14.52

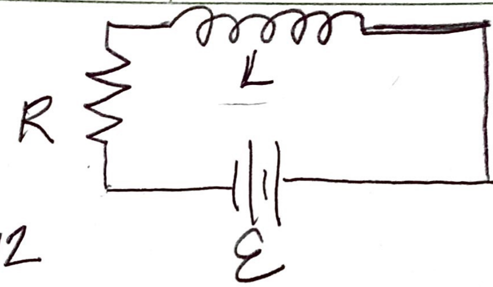

Fig 14.12

$\varepsilon = 12.0V$, $L = 20mH = 20e{-}3H$ & $R = 5.0\Omega$.

a) Time constant for circuit. $\tau = \frac{L}{R}$

$\tau = \frac{20e-3H}{5.0\Omega} = \boxed{0.0040s}$

b) Initial current $= \boxed{0 \text{ Amps}}$

c) Final current $I = \frac{\varepsilon}{R} = \frac{12V}{5\Omega} = \boxed{2.4A}$

d) $I = \frac{\varepsilon}{R}(1 - e^{-t/\tau})$. At 2τ,

$I = \frac{12}{5}(1 - e^{-2\tau/\tau}) = \boxed{2.08A}$

e) At this time, when current = 2.08A

$V_{resistor} = IR = (2.08)(5) = \boxed{10.4V}$

$V_{inductor} = 12 - 10.4 = \boxed{1.62V}$

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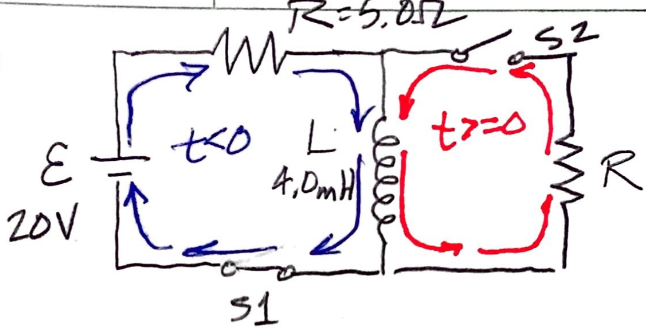
14.53



$\tau = \frac{L}{R} = \frac{4e\text{-}3H}{5}$

$= 8e\text{-}4s$

When S1 has been closed & S2 open current in left side of circuit $= \frac{\mathcal{E}}{R} = \frac{20}{5} = \boxed{4.0A}$

a) When switch states are changed at $t=0$, current I through L is $\frac{\mathcal{E}}{R}$ as before, $\boxed{4.0A}$

b) During discharge, $I = \frac{\mathcal{E}}{R} e^{-t/\tau}$

$= 4e^{-t/8e\text{-}4}$

$= 4e^{-4e\text{-}4/8e\text{-}4}$

$= \boxed{2.43A}$

c) The voltages across L & R at this time:

$V_R = IR$, so $V_R = (2.43A)(5\Omega) = \boxed{12.1V}$

Across L? In general

$\mathcal{E} = -L\frac{dI}{dt}$, & $I(\text{discharging}) = \frac{\mathcal{E}}{R}e^{-t/\tau}$

$\mathcal{E} = -L\frac{d}{dt}\left(\frac{\mathcal{E}}{R}e^{-t/\tau}\right)$

$\frac{d}{dt}e^{at} = te^{at}$ (Calculus!)

$\mathcal{E} = -L\left(\frac{-1}{\tau}\right)\left(\frac{\mathcal{E}}{R}e^{-t/\tau}\right)$

$\tau = \frac{L}{R}$, so

$\mathcal{E} = L\left(\frac{R}{L}\right)\left(\frac{\mathcal{E}}{R}\right)e^{-t/\tau} = \boxed{\mathcal{E}_0 e^{-t/\tau}}$

$\mathcal{E} = 20e^{-4e\text{-}4/8e\text{-}4} = \boxed{12.1V}$