5 **(a)** **(i)** State Kirchhoff's first law.

.....

.....[1]

(ii) Kirchhoff's first law is linked to the conservation of a certain quantity. State this quantity.

.....[1]

(b) A variable resistor of resistance R is used to control the current in a circuit, as shown in Fig. 5.1.

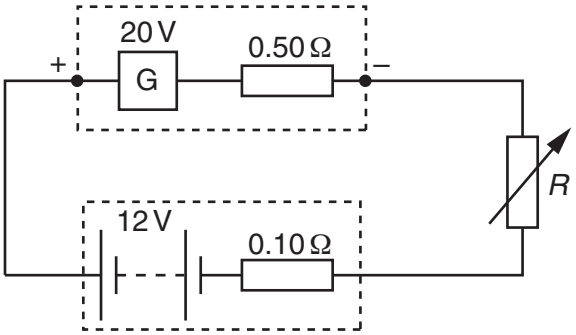

Fig. 5.1

The generator G has e.m.f. 20 V and internal resistance 0.50 Ω. The battery has e.m.f. 12 V and internal resistance 0.10 Ω. The current in the circuit is 2.0 A.

(i) Apply Kirchhoff's second law to the circuit to determine the resistance R.

R = ... Ω [2]

(ii) Calculate the total power generated by G.

power = ... W [2]

(iii) Calculate the power loss in the total resistance of the circuit.

power = ... W [2]

(iv) The circuit is used to supply energy to the battery from the generator. Determine the efficiency of the circuit.

efficiency = ... [2]