ECE2210 Final given: Fall 15

1. (12 pts) a) Find the s-type transfer function of the circuit shown.

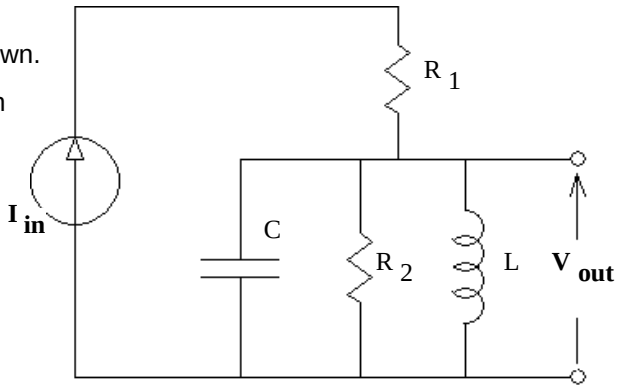
   You MUST show work to get credit. Simplify your expression for **H(s)** so that the denominator is a simple polynomial.

   $\mathbf{H}(s)$ = ?

   b) How many poles does this transfer function have?

   c) How many zeroes does this transfer function have?

   If it has 1 or more, express them (probably in terms of R_1, R_2, L and C).

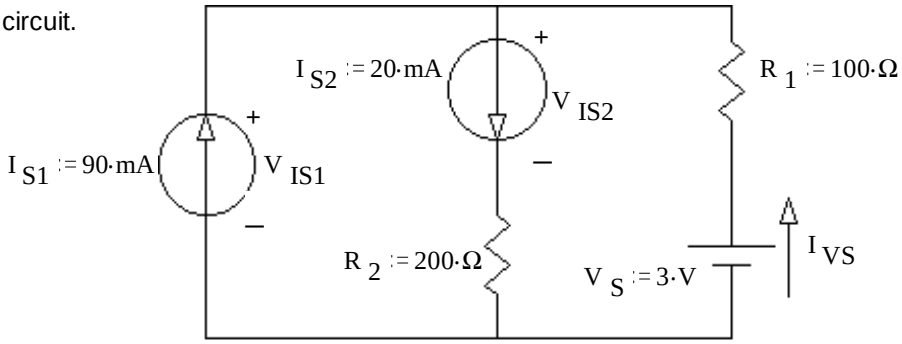


2. (18 pts) Find the values below. Show your work.

   Find: V_{IS1} V_{IS2} I_{VS} &

   P_{Vs} , The power V_S supplies to the circuit.

Note: feel free to show work & answers right on the schematic



3. (18 pts) For partial credit, you must show work and/or intermediate results.
   a) Find $\mathbf{Z_2}$

   b) Find $\mathbf{V_S}$

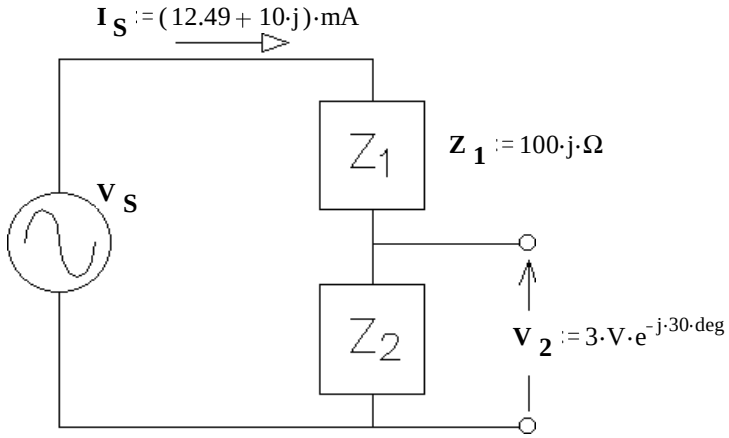
   c) Circle 1: i) $\mathbf{I_S}$ leads $\mathbf{V_2}$

   ii) $\mathbf{I_S}$ lags $\mathbf{V_2}$

   i) $\mathbf{I_S}$ leads $\mathbf{V_2}$

   Why? Show numbers:

   Or explain by other means:

