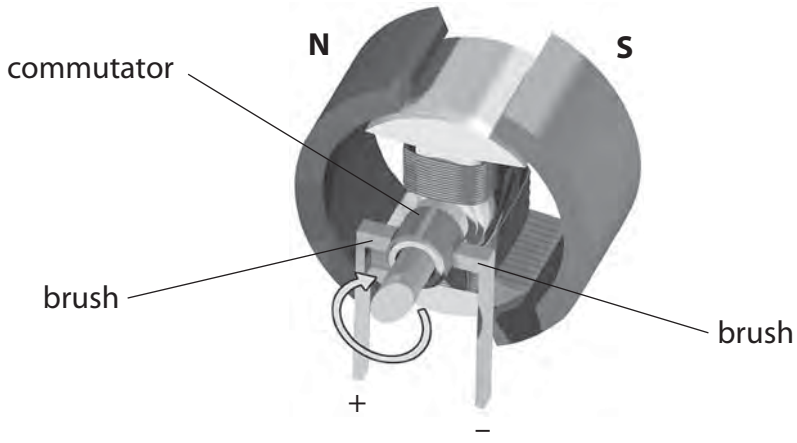
9 The diagram shows an electric motor.



(a) This electric motor needs a direct current (d.c).

(i) Explain what is meant by the term direct current.

(1)

(ii) Explain the purpose of the brushes and the commutator in a d.c. motor.

(3)

(iii) The motor turns clockwise when the direction of the current goes from + to – .

State what happens to the motor when both the magnetic field and the current are reversed.

(1)

(b) The photograph shows a machine at a coal mine.

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The machine lifts up containers of coal from the mine and lowers empty containers down.

The machine uses an electric motor connected to a 600 V d.c. supply.

The maximum current in the motor is 4000 A.

(i) State the equation linking power, current and voltage.

(1)

(ii) Calculate the maximum power available from the motor.

(2)

maximum power = ... MW

(c) The machine lifts a load weighing 400 000 N through 190 m.

(i) State the relationship between work done, force and distance moved.

(1)

(ii) Calculate the work done on the load.

(2)

work done on load = ... J

(d) The machine uses an average (mean) power of 1.9 MW to do 67 MJ of work.

(i) Calculate the time needed to do this work.

(3)

time = ... s

(ii) State the effect of using a lower average power to do this work.

(1)

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(Total for Question 9 = 15 marks)