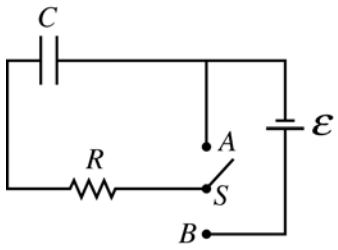


E&M 2.

In a lab, you set up a circuit that contains a capacitor *C,* a resistor *R*, a switch *S*, and a power supply, as shown in the diagram above. The capacitor is initially uncharged. The switch, which is initially open, can be moved to positions *A* or *B*.

(a)

i. Indicate the position to which the switch should be moved to charge the capacitor.

__ *A* __ *B*

ii. On the diagram, draw a voltmeter that is properly connected to the circuit in a manner that will allow the voltage to be measured across the capacitor.

After a long time you move the switch to discharge the capacitor, and your lab partner starts a stopwatch. You collect the following measurements of the voltage across the capacitor at various times.

t (s)	6	18	30	42	54
$V(V)$	252	74	33	10	6

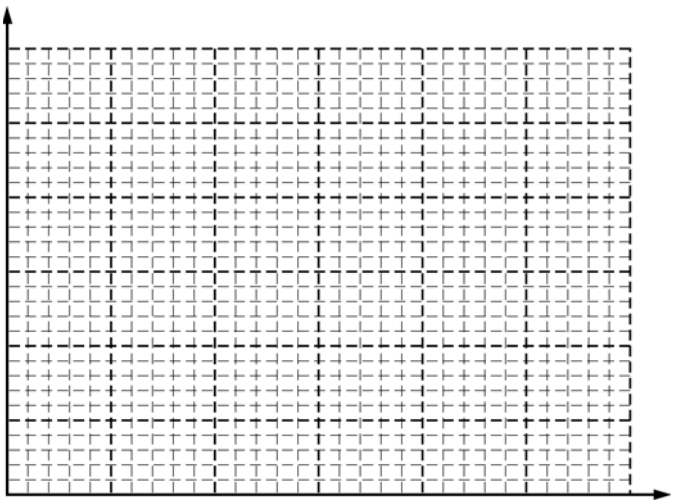
You wish to determine the time constant τ of the circuit from the slope of a linear graph.

(b)

i. Indicate two quantities you would plot to obtain a linear graph.

ii. Use the remaining rows in the table above, as needed, to record any quantities that you indicated that are not given. Label each row you use and include units.

(c) On the axes below, graph the data from the table that will produce a linear relationship. Clearly scale and label all axes including units, if appropriate. Draw a straight line that best fits your data points.

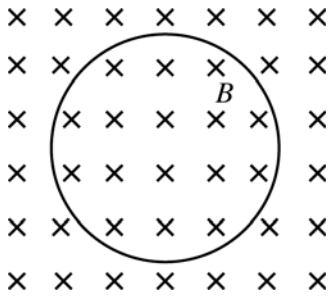


(d) From your line in part (c), obtain the value of the time constant τ of the circuit.

(e)

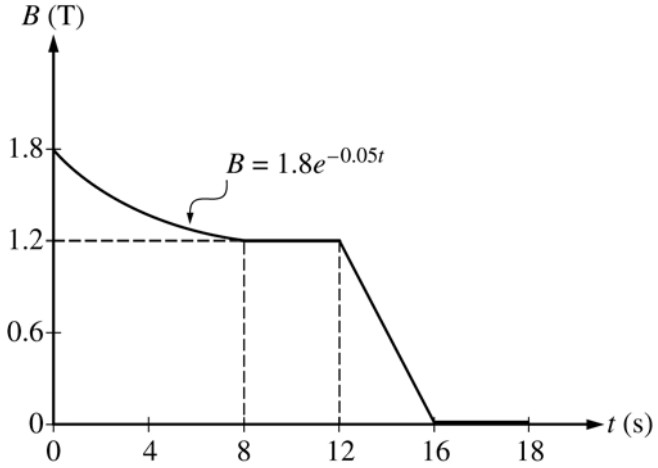
i. In the experiment, the capacitor C had a capacitance of 1.50 μF. Calculate an experimental value for the resistance R.

ii. On the axes in part (c), use a dashed line to sketch a possible graph if the capacitance was greater than 1.50 μF but the resistance R was the same. Justify your answer.



E&M 3.

The figure above shows a circular loop of area $0.25\ \text{m}^2$ and resistance $12\ \Omega$ that lies in the plane of the page. A magnetic field of magnitude B directed into the page exists in the area of the loop. The field varies with time t, as shown in the graph below.



(a)

i. Derive an expression for the magnitude of the induced emf in the loop as a function of time for the interval $t = 0$ s to $t = 8$ s.

ii. Calculate the magnitude of the induced current I in the loop at time $t = 4$ s.