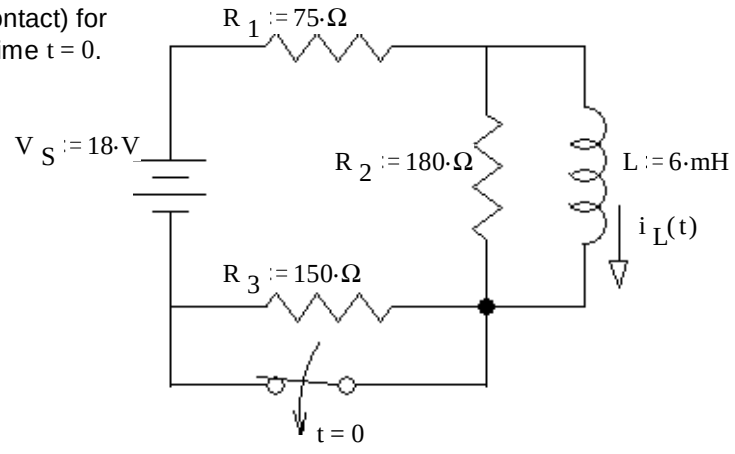


4. (22 pts) The switch has been open (not making contact) for a long time and is switched closed (as shown) at time t = 0.

   a) Find the complete expression for $i_L(t)$.

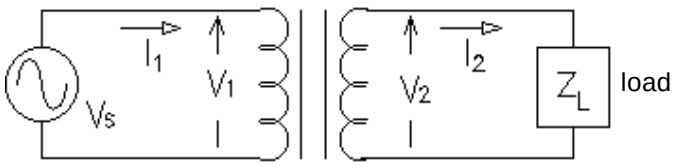
   b) Find i_L at time $t = 1.2\tau$.

   c) At time $t = 1.2\tau$ the switch is opened again. Will the time constant be different now? If yes, find the new time constant. JUST the time constant.



5. (7 pts) A transformer is rated at 240V/120V, 1.2kVA. Assume the transformer is ideal and all voltages and currents are RMS.

   How much power does the load consume?



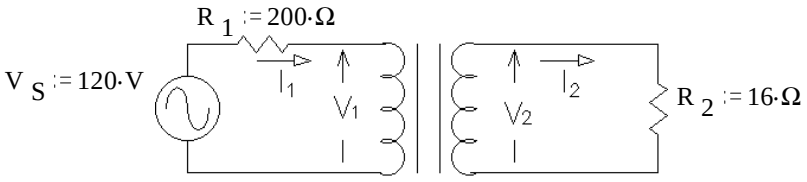
$V_S := 120 \cdot V$ $\quad |Z_L| = 8 \cdot \Omega$ $\quad pf := 80 \cdot \%$ lagging

6. (16 pts) The transformer shown in the circuit below is ideal. It is rated at 240/48 V, 20 VA, 60 Hz
   Find the following: All values are RMS unless specified otherwise.

   a) I_1 = ?

   b) V_2 = ?

   c) I_2 = ?



Use constant-voltage-drop models for the diodes and LEDs on this exam.

7. (18 pts) Assume that diode D_1 does conduct. Assume that diode D_2 does NOT conduct.

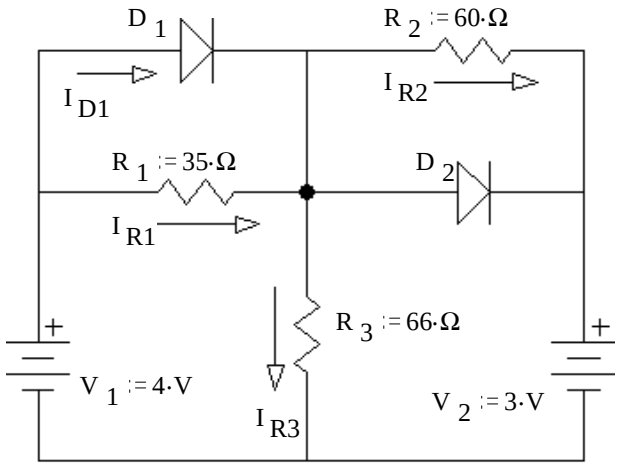
   a) Find I_{R1}, I_{R2}, I_{R3}, & I_{D1} based on these assumptions. Stick with these assumptions even if your answers come out absurd.

