## 522.

## Problem 38.25 (RHK)

In the circuit shown in the figure values of the circuit elements are $\mathrm{E}=100 \mathrm{~V}, R_{1}=10 \Omega, R_{2}=20 \Omega$, $R_{3}=30 \Omega$, and $L=2.0 \mathrm{H}$. We have to find the values of $i_{1}$ and $i_{2}$ (a) immediately after switch $S$ is closed; (b) $a$ long time later; (c) immediately after switch $S$ is opened again; (d) a long time later


## Solution:

(a)

Immediately after the switch $S$ is closed, there will be no flow of current in the inductor. At that instant current will flow through resistances $R_{1}$ and $R_{2}$ and its magnitude will be
$i_{1}=i_{2}=\frac{100}{30} \mathrm{~A}=3.33 \mathrm{~A}$.
(b)

A long time after the switch $S$ has been closed, the flow of current through the inductor $L$ will stabilise and there will be no change in current flow. The values of currents $i_{1}$ and $i_{2}$ can be obtained by applying Kirchoff's laws to loops. We have two linear equations for determining $i_{1}$ and $i_{2}$.
$R_{1} i_{1}+R_{2} i_{2}=\mathcal{E}$,
and
$\left(i_{1}-i_{2}\right) R_{3}=i_{2} R_{2}$.
Substituting the value

and E, and solving the linear equations, we find
$i_{1}=4.55 \mathrm{~A}$,
and
$i_{2}=2.73 \mathrm{~A}$.
(c)

Immediately after the switch $S$ is opened, the current $i_{1}$
will be zero and the current $i_{2}$ will be equal to the steady state current flowing through the inductor; and will be $i=(4.55-2.73) \mathrm{A}=1.82 \mathrm{~A}$.
(d)

A long time later both currents $i_{1}$ and $i_{2}$ will be zero.


