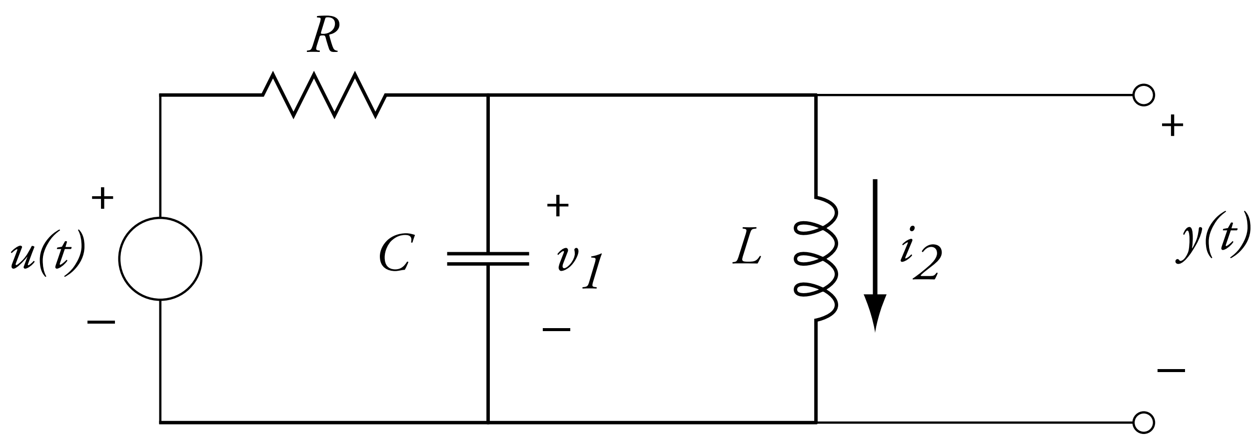
Circuits with Sources I
Concept Test

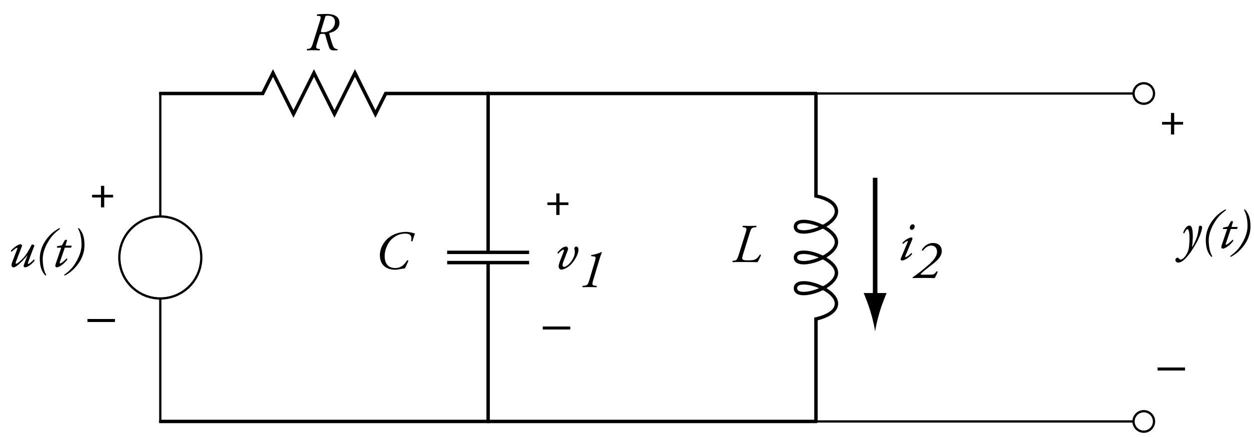


For the circuit above, take v_1 and i_2 to be the state variables. Find the differential equation for the state i_2.

My confidence in my answer is:

1. 0%
2. 20%
3. 40%
4. 60%
5. 80%
6. 100%

Circuits with Sources I
Concept Test



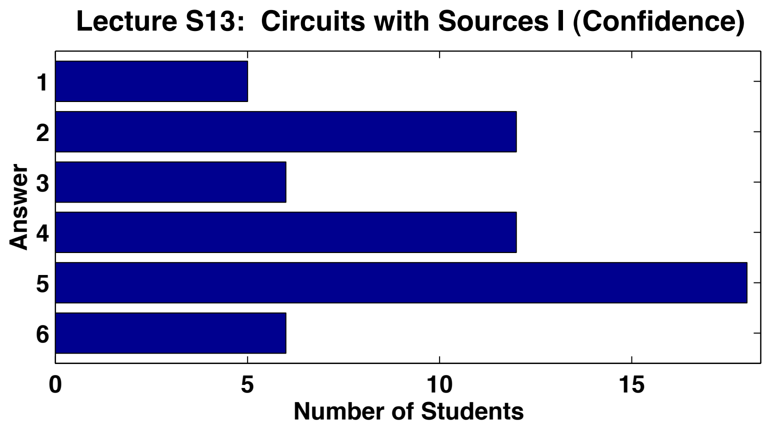
For the circuit above, take v_1 and i_2 to be the state variables. The differential equation for the state i_2 is