   I_{R1} = _____

   I_{R2} = _____

   I_{R3} = _____

   I_{D1} = _____



   (circle one)

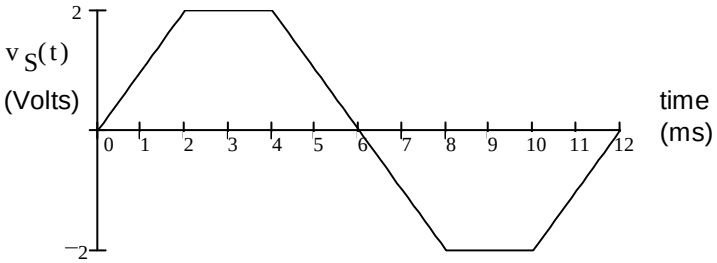
   b) Was the assumption about D_1 correct? yes no

   How do you know? (Specifically show a value which is or is not within a correct range.)

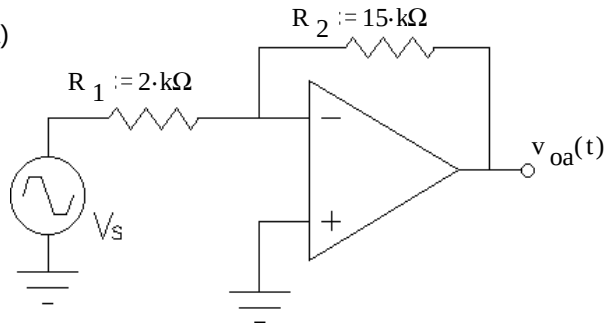
   c) Was the assumption about D_2 correct? yes no

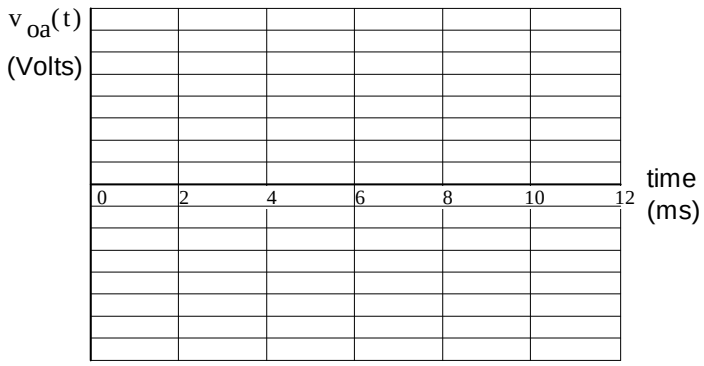
   How do you know?

8. (28 pts) The same input signal (at right) is connected to several op-amp circuits below. Sketch the output waveform for each circuit. Clearly label important voltage levels on each output. If I can't easily make out what your peak values are, I'll assume you don't know. Don't forget to show inversions. The op-amp is connected to +12V & -12V power supplies.

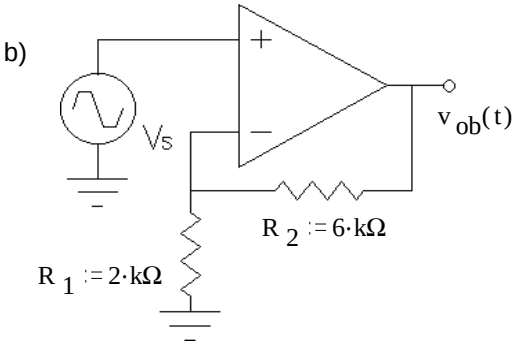


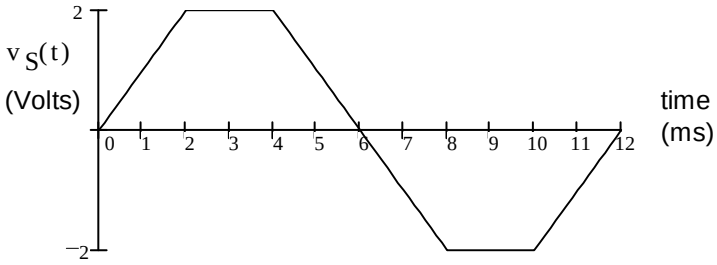
   a)

