P3.1 Summary questions

1. a. i. charge flow = current × time
   ii. coulombs

   b. Charge: a property of a particle (like mass), can be positive or negative
      Current: the rate of flow of charged particles, the flow of (usually) electrons
      Potential difference: a difference in (electrical) potential produced by the separation of charge that enable charges to do work, the energy (work done) by a charge
      Resistance: a measure of how easy it is for a current to flow
      \[ \text{resistance} = \frac{\text{p.d.}}{\text{current}} \]

2. a and b

3. a. Rub a polythene rod with a cloth. Electrons are transferred from the cloth to the rod, producing a net negative charge, and leaving the cloth positively charged.
   b. The negatively charged rod repels the electrons in the pieces of paper, so the tops of the pieces of paper become positively charged. They are attracted to the rod.
   c. There is an electric field around all charged objects. The field can be represented by field lines, which try to straighten. When you bring two negatively charged objects together the field lines are distorted. So the charges move apart (repel) to straighten the field lines.

4. a. Current = 0.1 A
   Time = 10 s
   charge flow = current × time
   \[ = 0.1 \text{ A} \times 10 \text{ s} \]
   \[ = 1 \text{ C} \text{ (1 significant figure)} \]

   b. Current = 2 mA = 2 × 10⁻³ A
   Time = 1 minute = 60 s
   charge flow = current × time
   \[ = 2 \times 10^{-3} \text{ A} \times 60 \text{ s} \]
   \[ = 0.1 \text{ C} \text{ (1 significant figure)} \]

   c. Charge = 450 C
   Time = 10 minute = 600 s
   \[ \text{current} = \frac{\text{charge flow}}{\text{time}} \]
   \[ = \frac{450 \text{ C}}{600 \text{ s}} \]
   \[ = 0.75 \text{ A} \text{ (2 significant figure)} \]
d  Current = 2.5 A  
Charge = 6.2 C 

time = \frac{charge \ flow}{current}  
\frac{2.5 A}{6.2 C}  
= 0.40 s (2 significant figure) 

5  They can both be correct because conventional current flows from positive to negative, but electrons flow from negative to positive. 

6  a  Before the cloud was charged it was neutral so there must be two regions of charge in the cloud, one positive and one negative. 

b  The electrons in the material at the top of the tree repelled it them positively charged. 

c  Charge = 0.0005 mC  
= 0.0005 \times 10^{-3} C  
Time = 0.5 s  
\text{current} = \frac{charge \ flow}{time}  
\frac{0.0005 \times 10^{-3} C}{0.5 s}  
= 1 \times 10^{-6} A (2 significant figure) 

d  Metal, because metal allows current to flow (electrons move through the metal to the ground. 

7  a  The pepper grains are in an electric field. 

b  Electrons in the pepper grain move away from the positive rod and towards the negative rod. 
There is a field around the pepper grain because one end is negative and one end is positive. 
This distorts the field, so the pepper grains line up so that the field lines are as straight as possible.