Hints to Assignment #10 -- 8.022
Comments, questions?

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[1] Purcell 7.17 (Back EMFs)

We have worked on this problem in class during the review for Quiz#2.

- convince yourself that I2 (the current through the L) is conserved. Find what its value is right before we open the switch.
- draw arrows for currents and back emfs. Apply kirchhoff's rule #2 and you have an equation for I2. I1=-I2 after the switch opens.

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[2] Purcell 7.28 (Magnetic field dumping)

Well, the problem walks you through the steps for solving it. This is a interesting way of thinking in astrophysics when it comes to calculating order of magnitudes of physical phenomena occuring in the cosmos. If you have a scenario for the regeneration of the magnetic field of celestial objects you can check your hypothesis by observing the dumping time. The numerical factor I came up with is 2pi, but this is not unique, depends how you take approximations.

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[3] Purcell 8.8 (Decay of energy)

Energy decays exponentially down to zero. You have to show that for the critical dumping the exponent is greater and thus it goes to zero faster.

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[4] Purcell 8.4 (Parallel RLC)

Draw I_1,I_2 and I_3 flowing through each leg of the circuit. Equate all voltages and use kirchhoff's #1 for currents. Seek a solution of the type V=V_o exp(rho t) and construct the characteristic polynomial of the diff. eqn. Check out the derivation in your lecture notes for the case of the series RLC and copy the steps. Q=omega/(2*gamma) is both cases, so find gamma and equate omegas.

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[5] Purcell 8.7 (Resonant Cavity)

Another problem that only sounds worse than it really is.

- go to p.285, section 7.8 to find out self-inductance of toroid of 1 turn (N=1).
- go to p.105 to find capacitance. The capacitor formed here had circular plates of radius "a" and the distance between the plates is "s".
- omega^2=1/(LC) where L and C come from the steps above.
- The E field among the plates of the capacitor is well known and in your home microwave wave comes from an oscillating dipole. The B field in the toroid is circular, along the phi^. You should be able to make an order of magnitude calculation of the resonant frequency of your microwave oven based on the range of realistic values of the a,b,h,s. It should be in the few GHz range, or check your oven's manufacturer label to convince yourself.

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[6]/[7] Driven RL/RC circuits (Purcell 8.12/8.13)

Quite similar problems. IT is a complex number exercise more than physics.

- Introduce complex number notation and express the voltage drops on the elements as deltaV=IZ where all are complex numbers.
- The trickiest part is the ORDER in deltaV=V_a-V_b or in general where writting it down for a circuit element.
- In 8.12 you should fine V_ab=V_o |-1+iRComega|/|+1+iRComega|
- In 8.13 again form V_ab as the difference of two complex numbers and request this complex number to be zero. Both real and imaginary parts should vanish. The imaginary condition is satisfied automatically which leads you to the condition L=R1R2 C for the real part to vanish. And you do have a device that measures L by adjusting R1,R2 so that V_ab to be zero!