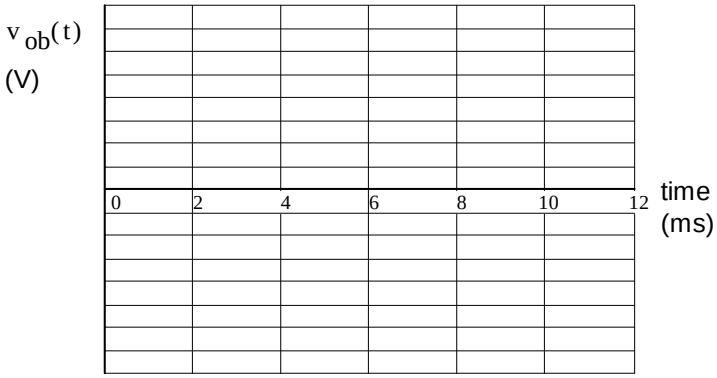


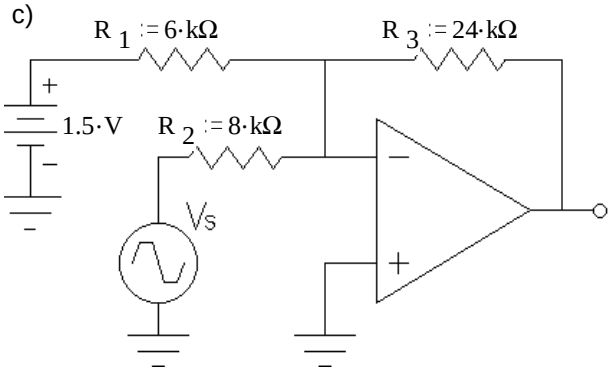


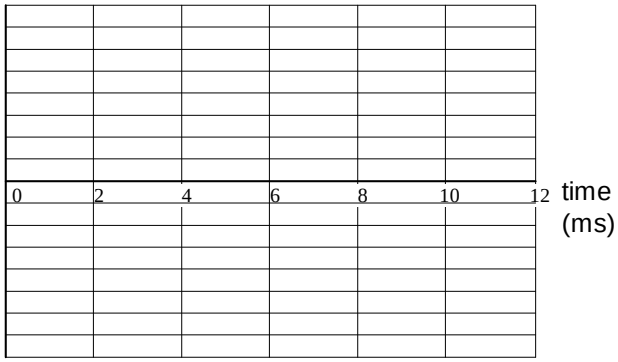
8. continued, the input is repeated at right. The op-amp is connected to +12V & -12V power supplies.