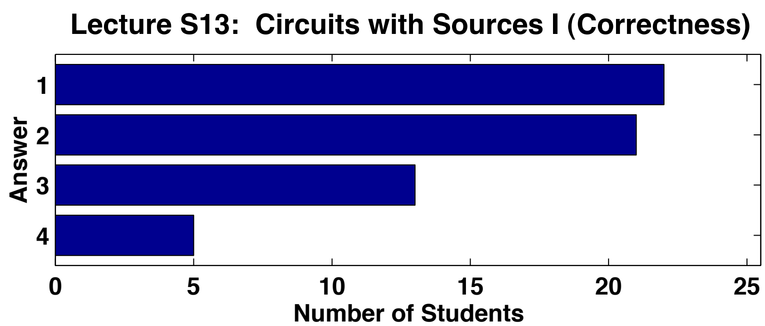
$$\frac{di_2}{dt} = \frac{1}{L} v_1$$

My answer was

1. **Completely correct.**
2. **Had one or two small errors.**
3. **Incorrect.**
4. **I didn't understand the problem.**

Circuits with Sources I
Solution





The differential equation for i_2 is

$$\frac{di_2}{dt} = \frac{1}{L} v_2$$

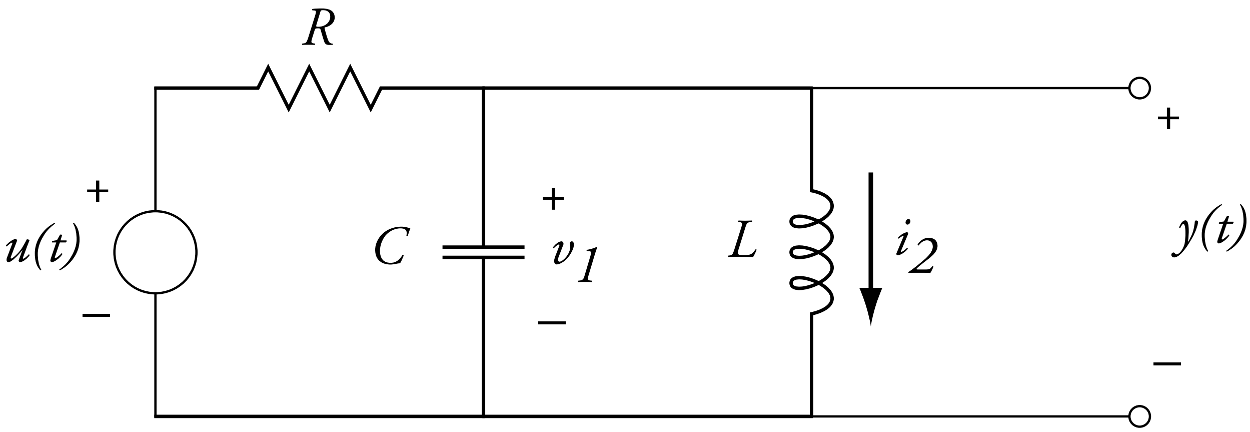
But $v_2 = v_1$, since the inductor and capacitor are in parallel, and the voltage across the inductor is referenced the same way as the capactior. Therefore,

$$\frac{di_2}{dt} = \frac{1}{L} v_1$$

Note that differential equation is in terms of states and parameters of the circuit only.

The class had some difficulty with this problem. There should be plenty of practice on the problem set.

