

GCSE Physics (9 – 1)

Static Electricity

Name:

Group:



Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.

For markers use	
Question	Mark
1	/4
2	/13
3	/6
4	/8
5	/10
6	/8
Total	/49
%	
Grade	

Information

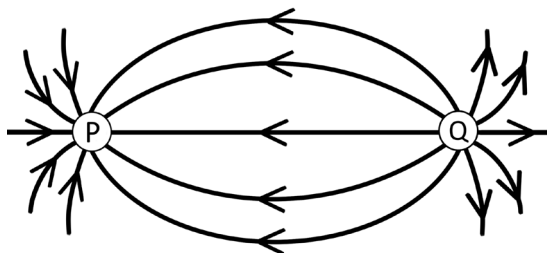
- The maximum mark for this paper is 49 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Static electricity is the build-up of electrical charge on the surface of insulating materials.

For each of the following questions **circle** the letter of the correct answer.

- a) The figure below shows an electric field between the two objects, P and Q.
What is the electric charge of P and Q.



	Charge of P	Charge of Q
A	Positive	Negative
B	Negative	Positive
C	Positive	Positive
D	Negative	Negative

(1 mark)

- b) Which subatomic particle is transferred between objects to create a static electrical charge?

A	B	C	D
Proton	Neutron	Electron	Nucleus

(1 mark)

- c) Static charge only builds up significantly on materials that do not allow electrical charge to flow easily through them. Which of the following materials is most likely to build up a static charge?

A	B	C	D
A copper pipe	A plastic comb	An iron nail	A silver ring

(1 mark)

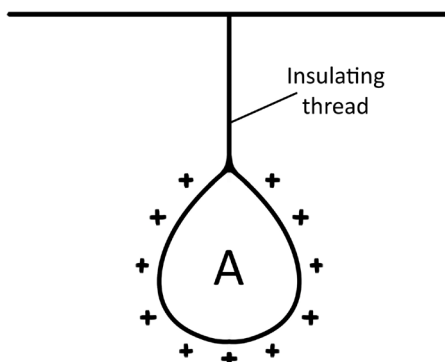
- d) As an aircraft flies, friction with the air causes it to build up a massive static charge. Before it is refuelled on the ground, a copper wire is attached from the aircraft to the earth. Why is this done?

- A To allow protons to flow from the aircraft to the ground, preventing a spark.
- B To increase the potential difference between the aircraft and the fuel hose.
- C To allow electrons to flow from the aircraft to the ground, preventing a spark.
- D To make the aviation fuel act as an electrical insulator.

(1 mark)

(Total for Question 1 is 4 marks)

2. A teacher uses a rubber balloon in a practical to show the effect of static charges. The figure below shows the balloon hanging down from the ceiling in the practical.



- a) The balloon has a positive charge. Explain, in terms of electrons how the balloon got this charge.

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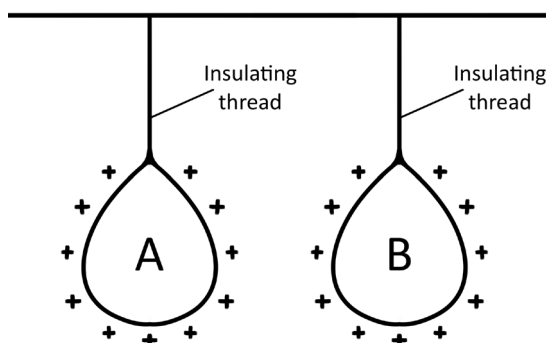
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(2 marks)

- b) The teacher brings a second balloon near to balloon B. The second balloon is also positively charged.



Describe and explain what will happen to balloon B.

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(2 marks)

The teacher touches balloon B with her bare hand. The balloon becomes uncharged (neutral).

- c) Explain how the balloon becomes uncharged. You should refer to electrons in your answer.

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(3 marks)

The image shows a person refuelling a car at a petrol station.

