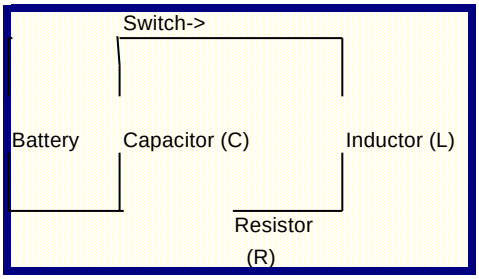
Example 6: Value of a resistor in an electrical circuit.

Find the value of a resistor in an electrical circuit that will dissipate the charge to 1 percent of its original value within one-twentieth of a second after the switch is closed.



q0 =	9	volts
q[t] =	0.09	volts
t =	0.05	seconds
L =	8	henrys
C =	0	farads
R =	300	ohms
q[t] =	0.25	

Color Coding

Target cell

Changing cells

Constraints

1/(L*C)	1250
(R/(2*L))^2	351.5625
SQRT(B15-B16)	29.973947
COS(T*B17)	0.07203653
-R*T/(2*L)	-0.9375
Q0*EXP(B19)	3.52445064

This model depicts an electrical circuit containing a battery, switch, capacitor, resistor, and inductor. With the switch in the left position, the battery charges the capacitor. When the switch is thrown to the right, the capacitor discharges through the inductor and the resistor, both of which dissipate electrical energy.

Using Kirchhoff's second law, you can formulate and solve a differential equation to determine how the charge on the capacitor varies over time. The formula relates the charge q[t] at time t to the inductance L, resistance R, and capacitance C of the circuit elements.

Use Solver to pick an appropriate value for the resistor R (given values for the inductor L and the capacitor C) that will dissipate the charge to one percent of its initial value within one-twentieth of a second after the time the switch is thrown.

Problem Specifications

Target cell	G15	Goal is to set to value of 0.09.
Changing cell	G12	Resistor.
Constraints	D15:D20	Algebraic solution to Kirchhoff's law.

This problem and solution are appropriate for a narrow range of values; the function represented by the charge on the capacitor over time is actually a damped sine wave.