ECE 320 - Quiz 5: Name _____

DC to DC Converters, Transistor Switches. October 1st, 2015

1) Design a circuit which converts 20V DC to 5V DC using a transistor, with the output capable of driving 300mA @ 5V. Calculate the efficiency

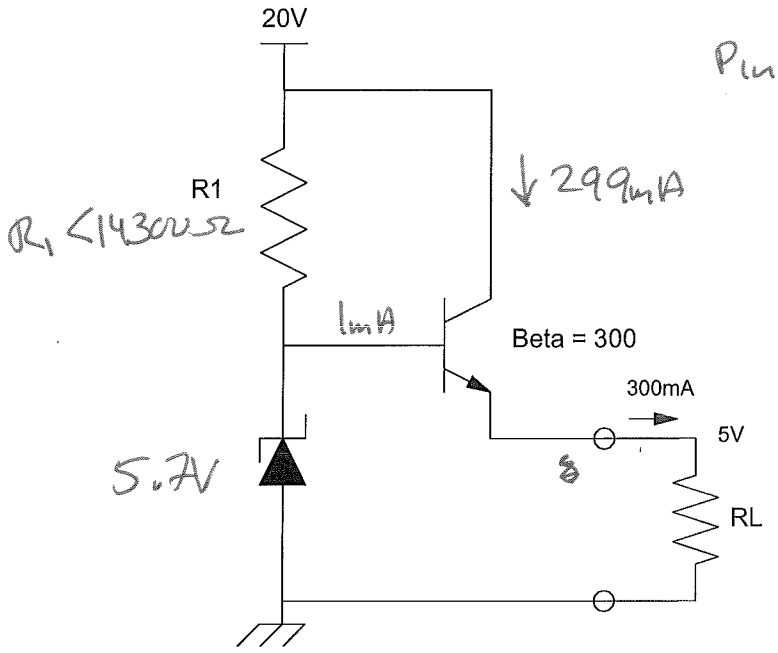
RL for 300mA	R1	efficiency
16.67Ω	<14.3k let R1=10k	24.7%

5V/300mA

$P_{out} = 300mA \cdot 5V = 1.5W$

$P_{in} = (20 \cdot (299mA + \frac{20-5.7}{R_1}))$

$= 6.06W$



2) The following Buck converter drops 20V down to 5V DC. Assume

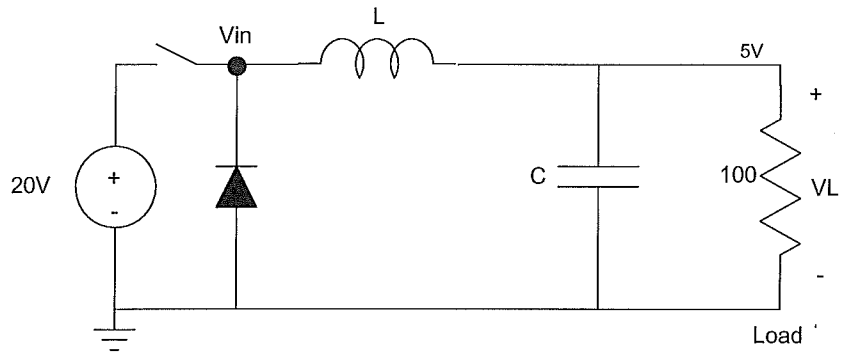
L = 1H

C = 0

Switching Frequency = 1kHz

Determine the following

On/Off Cycle Time for the switch for Vo = 5V	The ripple at the load	efficiency
$\frac{5}{20}$	318 mV_{pp}	90.7%