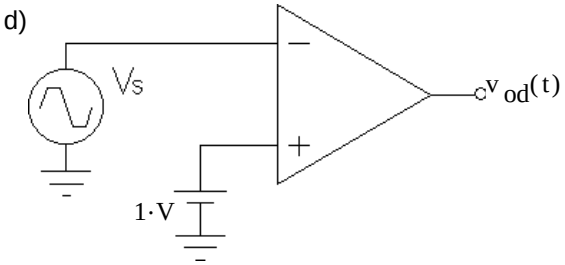


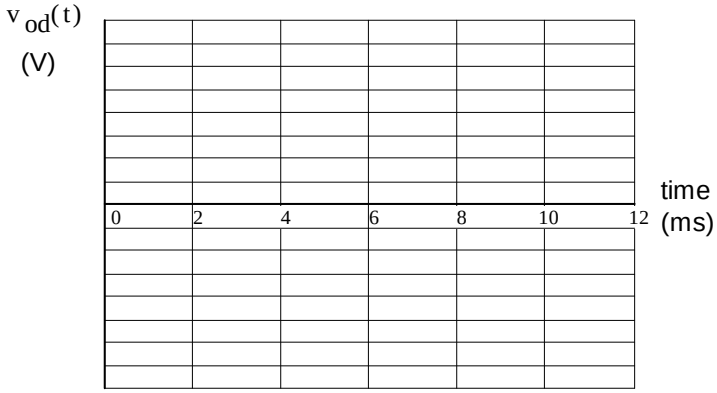




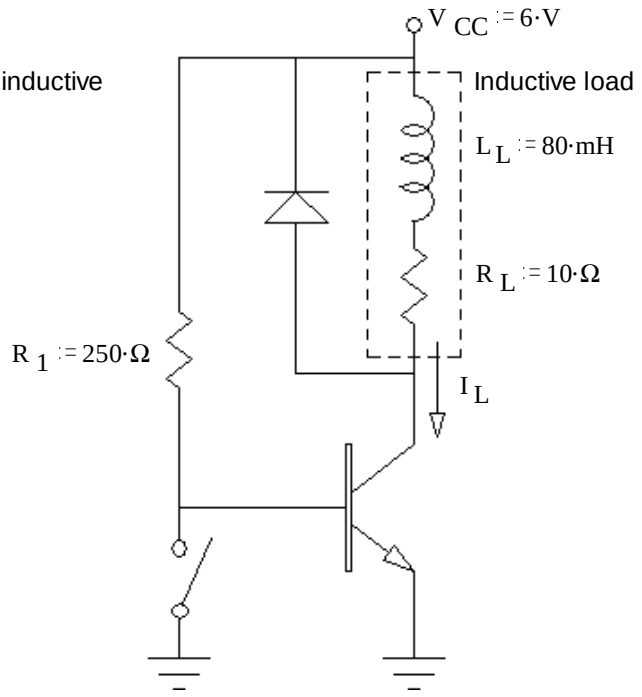








9. (24 pts) A transistor is used to control the current flow through an inductive load (in the dotted box, it could be a relay coil or a DC motor).



a) $\beta := 20$ Assume the switch has been open for a long time and the transistor is in the active region, find I_L, and V_{CE} and P_Q.

I_L = ?

V_{CE} = ?

P_Q = ?

b) Was the transistor actually operating in the active region?
yes no circle one

How do you know?
(Specifically show a value which is or is not within a correct range.)

c) What minimum β would be required to achieve saturation?

d) You can't change the β. Find the maximum value of R_1, so that the transistor will be in saturation. $\beta = 20$

e) The diode in this circuit conducts a significant current:

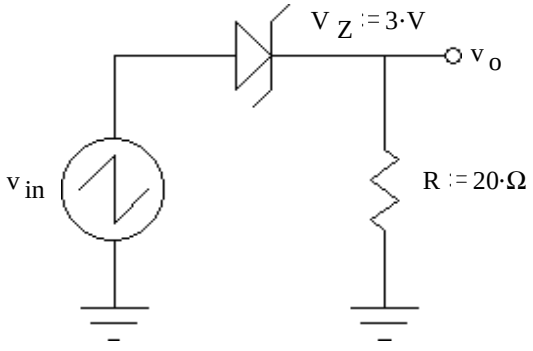
A) never.	C) whenever the switch is open.	E) whenever the switch is closed.
B) when the switch opens.	D) when the switch closes.	F) always.

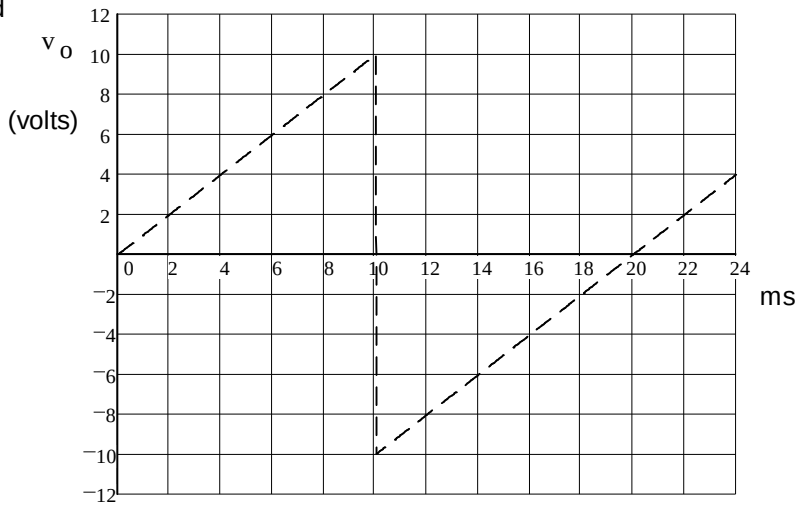
f) R_1, is that found in part d). The switch is opened and closed a few times.
What is the maximum diode current you expect. (Answer 0 if it never conducts.)

10. Do you want your grade and scores posted on the Internet?
If your answer is yes, then provide some sort of alias: _____
otherwise, leave blank

The grades will be posted on line in pdf form in alphabetical order under the alias that you provide here. I **will not** post grades under your real name or an alias that looks like a real name or u-number. The pdf spreadsheet will show the homework, lab, and exam scores of everyone who answers here.

