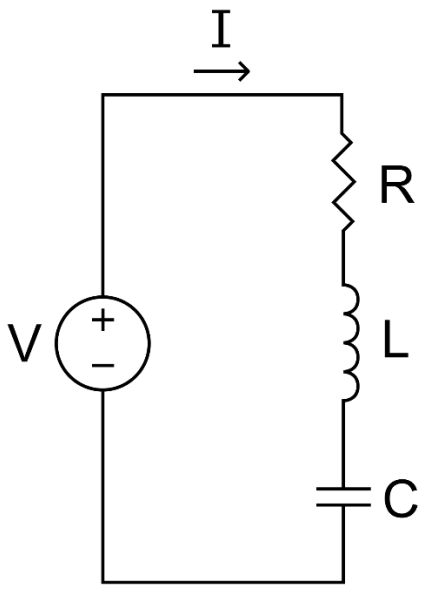
RLC Circuits, Solutions.

Directions: Do one step, and then pass it along to the next student. You do not have to solve the entire problem. If you see a mistake, correct it. If you are not sure, discuss. I will check back.

Solve the problem below.

1. An RLC circuit has an inductance of 10 H, a resistor of 800 Ω, and a capacitance of 10^{-5} F. A 9 V battery is attached to the system.
   a. Set up the equation of the system.
   b. Solve the system.
   c. Describe the damping of the system.
   d. Graph the system.
   e. Describe the long-term behavior of the system.



$$L = 10, R = 800, C = 10^{-5}, E(t) = 9$$

$$10q'' + 800q' + 10^5 q = 9$$

$$q'' + 80q' + 10^4 q = 0.9$$

$$k^2 + 80k + 10{,}000 = 0$$

$$k = \frac{\left(-80 \pm \sqrt{80^2 - 4(1)(10{,}000)}\right)}{2} = \frac{-80 \pm \sqrt{-33600}}{2}$$

