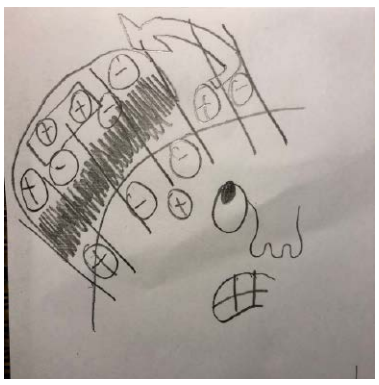
# Static Electricity
## Marking scheme

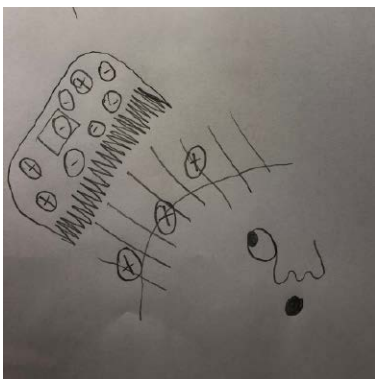
## 1. Describing static electricity

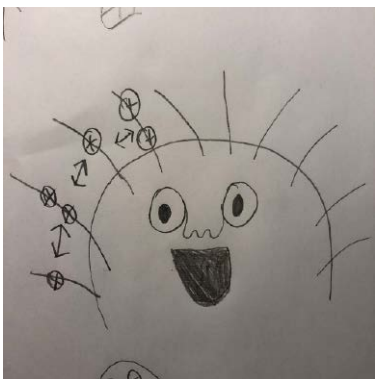
Key points your diagrams need to show (it doesn't matter if your diagrams are a little different to these).

1. Plastic comb being moved between hairs on someone's head
2. Electrons (charges) move from the hairs to the comb, leaving the comb with a negative charge and all the hairs with a positive charge
3. Positive charges do not move
4. Like charges repel. The charge on each hair is the same (all are positive) so the individual hairs repel each other (push away from each other)
5. As the hairs are all pushing away from each other, they spread out as far away from each other as possible, making the person look a little bit like a hedgehog!
6. **Challenge question: why's this hairy problem more of an issue on dry days than damp days?**

The best conditions for a build-up of static electricity on hair are when it's clean and dry. If it's raining or just damp, there are more water molecules on the hair, and they can prevent static electricity build-up on the hair and comb. This is because water on the hair contains dissolved substances and can conduct electrons. Water molecules also weigh down the hair and help strands of hair stick together, making it more difficult for individual strands of hair to be separated by electrostatic forces.







# 2. Static electricity facts

**Static electricity can be dangerous** ☑ True ☐ False

Very large charges of static electricity can discharge and cause sparks that may ignite fuels or other flammable materials. They could also discharge through a person, causing an electric shock. This can cause burns or damage, or disrupt the electrical signals controlling the heart.

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**Static electricity can be useful** ☑ True ☐ False

Devices such as photocopiers and some printers use static electricity, as do electrostatic precipitators. It's also used in electrostatic paint spraying.

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**Lightning is a form of static electricity** ☑ True ☐ False

Tiny particles of ice and hail inside a cloud bump into each other. These collisions cause the top of the cloud to become positively charged and the bottom to be negatively charged. Lightning occurs when these two charges grow large enough to spark within the cloud, or to connect with positive charges on the ground.

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The next seven questions are about electrostatic precipitators and how they work:

**Electrostatic precipitators are used to remove all pollutants from industrial gases** ☐ True ☑ False

Electrostatic precipitators are used to remove small dry particles from industrial process exhaust gases. Depending upon the industrial process, the exhaust gases may also include gaseous pollutants such as carbon dioxide, nitrous oxide, and hydrogen sulfide. Different processes are needed to remove gaseous pollutants.

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**Electrostatic precipitators remove dry dust particles from industrial gases** ☑ True ☐ False

Electrostatic precipitators are used to remove small dry particles such as soot, which is unburnt carbon, from the exhaust gases of some industrial processes. These particles can be harmful if breathed in.

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**Dust particles are given a negative charge by gaining electrons from a negatively charged metal grid**

- [x] True
- [ ] False

The dusty process gas passes through an electrically charged metal grid. Some of the electrons, which are negatively charged, are transferred to the dust particles.

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**The process gases including the negatively charged particles pass by a negatively charged collection plate**

- [ ] True
- [x] False

The dust particles are negatively charged and would be repelled by a negatively charged plate. They're attracted to a positively charged metal plate.

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**The collected particles can be removed from the collection plates by rapping**

- [x] True
- [ ] False

The process is completely dry. The particles don't react chemically with the collection plates – they can simply be removed by shaking or tapping the collection plates. The particles are then bagged up before being re-used, recycled or disposed of, according to the type of process dust collected.

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**The cleaned process gases leave the electrostatic precipitator**

- [x] True
- [ ] False

The process gases are no longer dusty (because they have lower levels of particulates or soot). The gases may need to go through additional processes to remove other pollutants.

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**The process gases leaving the electrostatic precipitator are negatively charged**

- [ ] True
- [x] False

The gases don't become electrically charged; only the dust particles were charged, and they've been removed. The process gases remain uncharged.

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## 3. All about charges

Everything is made of atoms. **Atoms** are made of sub-atomic particles called protons, neutrons and **electrons**. Electrons are **negatively** charged. If an atom loses an electron, it becomes **positively** charged. If an object (made of lots of atoms) gains electrons, it becomes **negatively** charged. Electrons can be transferred between atoms (and between particles or objects or whatever you like). Positive charges **can't** be moved between atoms (so this also means they can't be moved between objects).

An electrical **insulator** is a material that doesn't easily allow an electric current to flow. A plastic comb is an insulating object. When two insulating objects such as a plastic comb and a soft cloth are **rubbed** together, electrons can be **transferred** between them. Electrons move from the cloth to the plastic comb. This leaves a **positive** charge on the cloth and an equal negative charge on the comb. If the charged comb is used to comb clean dry hair, **electrons** transfer to the hairs, giving each one a negative charge. Like charges ("like" here means "the same") repel each other ("repel" here means "**push away**"). If lots of strands of hair next to each other all have a negative charge, they repel each other and make the hairs stand on end to avoid each other.

Unlike charges ("unlike" here means "different") attract. So, an object with a positive charge **attracts** an object with a negative charge. Charged objects don't have to touch each other to experience an attractive or repulsive force. Electrostatic forces are a **non-contact** force. An electric field is the area around a **charged** object where an electrostatic force exists. The force gets weaker further from the object.