$$ripple \approx \left(\frac{100}{100 + j\omega L}\right) 20V_{pp}$$

$$\approx \left(\frac{100}{100 + j\,6283}\right) 20$$

$$\approx .318\,V_{pp}$$

$$P_{out} = \frac{5^2}{100} = 25mW$$

$$= 250mW$$

on $P_{loss} = 0$

$\Sigma eff = 100\%$

off: $Eff = \frac{5}{5.7} = 87.7\%$

$$\eta = (.25)(100\%) + (.75)(.877)$$

$$= 90.7\%$$

3) The following Buck converter drops 20V down to 5V DC. Assume

L = 1H

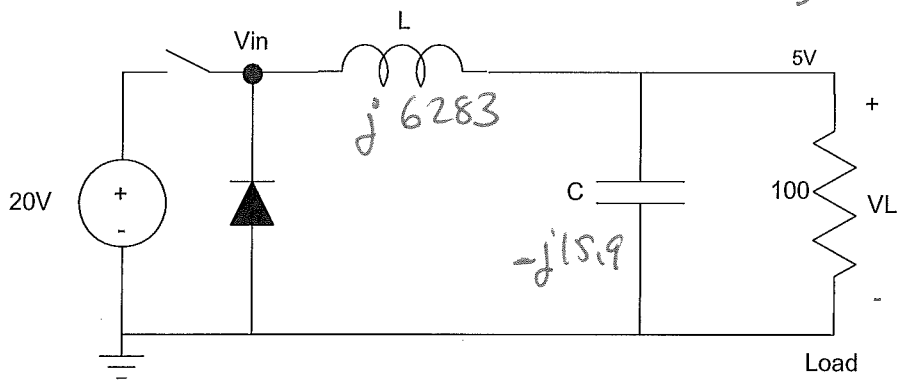
C = 10uF

Switching Frequency = 1kHz

Determine C so that the ripple is 10mV peak-to-peak

Ripple for C = 10uF	C for a ripple of 10mVpp
$498mV_{pp}$	$50\mu F$

$(50.66\mu F)$



$\approx 15.7\Omega$

$$V_L \approx \left(\frac{100 \| -j15.9}{100 \| -j15.9 + j6283} \right) 20V_{pp}$$

$\approx .0498\ V_{pp}$

25x too large

make C 5x ~~smaller~~ bigger

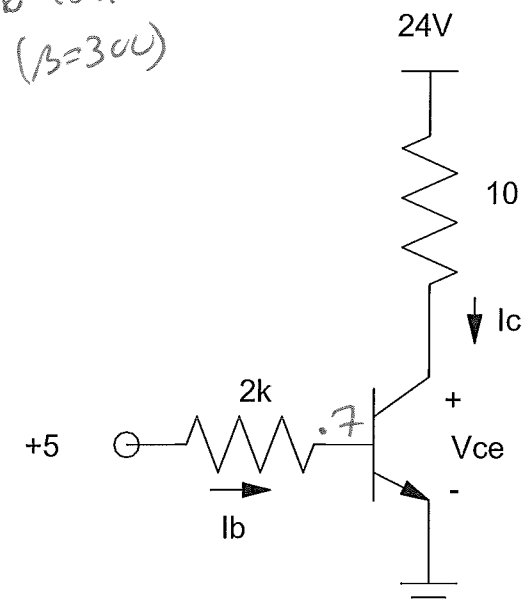
4) For the following circuit, assume the transistor has a current gain of 100 ($\beta = 100$). Determine the following

Ib	Ic	Vce	Transistor State off / active / saturated
2.15mA	215mA	21.85V	active

(β=100)
6.45mA
(β=300)

17.55V

active)



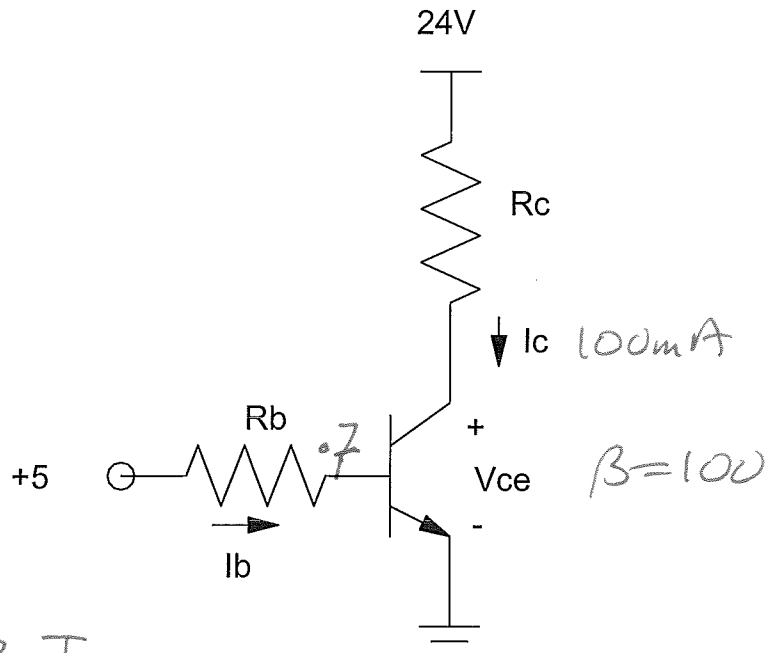
β=100

$\frac{5-.7}{2k} =$

5) Modify the following circuit so that the

- Current Ic = 100mA
- Current Ib < 10mA
- The transistor is saturated

Rb	Rc	Vce
430..4.3k	238 Ω	0.2V



$\beta I_b > I_c$

$I_b > 1mA$

$R_b = \frac{5-.7}{1mA} = 4.3k$

(upper limit)

$I_b < \frac{10}{\beta}mA$

$R_b = \frac{5-.7}{10mA} =$

R_b 430

Colbert Trivia! Citizens United was a supreme court decision which opened the doors to Super-PAC's along with their ability to raise unlimited amounts of money from anonymous donors. What happens to the money in a Super-PAC after the election?

- a) The money becomes the property of the candidate
- b) The money becomes the property of the owner of the Super-PAC
- c) Since the donors are anonymous, the money must be given to charity
- d) The money is confiscated by the Federal Election Commission
- e) The money must be transferred to another active Super-PAC