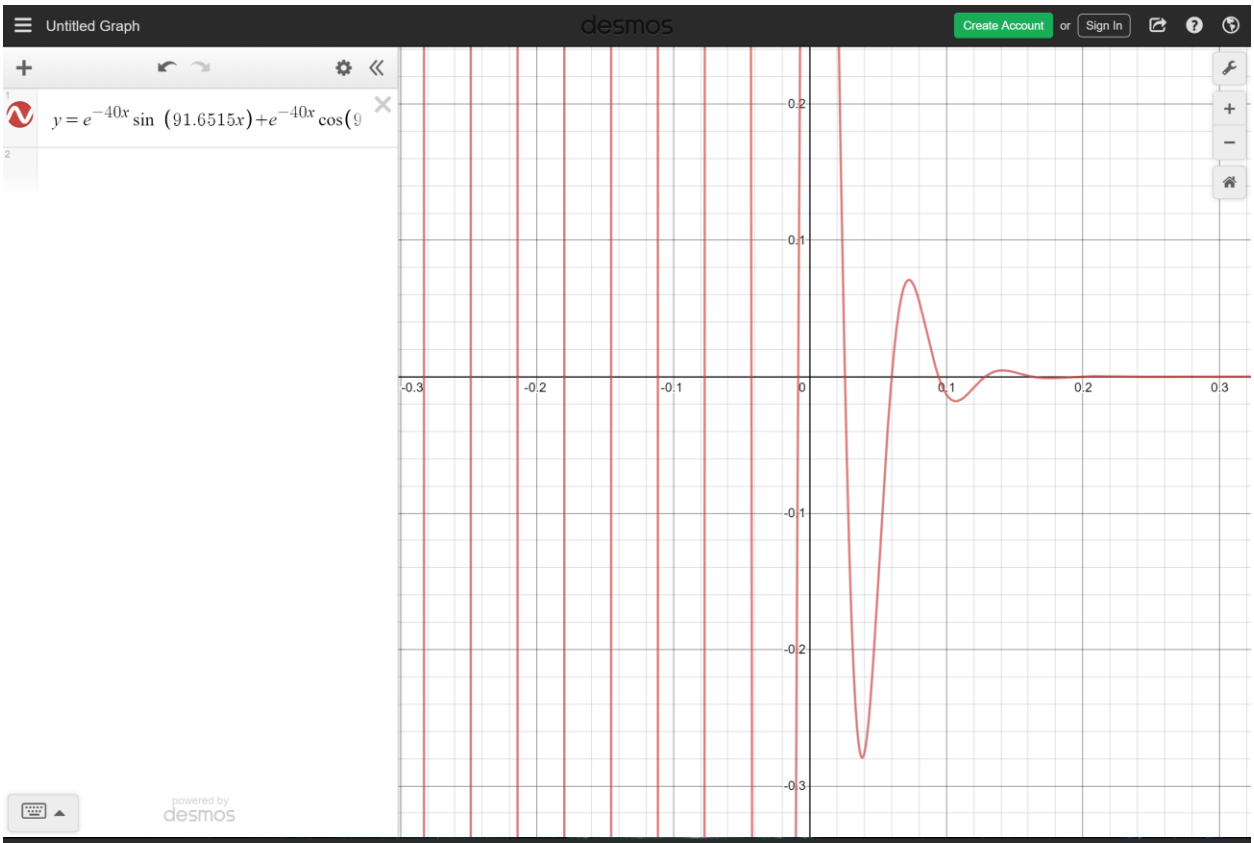
$$= -40 \pm 91.6515i$$

$$q_h = c_1 e^{-40t} \sin 91.6515t + c_2 e^{-40t} \cos 91.6515t$$

$$q_p = A \to A = 9 \times 10^{-5}$$

$$q(t) = c_1 e^{-40t} \sin 91.6515t + c_2 e^{-40t} \cos 91.6515t + 9 \times 10^{-5}$$

Underdamped
Graph shown with arbitrary constants since there are no initial conditions
Long term: 9×10^{-5} steady state.