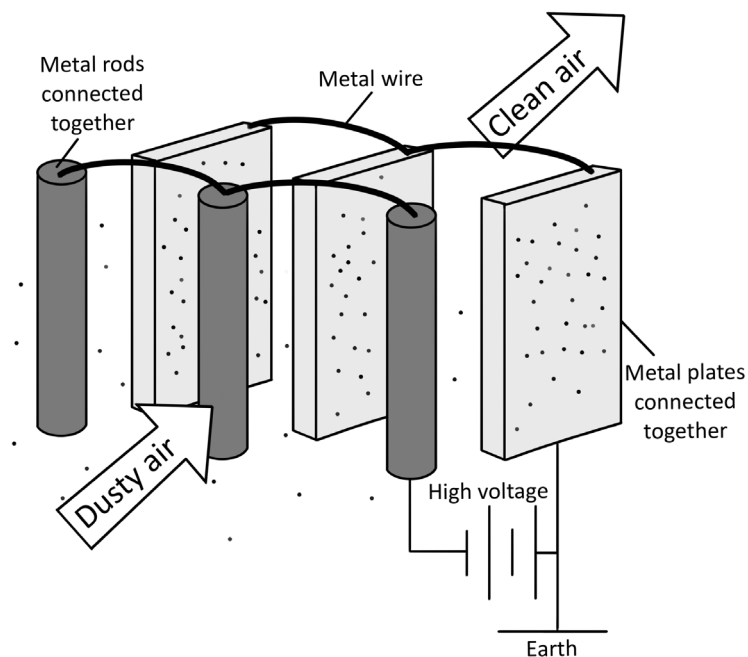


- [illegible]

(Total for Question 2 is 13 marks)

3. The figure below shows how an electrostatic filter traps dust.

Dusty air is blown through a system of metal rods and plates. A high voltage supply is used to maintain a large potential difference across the rods and plates.



a) Identify the charge of the metal rods and the metal plates.

Metal rods:

Metal plates:

(2 marks)

b) Using the diagram, explain how the electrostatic air filter removes dust particles from the air.
You should refer to the charges on the metal rods and metal plates in your answer.

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(4 marks)

(Total for Question 3 is 6 marks)

4. A manufacturer uses an electrostatic spray gun to paint metal car doors.

As the paint droplets leave the nozzle of the spray gun, they pass over a high-voltage electrode and gain a negative electrical charge. The figure below shows a person painting a car door.



- a) The negatively charged paint droplets spread out rapidly as they leave the nozzle, forming a very fine, wide mist. Explain why the paint droplets spread out.

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(2 marks)

- b) The metal car door is attached to the positive terminal of the power supply, giving it a positive charge. Explain **two** advantages of using this electrostatic method compared to using a normal, uncharged spray.

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(4 marks)

The car door is held up using a metal frame.

- c) Explain why the frame is made of a conducting material, rather than an insulating material like wood.

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(2 marks)

(Total for Question 4 is 8 marks)

5. During a thunderstorm, a massive build-up of static electricity occurs inside clouds. This can result in a lightning strike. The figure below shows a thundercloud above a tall building.



- a) Inside the thundercloud, particles of ice and water move around and rub against each other rapidly. Explain how this causes the bottom of the cloud to become negatively charged.

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(3 marks)

- b) The bottom of the cloud is highly negatively charged. As it passes over the building, the roof of the building becomes positively charged. Explain how the roof becomes positively charged, even though the cloud does not touch it.

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(2 marks)

- c) A lightning flash is a very large spark. State the condition required for a spark to jump across the air gap between the cloud and the building.

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(1 mark)

d) The lightning conductor protects the building from damage if it is struck by lightning.

Explain how the copper strip and its connection to the ground keep the building safe.

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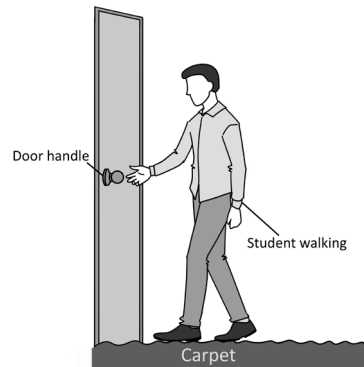
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(4 marks)

(Total for Question 5 is 10 marks)

6. A student walks across a nylon carpet and builds up a static electrical charge. When they reach for a metal door handle, a spark jumps between their finger and the metal.



- a) As the student walked across the carpet they became negatively charged. Explain how they became negatively charged.

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(2 marks)

- b) When the student reached for the door handle they caused the door handle to become positively charged. Explain how the student caused the door handle to become positively charged.

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(2 marks)

The student has the following information about their static shock.

- The spark transfers 4.8 mJ of energy.
- The potential difference between the student and the door handle is 3000 V.
- The spark lasts for 0.2 ms (milliseconds).

- c) Calculate the current in the spark.

(4 marks)

(Total for Question 6 is 8 marks)