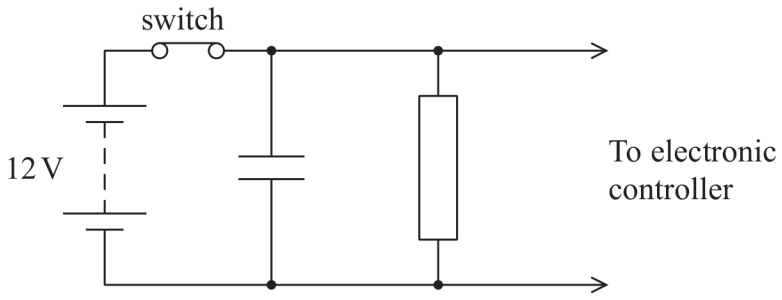
14 The train on a model railway is powered by contact with the rails. The train sometimes loses contact with the rails. The diagram shows a circuit that can maintain power for an electronic controller on the train even when the power is disconnected for a short time. The switch represents the contact between the train and the rails.



(a) Explain how this circuit can maintain power to the electronic controller if the switch is opened for a short time.

(3)

.....

.....

.....

.....

.....

.....

(b) The switch is opened.

Calculate the time taken for the potential difference across the capacitor to decrease to 4.0 V.

Assume the resistance of the electronic controller is infinite.

capacitance of capacitor = 47 mF
resistance of resistor = 470 Ω

(2)

.....

.....

.....

.....

Time taken = ...

DO NOT WRITE IN THIS AREA

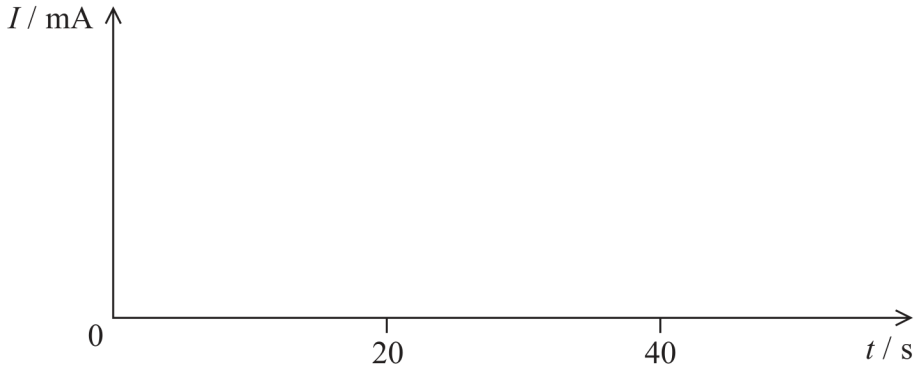
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) The switch is closed at time $t = 0$ and then opened at $t = 20\,\text{s}$.

Sketch a graph on the axes below to show how current I through the resistor varies with t.

(4)



(Total for Question 14 = 9 marks)