Circuits with Sources II
Concept Test

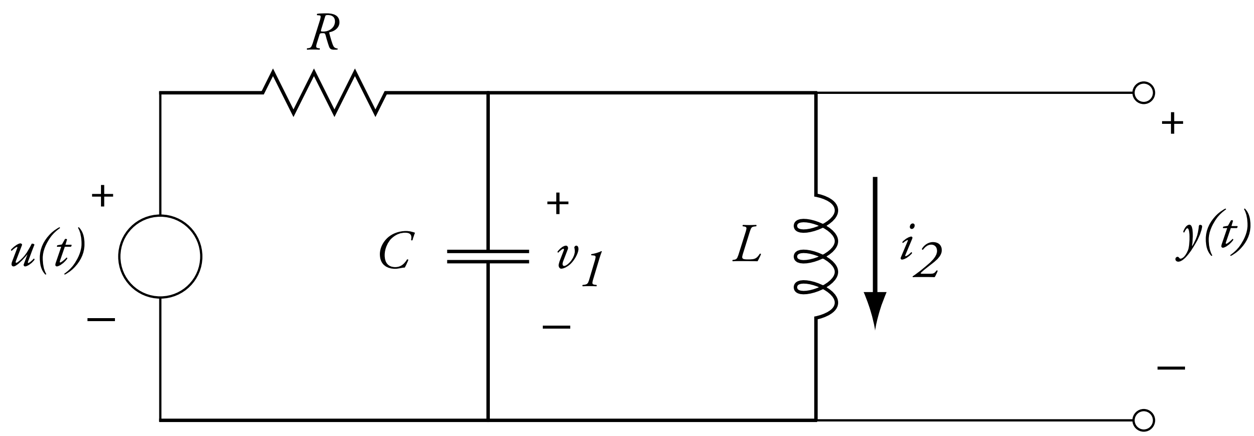


For the circuit above, take v_1 and i_2 to be the state variables. Find the differential equation for the state v_1.

My confidence in my answer is:

1. 0%
2. 20%
3. 40%
4. 60%
5. 80%
6. 100%

Circuits with Sources II
Concept Test



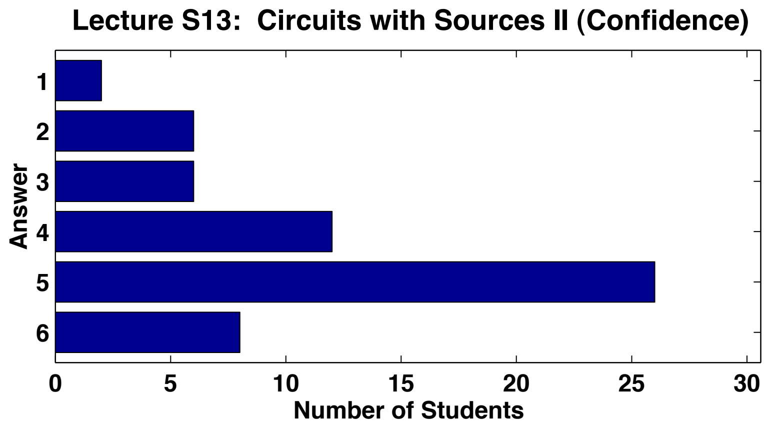
For the circuit above, take v_1 and i_2 to be the state variables. The differential equation for the state v_1 is

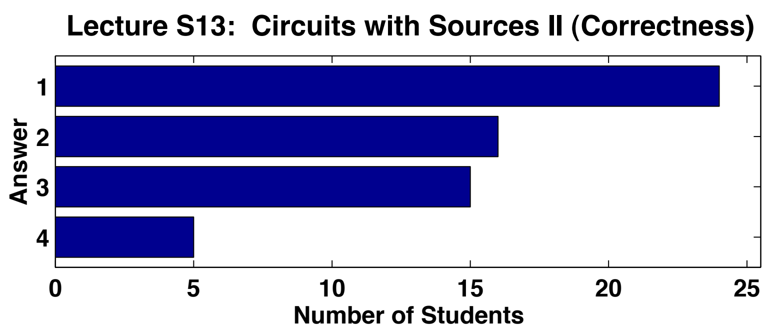
$$\frac{dv_1}{dt} = -\frac{1}{RC}v_1 - \frac{1}{C}i_2(t) + \frac{1}{RC}u(t)$$

My answer was

1. **Completely correct.**
2. **Had one or two small errors.**
3. **Incorrect.**
4. **I didn't understand the problem.**

Circuits with Sources II Solution





The differential equation for v_1 is

$$\frac{dv_1}{dt} = \frac{1}{C} i_1$$

So we need to solve for i_1. We can apply KCL to the node at the top of the capacitor to obtain

$$i_1 + \frac{v_1 - u}{R} + i_2 = 0$$

Solving for i_1,

$$i_1 = -\frac{1}{R} v_1 - i_2(t) + \frac{1}{R} u(t)$$

Therefore,

$$\frac{dv_1}{dt} = -\frac{1}{RC}v_1 - \frac{1}{C}i_2(t) + \frac{1}{RC}u(t)$$