Preliminary work:

1. Learn how an oscilloscope basically displays the signal (trigger modes, sweep types, input amplifiers display modes etc. - see course web-page.)
2. Assume you are given two signals;
   \[ v_1(t) = 0.5\cos(6180t) \]
   and
   \[ v_2(t) = 3\cos(6180t - \pi/4). \]
   State the phase difference between them and plot them (showing only critical timings is sufficient).
3. Plot the signals to create a Lissajous Figure by plotting \( v_1(t) \) on the Y axis and \( v_2(t) \) on the X axis. (see course web-page.)

Lab work:

1. Demonstrate to yourself that an oscilloscope operates by triggering the trace at a given input level for a sinusoidal signal at 100 kHz 1V_{p-p}.
   a. Use different triggering methods (normal, auto) and explain how they work.
   b. Apply a square-wave and try to see the details of leading and falling edges. (Trigger at the rising when measuring rise time; and trigger at the falling edge when measuring fall time)
   c. Measure the rise and fall times of the signal.
2. Adjust the sweep rate of oscilloscope to 0.5 sec/div and signal generator frequency to 1 Hz to see how the signal is traced.
3. Apply a sinusoidal signal at 100 Hz with 1 V_{p-p} amplitude again.
   a. Measure the rms amplitude using an oscilloscope.
   b. Measure the rms amplitude again using a voltmeter.
4. Comment on the results.

Notes: Rise Time: Time taken for a signal to rise from 10% to 90% of the signal amplitude.
   Fall Time: Time taken for a signal to fall from 90% to 10% of the signal amplitude.
   Signal generator gives twice the displayed value when loaded by high-impedance (much greater than 50 ohms).
5. Connect the circuit given below:

\[ R = 10 \, \text{k}\Omega \]

\[ \begin{array}{c}
\text{+} \\
\text{C} = 15 \, \text{nF}
\end{array} \quad \begin{array}{c}
\text{v}_1(t) \\
\text{v}_2(t)
\end{array} \quad \begin{array}{c}
\text{-} \\
\text{R} = 10 \, \text{k}\Omega
\end{array} \quad \begin{array}{c}
\text{+} \\
\text{-}
\end{array} \]

a. Adjust and measure the i/p to \( 1V_{\text{p-p}} \) at 1 kHz.
b. Measure the phase delay between \( v_1 \) and \( v_2 \) as follows:
   i. By using the time sweep mode of the scope (the usual mode).
   ii. By using the X-Y mode of the scope (Lissajous figure).

6. For the same circuit apply a square-wave at 100 Hz (\( 1V_{\text{p-p}} \))
   a. Measure the natural response of the capacitor voltage.
   b. Comment on how the input voltage represent both the initial condition and the throwing of the switch.