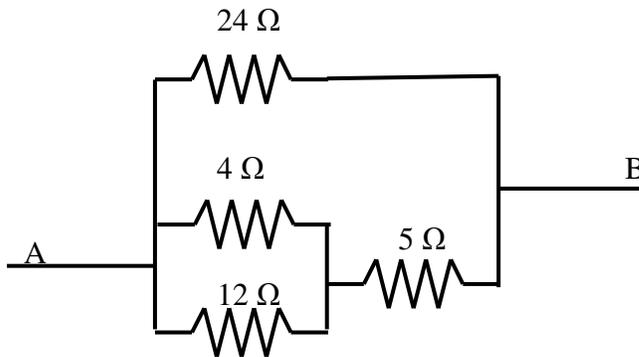


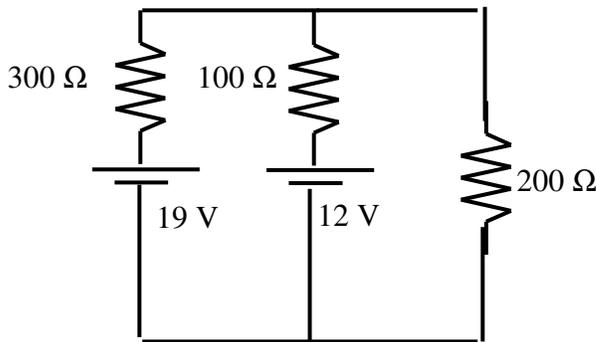
PHYS-COIS 2250H – Electronics
Midterm: Wednesday 31st Oct 2012.
Allowed: 1 hour, 50 mins. Calculator.

Answer all questions. Each question is worth equal marks. Show your working!

1. a) Describe in words, carefully, what is meant by Ohm's Law: $V = IR$ and when it is applicable.
 b) Find the total resistance between points A and B below:



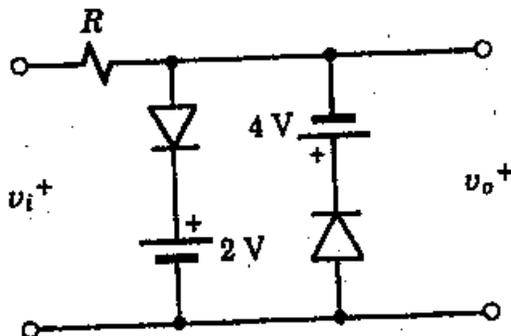
- c) Find the current through, and the potential difference across, the 100 Ω resistor in the circuit below:



- d) Use a truth table to verify the following DeMorgan's theorem:

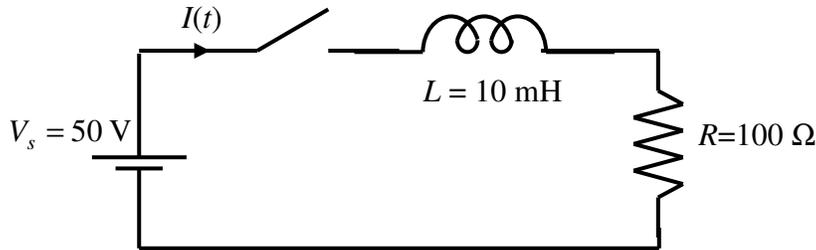
$$\overline{A + B} = \overline{A} \cdot \overline{B}$$

2. a) For the diode circuit shown, sketch $v_o(t)$ directly below a sketch of $v_i(t)$, when $v_i = 10\sin(\omega t)$, and give your reasoning. Assume the diodes are ideal.

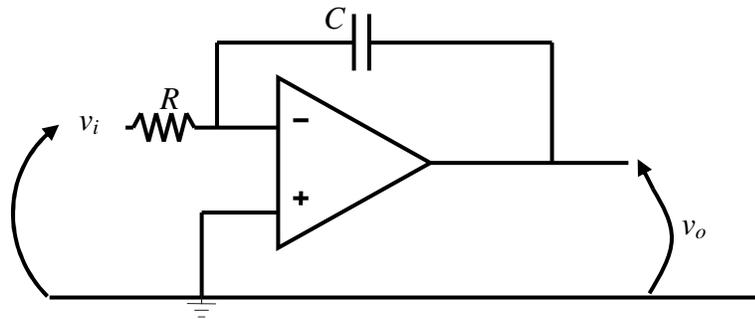


b) For the circuit below, determine the current $I(t)$ in terms of V_s , L and R . Sketch this function and give the current at $t = 50 \mu\text{s}$ after the switch is first closed.

[Note that a differential equation of the form $\frac{dy}{dx} + P(x)y = Q(x)$ can be solved by first multiplying each side by $e^{\int P(x)dx}$, and then the left hand side can be represented as a derivative of a single function].



3. Consider the operational amplifier circuit shown below:



- By assuming the usual op-amp approximations for negative feedback, find the output voltage of this circuit.
- Repeat the same calculation if the resistor and capacitor are exchanged with each other.
- With the help of a diagram only, but with no analysis, explain what is meant by the *equivalent circuit* for an operational amplifier.

- Draw the circuit below, with the three pins of the transistor labeled appropriately. Is it an npn or pnp?
 - Calculate the collector current and the output voltage, assuming that $\beta = 100$.
 - Repeat the calculation for $\beta = 200$ and determine if the computed answer is physically realistic – if not, why not?

