1 Fig. 9.1 shows a positively charged plastic rod, a metal block resting on an insulator, and a wire connected to earth.

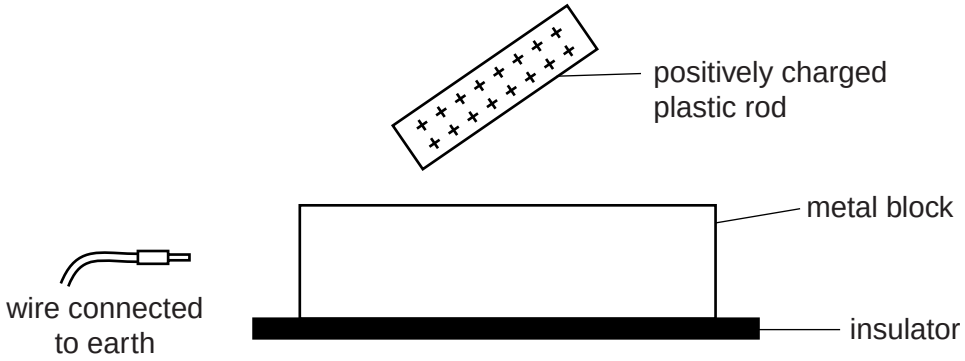

Fig. 9.1

(a) On Fig. 9.1, draw the charge distribution in the metal block. [2]

(b) The earth wire is held against the metal block, as shown in Fig. 9.2.

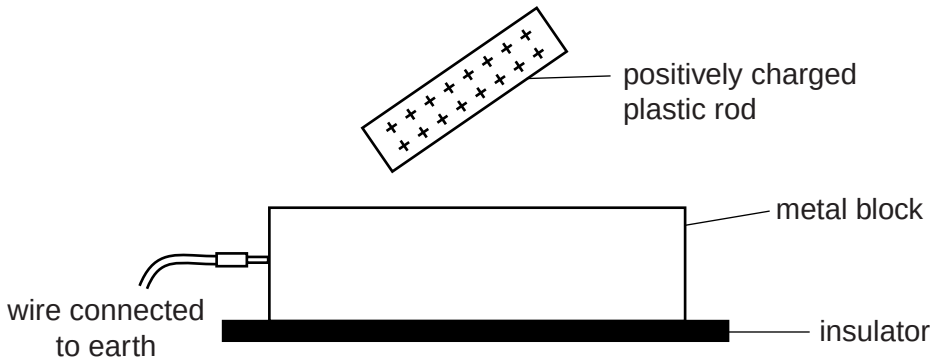

Fig. 9.2

On Fig. 9.2, draw the new charge distribution. [1]

(c) The charged rod and the earth wire are removed and the metal block is left charged.

State the order in which the rod and the wire were removed. Explain your answer.

.....

.....

.....

..... [2]

(d) Name this charging process.

..... [1]

[Total: 6]

2 Fig. 9.1 represents two identical metal plates, positioned horizontally, one above the other in a vacuum.

Fig. 9.1

A negative charge of 0.000 000 042 C (4.2×10^{-8} C) is transferred to the upper plate, leaving the lower plate with a positive charge of the same size.

(a) On Fig. 9.1, draw the pattern of the electric field between the two plates and indicate the direction of the lines of force. [3]

(b) **(i)** A conducting copper wire is used to connect the two plates and this leaves the plates uncharged. Charge flows in the wire for 0.000 000 035 s (3.5×10^{-8} s).

Calculate the average current in the wire during this time.

current = ... [3]

(ii) State, in terms of its atomic structure, why the copper wire is an electrical conductor.

.....

.....

..... [2]

[Total: 8]

3 A charger for a cellphone (mobile phone) is marked:

input: a.c. 240 V, 50 Hz, 80 mA.
output: d.c. 5.3 V, 500 mA.

(a) State

(i) the component in the charger that converts a.c. to d.c.,

.....

(ii) the quantity that has the value 50 Hz.

.....
[2]

(b) Calculate

(i) the output power of the charger,

output power = ...[2]

(ii) the energy transferred in the output circuit when the cellphone is charged for 1.5 hours.

energy = ...[2]

(c) In the following list, underline the quantity that is stored in the battery of the cellphone.

voltage Current Power energy [1]

[Total: 7]

4 **(a)** Explain why

(i) metals are good conductors of electricity,

.....

.....

(ii) insulators do not conduct electricity.

.....

.....

[3]

(b) The battery of an electric car supplies a current of 96 A at 120 V to the motor which drives the car.

