2.8 Static electricity

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS electric field

Objective

Explain static charging by electron transfer, the attraction and repulsion rule, sparking, and the radial electric field of a charged sphere (physics only). Original questions for spec statement 4.2.5.

1 Key knowledge and worked examples

When two **insulating** materials are rubbed together, **electrons** (negative charge) transfer from one surface to the other:

- the material that **gains** electrons becomes **negatively charged**;
- the material that **loses** electrons keeps an **equal positive charge**.

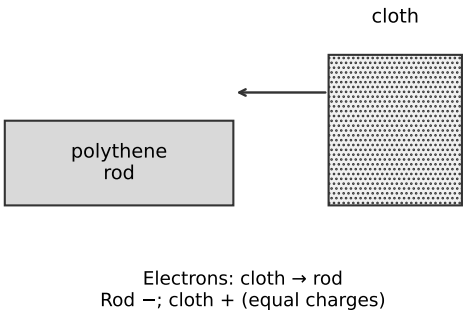
Only electrons move – the positive charges (nuclei) stay put. Charging by friction never creates charge; it separates it.

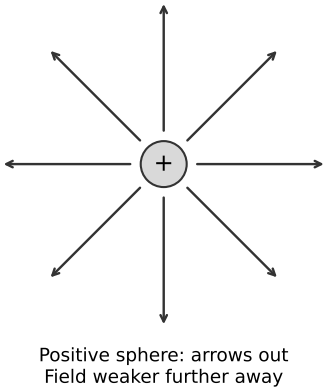
Charged objects exert forces **without contact** (a non-contact force):

- **like charges repel; unlike charges attract.**

A **spark** jumps when the field between charged objects is strong enough to make air conduct – the charge suddenly flows across the gap.

Electric field : the region around a charged object where another charge feels a force. It is **strongest close to the object** and gets weaker with distance.





Electrons move; the field tells the force.

Drawing the field of an isolated charged sphere: straight **radial** arrows, pointing **away** from a positive charge (towards it for negative), drawn further apart as distance grows – showing the field getting weaker.

Worked example (explanation). A student rubs a balloon on hair and it sticks to a wall.

1. Rubbing transfers electrons from hair to balloon, so the balloon is negatively charged.
2. The charged balloon attracts **charges in the wall**: it slightly shifts bound charges in the insulating wall, leaving opposite charge nearer the balloon; the wall remains neutral overall.
3. Unlike charges attract, the nearer opposite charge experiences stronger attraction than the repulsion of the further like charge, pulling the balloon towards the wall.

Common credited points: sparking is caused by a large enough potential difference/pd between the charged object and a conductor; the concept of a field explains the non-contact force (the second charge feels a force because it sits in the first charge's field).

2 Practice

2.1 A polythene rod is rubbed with a dry cloth and becomes negatively charged. Explain, in terms of electrons, what happened to each object. [2]

2.2 Three rods are charged. Rod X repels rod Y; rod Y attracts rod Z. State what this shows about the charges on X and Z, and what happens when X meets Z if X is negative. [3]

2.3 Copy and complete: an electric field is a region where _____. State where the field of a charged sphere is strongest. [2]

3 Exam-style questions

3.1 A Van de Graaff generator's metal dome becomes negatively charged. A student touches the dome and their hair stands on end.

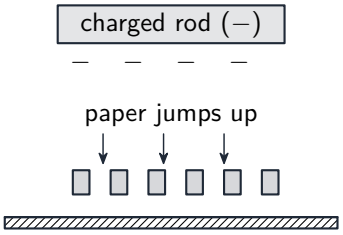
(a) Explain why the hair stands on end. [3]

(b) The dome's electric field is strongest at its most curved point. Use this to explain why a spark jumps to a nearby earthed conductor from a sharp point rather than a flat area. [2]

3.2 A charged rod is held just above small pieces of paper, which jump up to it although nothing touches them.

(a) Explain how the rod attracts neutral paper. [3]

(b) State and explain what happens to the force if the rod is moved further away. [2]



3.3 An aerial fitter works on a roof. The aerial cable comes close to an 11 000 V overhead line but does not touch it.

(a) Explain, using the idea of an electric field, why a spark could still jump from the line to the cable. [3]

(b) The fitter earths the cable before working. A student claims this makes sparks impossible and the fitter safe. Explain why the claim is false. [3]