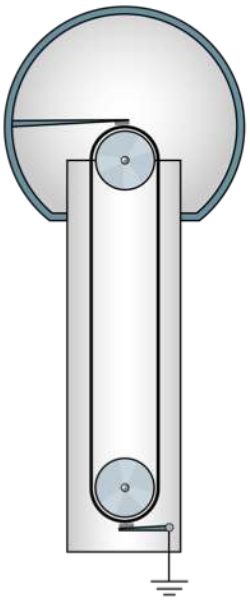
0 1

A physics teacher turns on a Van de Graaff generator, then tells her class that the dome has become **positively charged**.



0 1 . 1

Describe in terms of the flow of electrons why the dome became **positively charged** when the Van de Graaff generator was switched on.

Electrons flowed away from the dome of the machine (leaving it with a net/overall positive charge) [1].

0 1 . 2

The Van de Graaff generator is then switched off and discharged.

Next, a pupil stands on an insulating rubber mat and places their hands onto the dome of the generator. When it is switched on, their hair stands on end. Explain why this happens.

Electrons in the body of the pupil are attracted to and flow towards the positively-charged dome [1]. Their strands of hair develop a positive (induced) charge and repel one another [1].

0 1 . 3

Had the pupil not stood on the rubber mat, their hair may not have stood on end. Explain why.

Rubber is an electrical insulator. Had the person been standing directly on the floor, electrons (from 'ground') could have flowed into their body [1], towards any regions of (induced) positive charge, such as that in their hair. This would in turn mean that their strands of hair would no longer repel one another [1].

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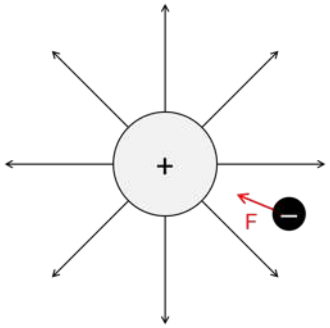
0 2

Many power stations use electrostatic precipitators to reduce the amount of harmful smoke which they release into the environment. Smoke is made up of tiny solid particles (including carbon which was not involved in combustion reactions). These can damage buildings and cause breathing difficulties and other health issues for humans and animals.

In an electrostatic precipitator in the chimney of a power station, smoke particles pass through a grid which is connected to a power supply. This causes the smoke particles to develop an electric charge. Collecting grids with the opposite electric charge are placed further up the chimney.

0 2 . 1

In this diagram, a negatively-charged smoke particle is travelling upwards, close to a positively-charged collecting sphere.



Draw the pattern of electric field lines in the space around the positively-charged collecting sphere.

Field lines directed away from positive sphere [1] with arrows pointed outwards [1].

0 2 . 2

On the same diagram, draw an arrow to represent the electrostatic force which will be exerted on the negatively-charged smoke pattern. Label this arrow 'F'.

Arrow pointed towards centre of positive charge, as shown.

0 2 . 3

In some electrostatic precipitators, the collectors are negatively-charged, and the smoke particles are positively-charged.

State what effect this would have (if any) on the removal of smoke particles by the precipitator. Explain your answer.

No effect [1] because the smoke particles would still be attracted towards the collectors [1].

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