Untitled Graph
desmos
Create Account
or
Sign In
$y = e^{-40x} \sin(91.6515x) + e^{-40x} \cos(9$
0.2
0.1
-0.1
-0.2
-0.3
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
powered by
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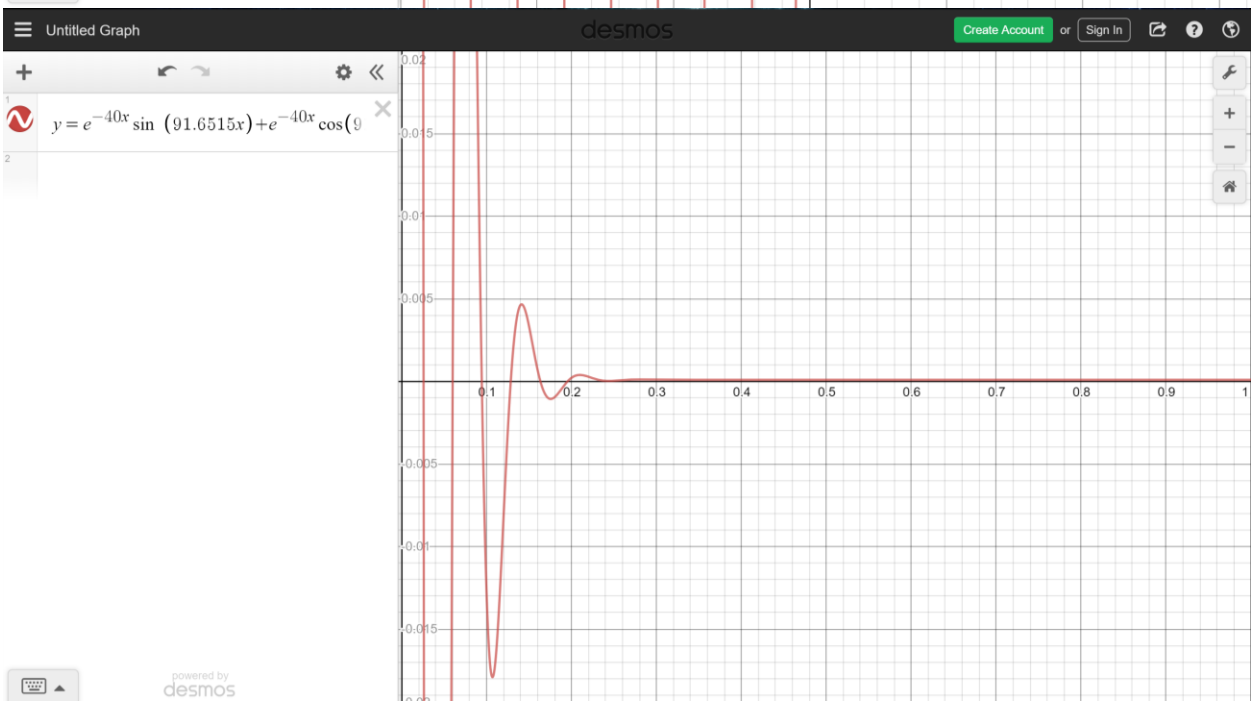
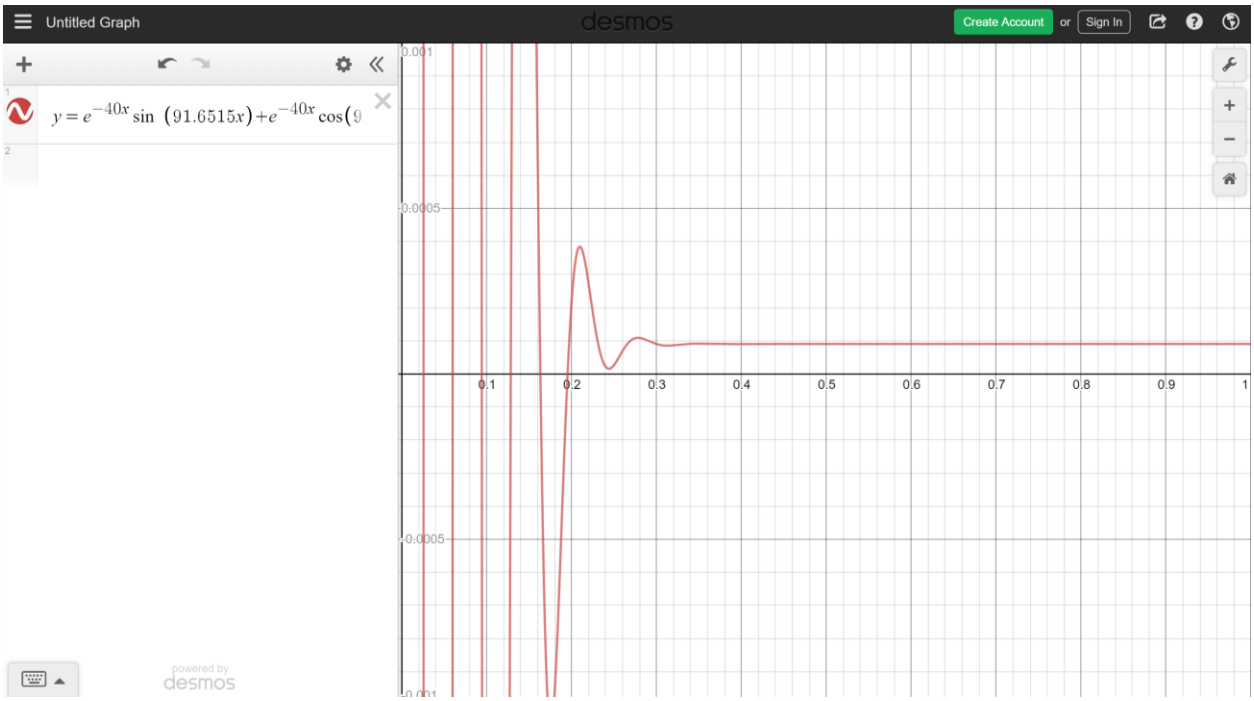

Untitled Graph
desmos
Create Account
or
Sign In
$y = e^{-40x} \sin(91.6515x) + e^{-40x} \cos(9$
0.02
0.015
0.01
0.005
-0.005
-0.01
-0.015
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
powered by
desmos


Untitled Graph
desmos
Create Account
or
Sign In
$y = e^{-40x} \sin(91.6515x) + e^{-40x} \cos(9$
0.001
0.0005
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
-0.0005
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