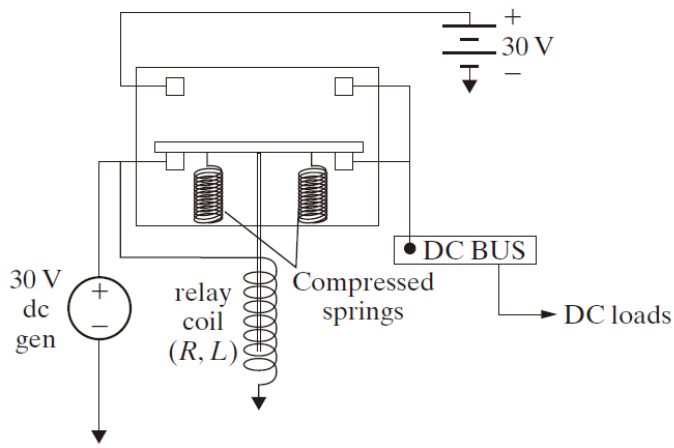
1. The relay shown in Fig. P7.103 connects the 30 V dc generator to the dc bus as long as the relay current is greater than 0.4 A. If the relay current drops to 0.4 A or less, the spring-loaded relay immediately connects the dc bus to the 30 V standby battery. The resistance of the relay winding is 60Ω. The inductance of the relay winding is to be determined.

a) Assume the prime motor driving the 30 V dc generator abruptly slows down, causing the generated voltage to drop suddenly to 21 V. What value of L will assure that the standby battery will be connected to the dc bus in 0.5 seconds?

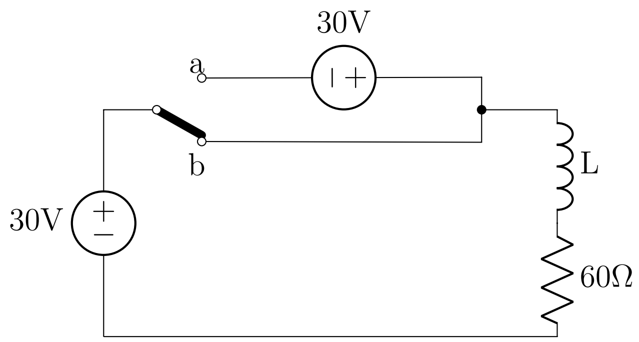
b) Using the value of L determined in (a), state how long it will take the relay to operate if the generated voltage suddenly drops to zero.

Figure P7.103



Ans:

Convert to circuit diagram:



a).From the question that we can known :

$$I_s = \frac{21}{60}A \qquad I_0 = \frac{30}{60}A \qquad \tau = \frac{L}{R} = \frac{L}{60}$$

Then we can calculate i(t):

$$i(t) = I_s + (I_0 - I_s)e^{-\frac{t}{\tau}}$$
$$i(t) = 0.35 + 0.15e^{-\frac{60t}{L}}$$

If we want assure that the standby battery will be connected to the dc bus in 0.5 seconds.

We need i(0.5) = 0.4A:

$$i(t) = 0.35 + 0.15e^{-\frac{30}{L}} = 0.4$$

Since we can calculate L:

$$L = \frac{30}{ln3} = 27.31H$$

b).Because of the generate voltage suddenly drops to zero (V: 30V → 0V)

Thus:

$$i(t) = 0 + (\frac{30}{60} - 0)e^{-\frac{60t}{L}} = 0.5e^{-\frac{60t}{27.31}} \qquad \text{(L = 27.31H)}$$

When the relay to operate that i>0.4, so at i = 0.4 this time the relay will release:

$$i = 0.5e^{-\frac{60t}{27.31}} = 0.4$$

Thus:

$$t = \frac{27.31ln1.25}{60} \cong 0.1s$$