UNIVERSITY OF MANITOBA

April 13, 2016 — FINAL EXAM

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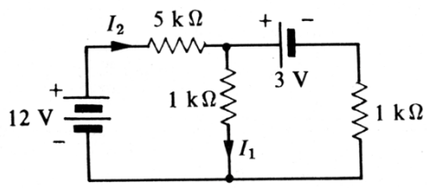
DEPARTMENT & COURSE NO.: PHYS 2610 — TIME: 3 hours

EXAMINATION: Circuit Theory and Introductory Electronics — EXAMINER: W Ens

Answer all questions. All questions are of equal value.

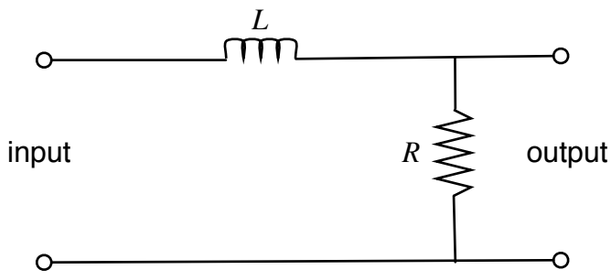
1. (a) Calculate I_1 and I_2



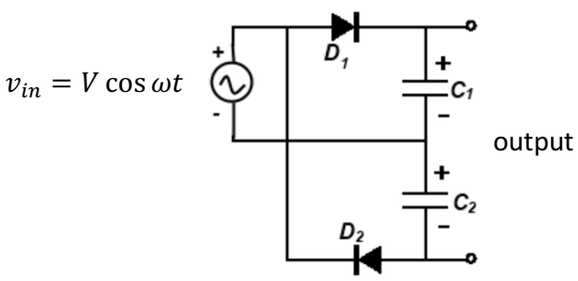
(b) A high impedance voltmeter is used to measure the output voltage of an unknown network, giving a result of 4.5 V. When a 300 Ω resistor is connected across the output, the voltage is reduced to 1.25 V. What are the Thevenin equivalent voltage and resistance of the unknown circuit?

2. (a) In the RL circuit below, determine the output voltage as a function of time if the input is stepped from zero to V at time $t = 0$. What is the current at very long times?

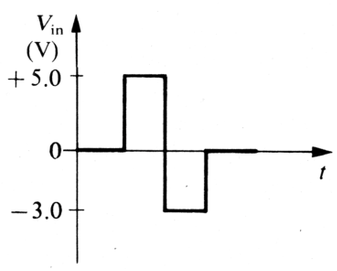
(b) Determine the output voltage if $v_{in} = V \cos \omega t$. What is the phase shift? Is this a high-pass or a low-pass filter? What is the breakpoint frequency, where the gain drops by 3 dB from its maximum value?

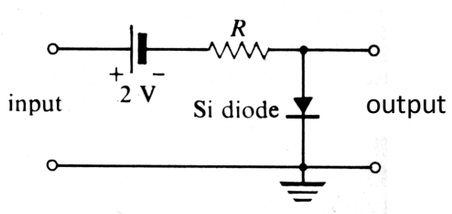


3. (a) For zero load current, the output of the voltage doubler is pure dc. What happens to the output when the load becomes appreciable? Sketch the input and output waveforms for a load resistance R_L connected across the output so that the decay time constant is about 10 times the input period. Give approximate expressions for the peak output voltage and the peak-to-peak ripple in this case. Ignore the voltage drop across the diodes.

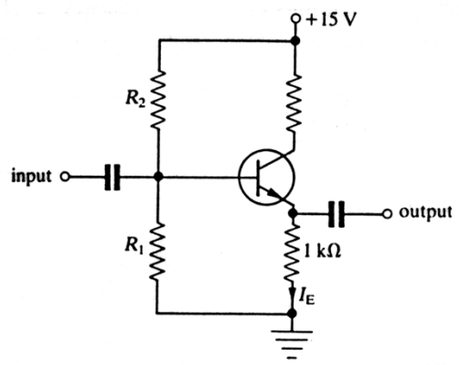


(b) Sketch the output waveform to scale for the following circuit with the input as shown.

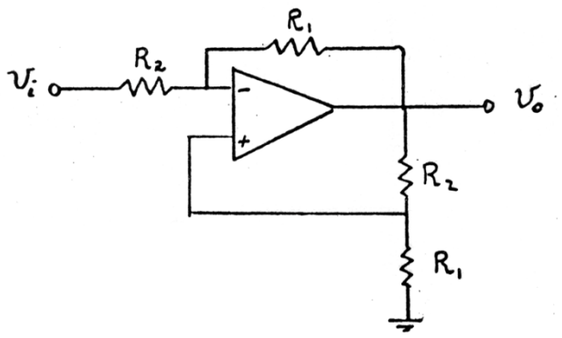




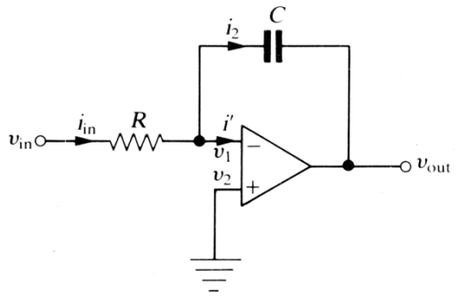
4. For the emitter follower shown below, select R_1 and R_2 if $I_E = 5$ mA, and $\beta = 100$. What is the voltage gain? Estimate the input impedance if $R_{BE} = 1$ kΩ.



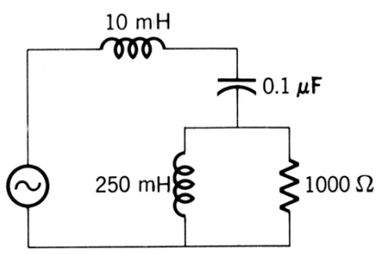
5. (a) Find an expression for the output voltage for the circuit shown below.



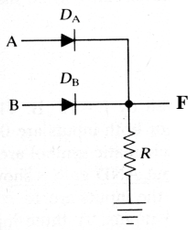
(b) Show that the output of the circuit below is approximately proportional to the integral of the input, and give the condition for the validity of the approximation.

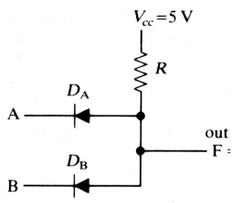


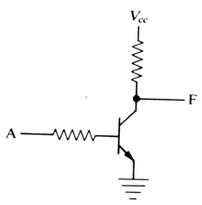
6. Determine the rms current in the 1000-Ω resistor if the input rms voltage is 10 V, and the input frequency is 1000 Hz. It might be easier to substitute numbers at the beginning, to simplify the algebra.

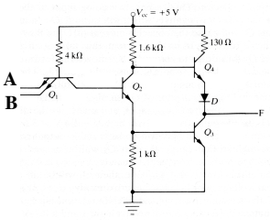


7. (a) Identify the type of logic gate for each of the following circuits.









(b) Sketch a logic circuit to implement $F = (A \cdot B) \cdot (C \cdot D)$ using only NOR gates.

(c) Initially $R = S = Q = 0$V on the RS flip flop. At time $t = 0$, S goes to 1. Sketch v_A as a function of time.