physics throughout. The method is detailed and fully developed. The explanation is clear, coherent and logical.	5–6

Indicative content

Circuit diagram including

- power supply
- ammeter (in series with the lamp)
- voltmeter (in parallel with the lamp)
- filament lamp
- a means of varying the potential difference, e.g. a variable resistor

Description of method

- measure the current with the ammeter
- measure the potential difference with the voltmeter
- vary the potential difference
- calculate the resistance ($R = V \div I$)
- repeat and compare

Model answer

- Connect the filament lamp in series with an ammeter, a variable resistor and a power supply. Connect a voltmeter in parallel across the lamp.
- Switch on and record the current from the ammeter and the potential difference from the voltmeter.
- Adjust the variable resistor to change the potential difference, and record at least six pairs of readings over a wide range.
- Calculate the resistance for each pair of readings using $R = V \div I$.
- Repeat the readings and calculate a mean for each potential difference.
- Plot a graph of resistance against potential difference and compare: the resistance increases as the potential difference increases, because the filament gets hotter.

Total: 7 marks

7 Question 7 — mark scheme

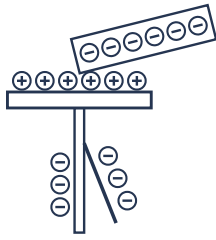
Physics only · Spec 2.23P, 2.24P, 2.26P

4 marks

PART	ANSWER	MARK
(a)(i)	use friction accept rub (the plastic strip) with a (dry) cloth	1

(a)(ii) C

1



A and B are incorrect because the cap would become charged

D is incorrect because the cap would have the opposite charge to the strip: electrons are repelled down from the cap, leaving it positive

(b) electrons move (to earth)

1

accept negative charges move

reject "positive electrons" for this mark

and **one** from: (the leaf and / or rod) have been discharged **or** the gold leaf is no longer repelled

1

Total: 4 marks

8

Question 8 — mark scheme

Physics only · Spec 2.24P, 2.25P, 2.28P

5 marks

PART	ANSWER	MARK
(a)	A removes electrons from the paint drops B would give the drops a negative charge C and D are incorrect because protons are not transferred	1
(b)	the (like-charged) drops repel each other (so) the spray is wider (from sprayer Y) accept more spread out / finer / covers a larger area / more dispersed	1
(c)	metal (wire) is a conductor, so it can conduct electrons / charge (from earth) (so) it prevents (positive) charge building up on the object accept discharges the object accept: so the object keeps attracting the positive drops	1

Total: 5 marks

END OF MARK SCHEME