LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE 240 Circuits I
Quiz 8 Solution

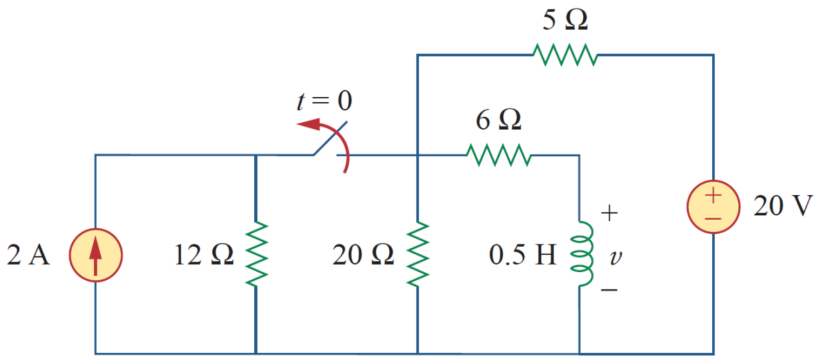
Name: _____

Campus ID: _____

Total Marks: 10
Time Duration: 15 minutes

Question 1 (10 marks)

The circuit given below is in steady state with switch in closed state. The switch is opened at t = 0.



(a) [3 marks] Determine the current through inductor at t = 0.

Solution:
Inductor will act as a short circuit. Apply nodal analysis to the circuit at t = 0^-:
$\frac{V_1}{20} + \frac{V_1}{12} + \frac{V_1}{6} + \frac{V_1-20}{5} - 2 = 0$

$-> V_1(0^-) = 12V$
$-> I_L(0^-) = \frac{V_1}{6} = 2A$

(b) [4 marks] Determine the the voltage $v(t)$ at t = 0^+.

Solution:
Inductor will act as a 2A current source. Apply nodal analysis to the circuit at t = 0^+:
$\frac{V_1}{20} + \frac{V_1-20}{5} + 2 = 0 -> V_1(0^+) = 8V$

$\frac{V_1(0^+)-v(0^+)}{6} = 2A -> v(0^+) = -4V$

(c) [3 marks] Determine the the voltage $v(t)$ for all times.

Solution:
This is a first order circuit, so its solution will be of the form $v(t) = K_1 + K_2 e^{-\frac{t}{\tau}}$.
$K_1 = v(\infty) = 0V$ because the inductor acts as a short circuit at t = ∞.
Plug in t = 0 to get $K_2 = -4$
Find R_{eq} across the inductor: $R_{eq} = 6 + (5||20) = 10\Omega$
$\tau = \frac{L}{R_{eq}} = 0.05s$
Therefore, $v(t) = -4e^{-20t}\ V; t > 0$