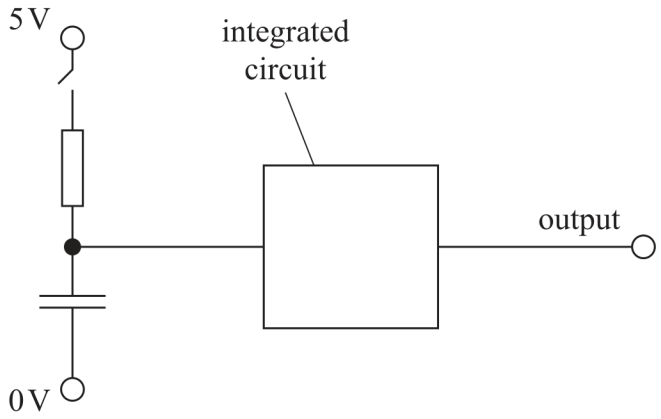
15 A resistor-capacitor circuit provides an input for an integrated circuit as shown. The integrated circuit can be assumed to have infinite resistance.



(a) (i) Sketch a graph to show how the potential difference V_C across the capacitor varies with time t as the switch is closed. The time constant T for this circuit is marked on the time axis.

(2)

(ii) Explain how the potential difference V_R across the resistor varies with time after the switch is closed.

(2)

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(iii) Show that V_C is given by the equation

$$V_C = 5 - 5e^{-\frac{t}{RC}}$$

where R is the resistance of the resistor
and C is the capacitance of the capacitor.

(2)

(b) The input to the integrated circuit should be 3.3 V at a time 3.5 seconds after the switch is closed.

The following capacitors are available:

4.7 μF 10 μF 15 μF 47 μF 150 μF

Deduce which capacitor should be used.

$R = 68\,\text{k}\Omega$

(3)

(Total for Question 15 = 9 marks)