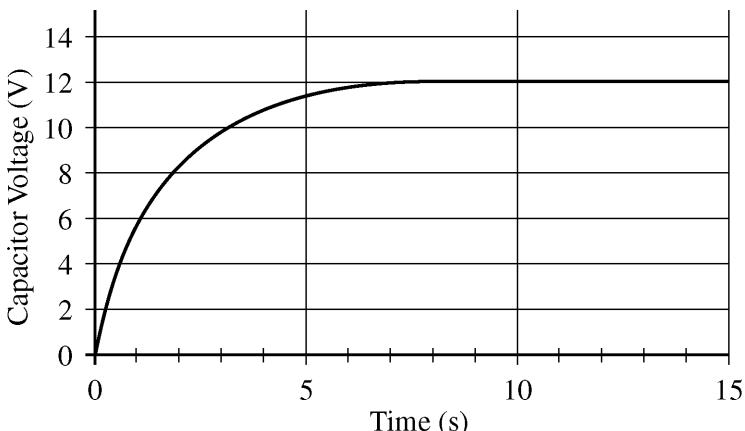
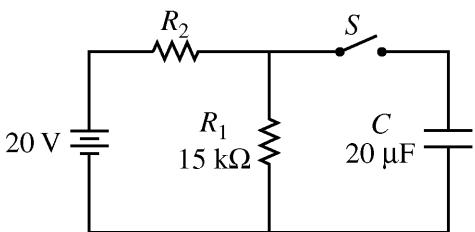


**2004 AP<sup>®</sup> PHYSICS C: ELECTRICITY AND MAGNETISM  
FREE-RESPONSE QUESTIONS**



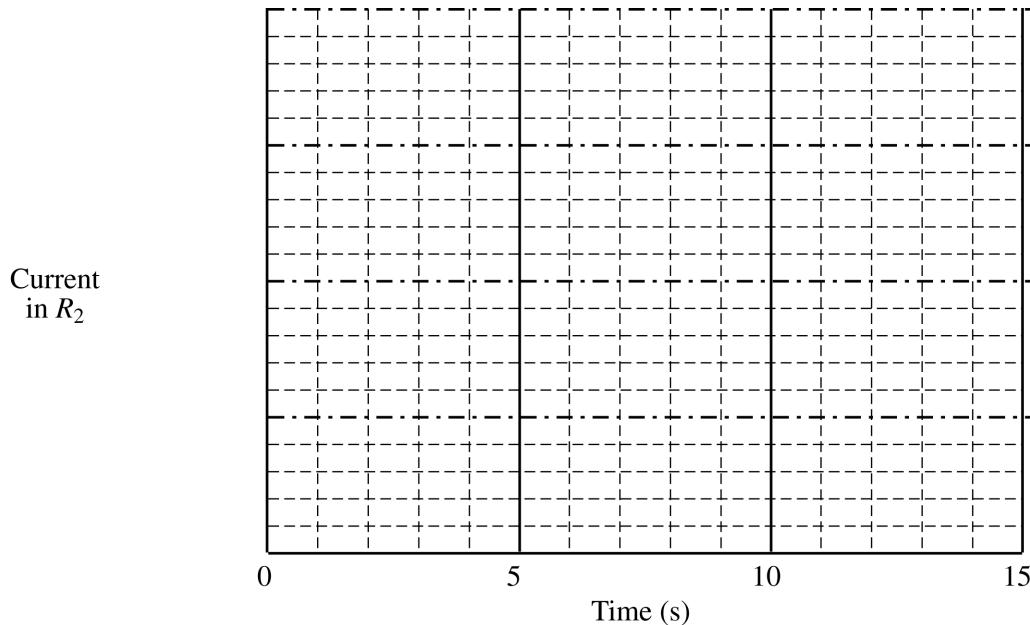
E&M. 2.

In the circuit shown above left, the switch  $S$  is initially in the open position and the capacitor  $C$  is initially uncharged. A voltage probe and a computer (not shown) are used to measure the potential difference across the capacitor as a function of time after the switch is closed. The graph produced by the computer is shown above right. The battery has an emf of 20 V and negligible internal resistance. Resistor  $R_1$  has a resistance of 15 k $\Omega$  and the capacitor  $C$  has a capacitance of 20  $\mu\text{F}$ .

- Determine the voltage across resistor  $R_2$  immediately after the switch is closed.
- Determine the voltage across resistor  $R_2$  a long time after the switch is closed.
- Calculate the value of the resistor  $R_2$ .
- Calculate the energy stored in the capacitor a long time after the switch is closed.

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- (e) On the axes below, graph the current in  $R_2$  as a function of time from 0 to 15 s. Label the vertical axis with appropriate values.



Resistor  $R_2$  is removed and replaced with another resistor of lesser resistance. Switch  $S$  remains closed for a long time.

- (f) Indicate below whether the energy stored in the capacitor is greater than, less than, or the same as it was with resistor  $R_2$  in the circuit.

Greater than       Less than       The same as

Explain your reasoning.