

Name: _____

Student ID: _____

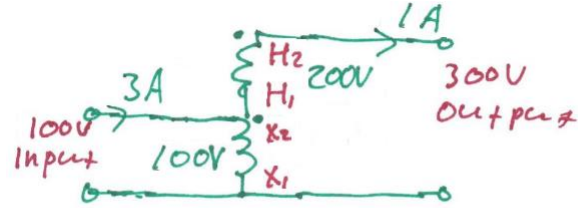
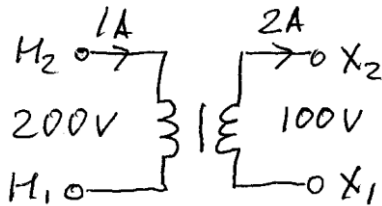
Close notes and books. Quizzes suspected of cheating and/or turned in late will not be marked. **You have 20 minutes** to answer the following questions:

Q1 (40pts): Assume an **ideal transformer** depicted below with rated apparent power $S = 200V \cdot 1A = 200VA$.

a) (20pts) Re-connect it as a **STEP-UP (100/300V) AUTOTRANSFORMER**. Sketch a circuit (with input on the left, and output on the right). Label each winding terminal with "**H-X**" and **dots**.

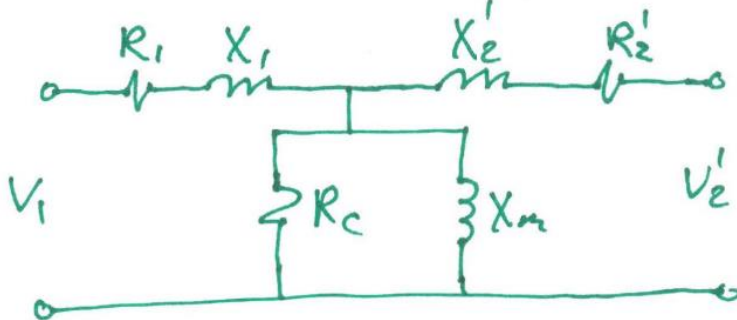
b) (20pts) Label the input and output terminals with voltages (in Volts) and currents (in Amps).

Calculate and label the new apparent power S (in VA).



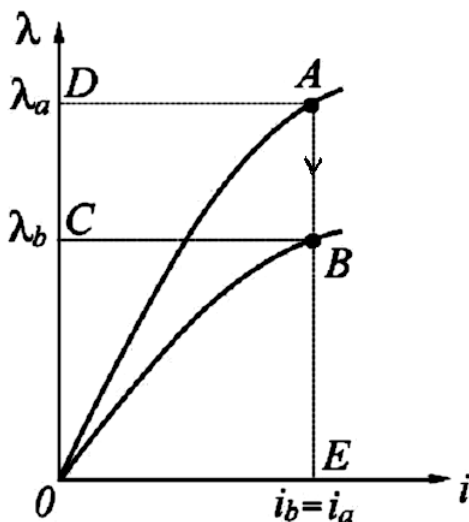
$$S = 3A \cdot 100V = 1A \cdot 300V = \underline{300VA}$$

Q2 (20pts): Sketch the **T-Equivalent Circuit** of a practical **non-ideal** two-winding transformer and label its elements as we discussed in class. What are the sources of power losses (dissipation of energy) and how are these losses represented in equivalent circuit?



The energy is dissipated in the winding resistance (represented by R_1 and R_2') and core losses (represented by R_c)

Q3 (40pts): Consider a basic electromagnet device discussed in class. The system has moved from point **A** to point **B**, as shown in the $\lambda - i$ figure. Express the change in coupling field energy ΔW_f , co-energy ΔW_c , electrical input ΔW_e , and mechanical output ΔW_m in terms of respective areas. For each, state **positive** or **negative**. State where did the energy come **from** and went **to**? Conclude if the plunger pulled IN or OUT?



Change	ΔW_f	ΔW_c	ΔW_e	ΔW_m
Area	OBCO-OADO < 0	OBEO-OAEO = -OABO < 0	-ABCD < 0	-OABO < 0
Positive or negative?	negative	negative	negative	negative
Energy came from ? Energy came from mechanical system input ΔW_m (the plunger was pulled out!), and from coupling field ΔW_f (because the stored energy is reduced).				
Energy went to ? Energy went to electrical system ΔW_e				
Based on the energy conversion balance $\Delta W_e = \Delta W_f + \Delta W_m$, conclude whether the plunger was pulled IN or OUT? The field has decreased, so the plunger was pulled out!				