11. (17 pts) A voltage waveform (dotted line) is applied to the circuit shown. Accurately draw the output waveform (v_o) you expect to see. Label important times **and** voltage levels.





Answers

1. a) $\dfrac{\frac{1}{C}\cdot s}{s^2+\frac{1}{C\cdot R_2}\cdot s+\frac{1}{C\cdot L}}$ b) 2 c) 1 s = 0

2. $10\cdot V$ $6\cdot V$ $-70\cdot mA$ $-210\cdot mW$

3. a) $187.5\Omega\angle\underline{-68.78^o}$ b) $1.62V\angle\underline{-8.93^o}$

   c) i) $\underline{+38.6^o} < \underline{-30^o}$

4. a) $240\cdot mA - 160\cdot mA\cdot e^{-\frac{t}{0.113\cdot ms}}$ b) $192\cdot mA$ c) $60\cdot\mu s$

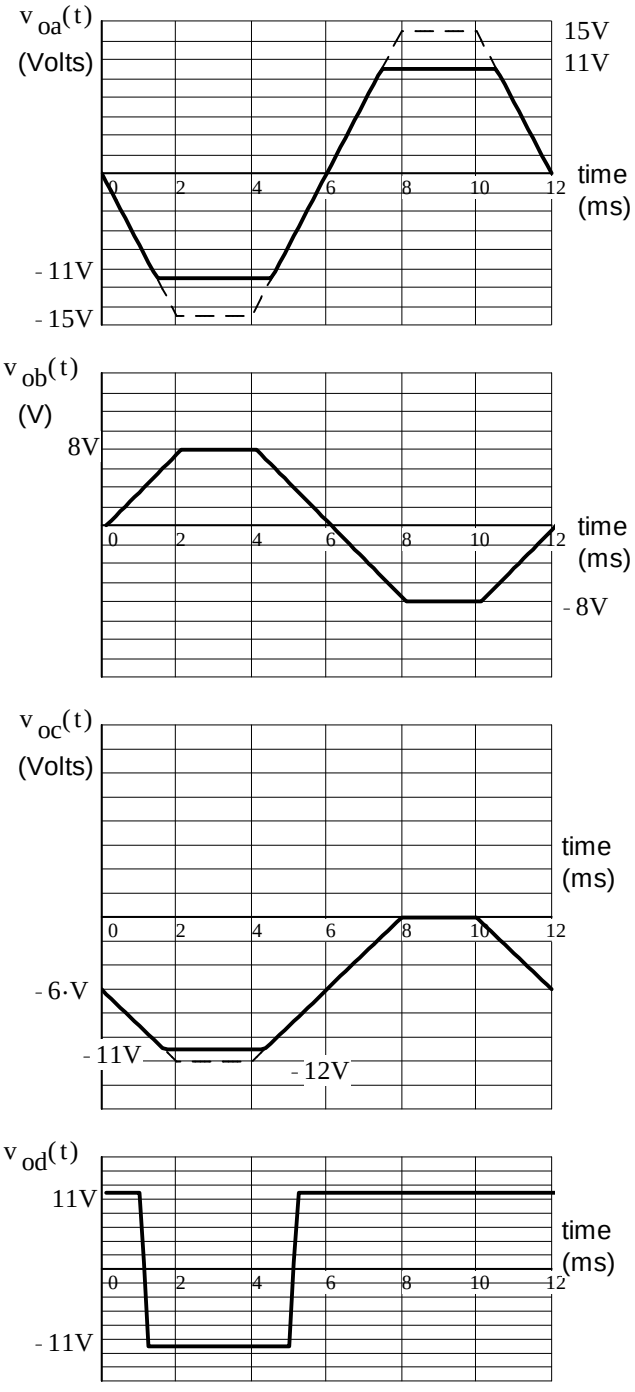
5. $360\cdot W$

6. a) $200\cdot mA$ b) $16\cdot V$ c) $1\cdot A$

7. a) $20\cdot mA$ $5\cdot mA$ $50\cdot mA$ $35\cdot mA$

   b) yes $35\cdot mA > 0$ c) yes $V_{D2} = 0.3\cdot V < 0.7V$

8.



9. a) $424\cdot mA$ $1.76\cdot V$ $0.746\cdot W$

   b) yes $1.76\cdot V > 0.2\cdot V$

   c) 27.4 d) $183\cdot\Omega$ e) D) f) $580\cdot mA$

11.