(i) State the useful energy change that takes place in the battery.

.....[1]

(ii) Calculate the energy delivered to the motor in 10 minutes.

energy = ... [2]

(iii) The motor operates with an efficiency of 88 %.

Calculate the power output of the motor.

power = ... [2]

[Total: 8]

5 The solar charger shown in Fig. 7.1 is used to charge portable electronic devices in a part of the world without any other electricity supply.

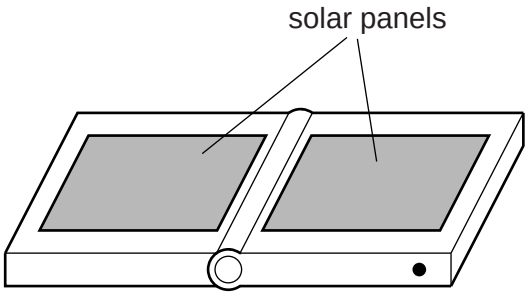

Fig. 7.1

The dimensions of each of the solar panels are 0.25 m × 0.20 m. The solar power incident on 1.0 m^2 of flat ground in this part of the world is 260 W.

(a) Calculate the total solar power incident on the two panels of the charger.

solar power = ... [2]

(b) The output of the charger is 0.95 A at 20 V.

Calculate the efficiency of the charger.

efficiency = ...[3]

(c) Three devices A, B and C are connected together and then connected to the 20V charger. The potential difference (p.d.) across A is measured as 14V, across B it is 14V and across C it is 6V.

Complete Fig. 7.2 to show the arrangement of the devices connected to the charger. Draw devices B and C as similar boxes to the box shown for device A.

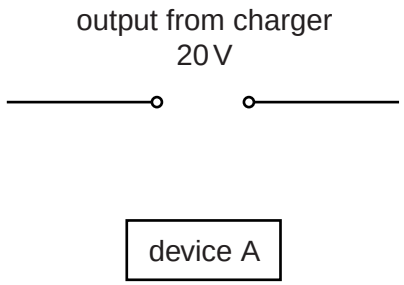

Fig. 7.2 [2]

(d) Two other devices, D and E, have resistances of 20Ω and 30Ω.

Calculate the total resistance of D and E when they are connected in parallel.

total resistance = ...[2]

[Total: 9]

6 Fig. 8.1 shows a small, uncharged copper sphere suspended from a nylon thread, and a plastic rod being rubbed with a woollen cloth.

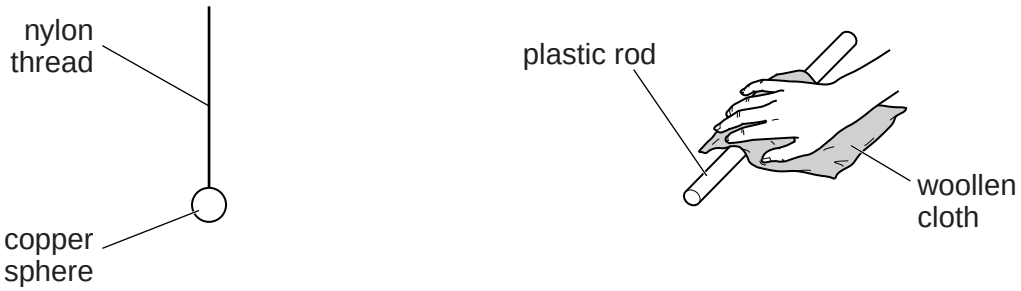

Fig. 8.1

The rod becomes negatively charged as it is rubbed.

(a) Explain, in terms of electrons, why copper is a conductor but nylon is an insulator.

.....

.....

..... [2]

(b) Describe how the negatively charged rod may be used to induce a positive charge on the copper sphere.

.....

.....

.....

..... [3]

(c) The copper sphere is given a positive charge, as shown in Fig. 8.2.

Fig. 8.2

On Fig. 8.2, draw arrows to indicate the direction and pattern of the electric field that surrounds the positively charged sphere. [2]

[Total: 7]

7 A remote ski lodge receives 18 kW of electric power from a 120 V supply.

(a) Calculate

(i) the current that the ski lodge draws from the supply,

current = ... [2]

(ii) the electrical energy supplied to the ski lodge in 30 minutes.

energy = ... [2]

(b) The power supply to the ski lodge is from a nearby transformer that is connected to long-distance transmission cables. The voltage of the transmission cables is very much larger than 120 V.

Explain why energy losses in the transmission cables are lower when the voltage is high.

.....

.....

.....

.....

..... [3]

[Total: 7]