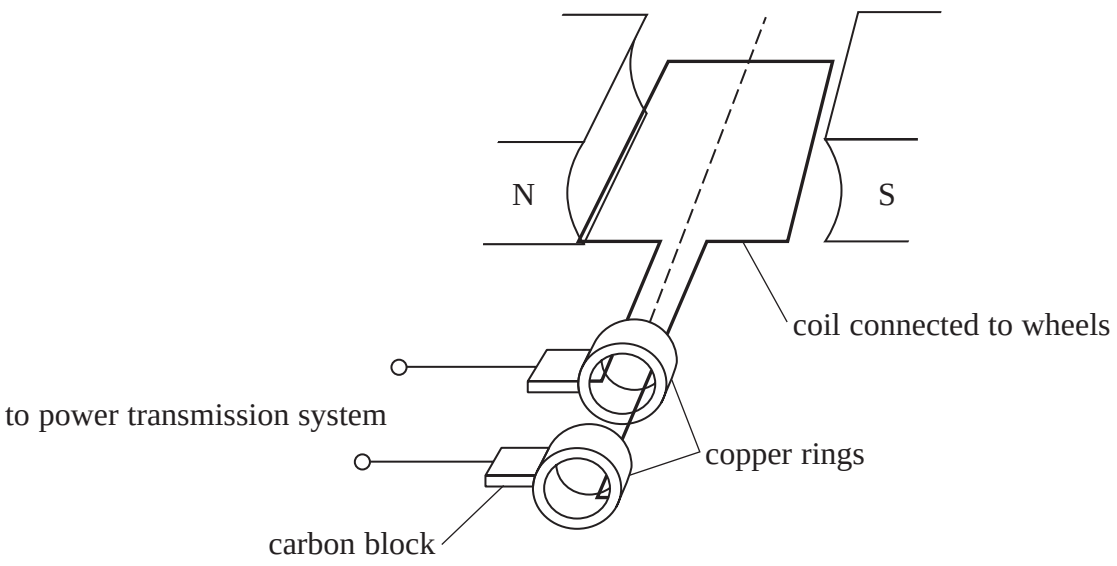
18 Regenerative braking supplies a current back to the power transmission system whilst slowing a vehicle. The arrangement shown can be used as a regenerative braking system on a train.



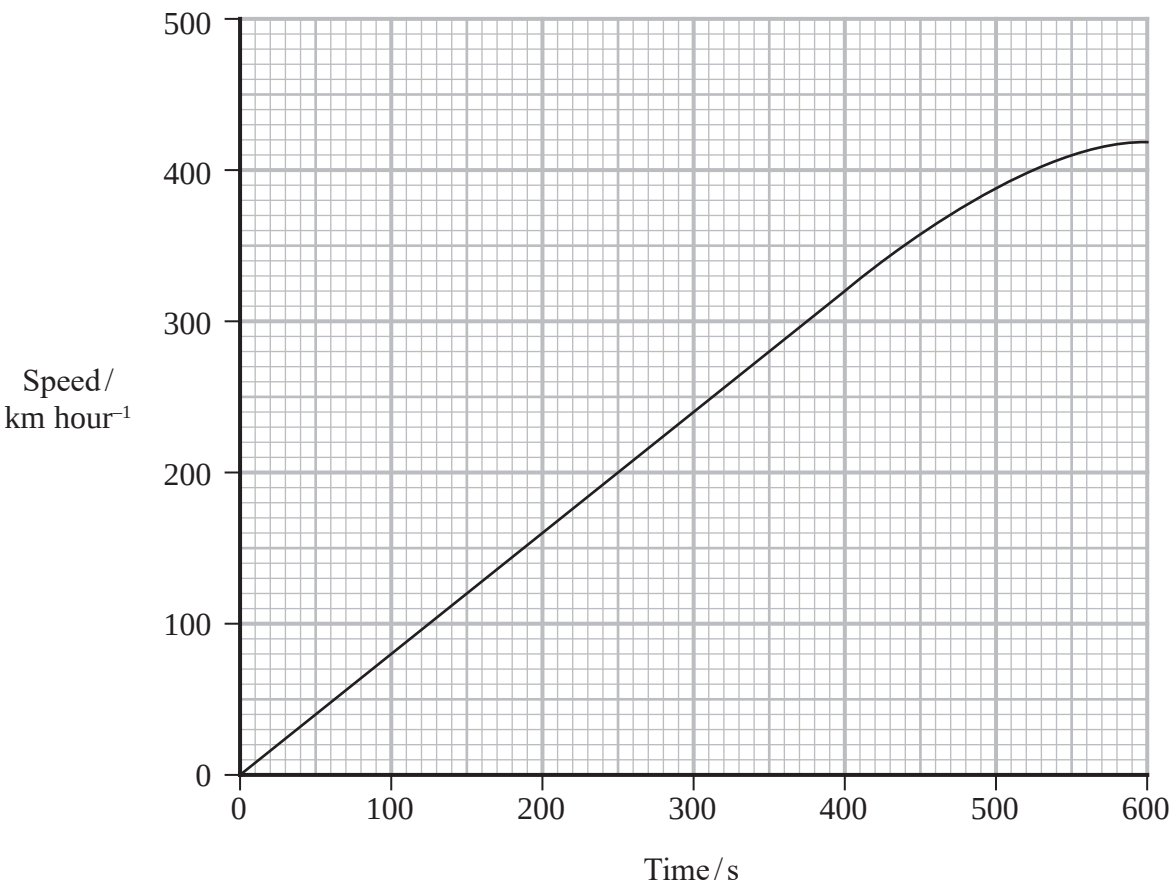
The coil rotates with the wheels of the train. Two copper rings are connected to the ends of the coil. The rings rotate with the coil and two carbon blocks make electrical contact with the rings as they rotate.

(a) Describe how this arrangement can be used as a regenerative brake.

(4)

(b) A specification for a new train states that the train should be able to accelerate to a speed of 360 km hour^{-1} from rest, and that this acceleration should be completed within 40 km of level track.

The graph shows the performance of the train on a test run.



(i) Calculate the acceleration of the train as it accelerates to a speed of 360 km hour^{-1}.

(3)

Acceleration of train = ...

(ii) Deduce whether the performance of the train met the specification on this test run.

(3)

(c) On curved tracks there is a maximum safe speed for the train.

(i) Explain why there is a maximum safe speed for a train travelling on a curved track.

(4)

(ii) When the train travels at 200 km hour^{-1}, the minimum safe radius of curvature of the track is 1800 m.

Calculate the minimum safe radius of curvature for a speed of 360 km hour^{-1}.

(2)

Minimum safe radius of curvature = ...

(Total for Question 18 = 16 marks)