14 The world solar challenge is set every two years, in Australia. The challenge is to complete a three thousand kilometre route with a vehicle powered only by the Sun.

Vehicles have their surfaces fitted with solar panels, as shown in the photograph.

(a) One of the solar panels has an e.m.f. of 8.2 V when in sunlight. The terminal potential difference is 5.5 V when a current of 0.45 A is drawn from the solar panel.

Calculate the internal resistance of the solar panel in these conditions.

(3)

Internal resistance = ...

(b) A bank of 380 of these solar panels is used to charge the battery in a vehicle. The panels are connected in parallel and the current provided by each panel is 0.45 A. When fully charged, the energy stored in the battery is 12 kWh.

Calculate the time, in hours, to fully charge this battery if the solar panels are in sunlight. Assume the efficiency of charging this battery is 100%.

(3)

(c) The vehicle can reach a maximum speed of $34 \, \text{m s}^{-1}$ on flat ground. The electric motor used to move the vehicle has a power of 4.5 kW.

(i) Calculate the initial acceleration of the vehicle as it starts from rest.

mass of vehicle and driver = 420 kg

(3)

Initial acceleration = ...

(ii) State one assumption made in this calculation.

(1)

(d) Solar power alone would not be suitable for a family car because it is not sunny all the time.

Give two further reasons why solar power alone would not be suitable.

(2)

(Total for Question 14 = 12 marks)