1. Consider the RC circuit shown below with a switch that moves between positions $A$ and $B$.

   ![Circuit Diagram]

(a) Assume the switch has been connected to position $B$ for a long time before it moves to position $A$ at time $t = 0s$. For this “charging” circuit:

   i. Determine the time-constant, $\tau$.
   ii. Using the time-constant, estimate the 10%-90% rise-time, $t_r$.
   iii. Write the mathematical expression for the capacitor’s voltage, $v_c$.
   iv. Sketch $v_c$ versus time using values at multiples of the time-constant as a guide (use at least five points).
   v. Label the rise-time on the sketch of $v_c$ and check that your estimate of its value appears correct.
   vi. Find the mathematical expression for the resistor’s voltage, $v_R$.
   vii. Find the mathematical expression for the current, $i$.
   viii. Sketch $i$ versus time using values at multiples of the time-constant as a guide (use at least five points).

(b) Assume the switch has been connected to position $A$ for a long time before it moves to position $B$ at time $t = 0s$. For this “discharging” circuit:

   i. Write the mathematical expression for the capacitor’s voltage, $v_c$.
   ii. Sketch $v_c$ versus time using values at multiples of the time-constant as a guide (use at least five points).
   iii. Find the mathematical expression for the resistor’s voltage, $v_R$.
   iv. Find the mathematical expression for the current, $i$.
   v. Sketch $i$ versus time using values at multiples of the time-constant as a guide (use at least five points).
2. Consider the RC circuit shown below with a switch that moves from position $B$ to $A$ at time $t = 0$s, i.e., this is a “charging” circuit.

![Diagagram of an RC circuit with a switch moving from position B to A at time t = 0s.]

Given $v_c = 0.5V$ at time $t = 0.5ms$ and $v_c = 4.5V$ at time $t = 11.5ms$, find the following:

(a) 10%-90% rise-time, $t_r$, of the circuit,
(b) time-constant, $\tau$, of the circuit,
(c) value of the unknown resistor, $R$,
(d) mathematical expression for the capacitor’s voltage, $v_c$,
(e) sketch of $v_c$ versus time using values at multiples of the time-constant as a guide (use at least five points), and
(f) label rise-time on the sketch.

3. Consider the RC circuit shown below with a switch that moves from position $A$ (after being there for a long time) to position $B$ at time $t = 0$s, i.e., this is a “discharging” circuit.

![Diagagram of an RC circuit with a switch moving from position A to B at time t = 0s.]

Given the circuit’s time constant is $\tau = 2ms$ find the following:

(a) value of the capacitor, $C$,
(b) mathematical expression for the voltage, $v_c$, and
(c) sketch of $v_c$ versus time using values at multiples of the time-constant as a guide (use at least five points).
4. Consider the RC circuit shown below with a switch that moves from position B (after being there a long time) to position A at time \( t = 0 \)s. Given that at time \( t = 330 \)µs the resistor's voltage is \( v_R = 2 \)V, determine the time constant, \( \tau \), for the circuit.

![RC Circuit Diagram 1](image1)

5. Consider the RC circuit shown below with a switch that moves from position A (after being there for a long time) to position B at time \( t = 0 \)s. Given the circuit’s time constant is \( \tau = 7.5 \)µs and at a particular time after the switch has moved the current is measured to be \( i = -240 \)µA, find the time at which the measurement was taken.

![RC Circuit Diagram 2](image2)