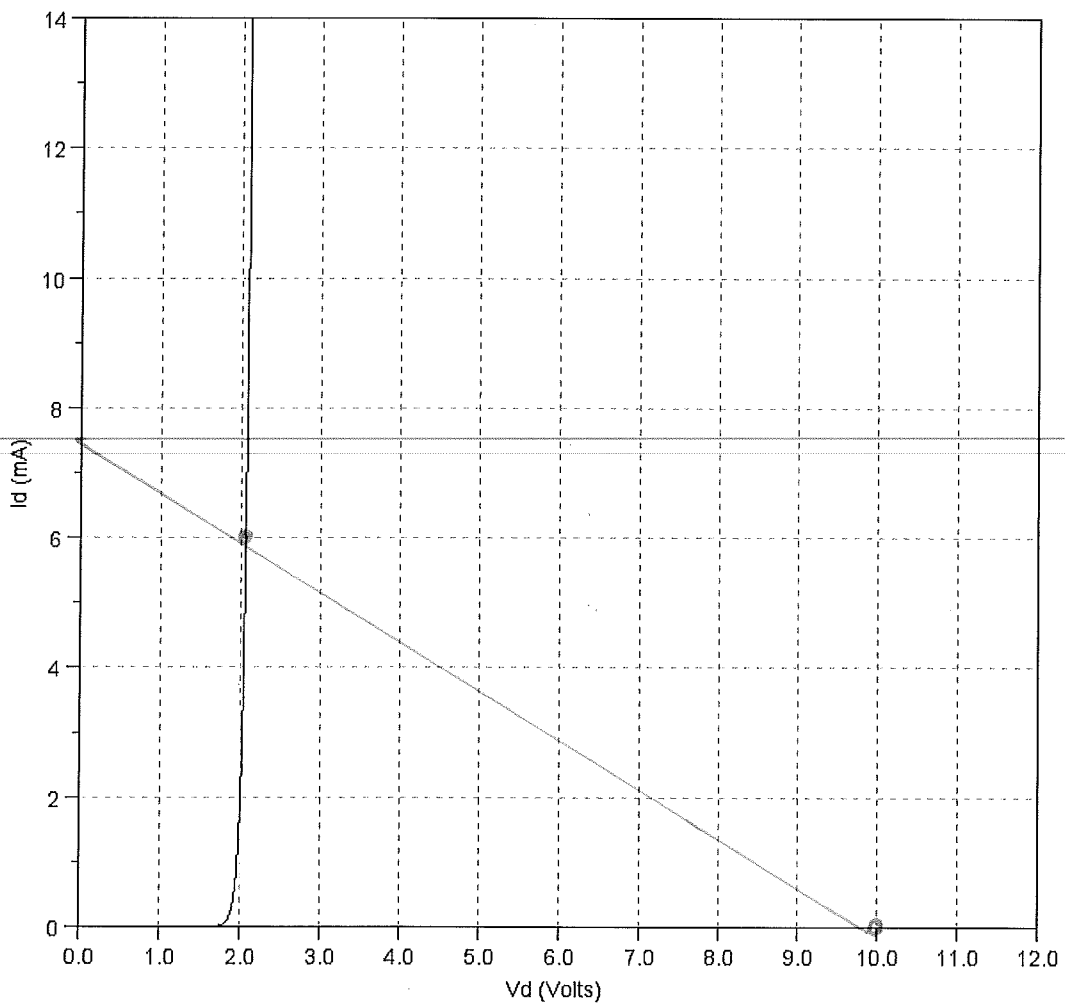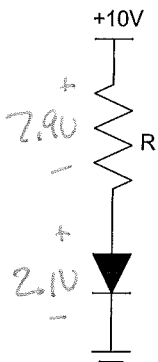# ECE 321: Quiz #2   Name _____

Operational Amplifier Circuits - November 10, 2016

1) The VI characteristics for a white LED are given below. Draw the load-line and determine R so that 6mA flows through the LED.

| Load Line	Vd	Id	R
show on graph	2.1V	6 mA	1317 Ω

$$R = \frac{7.9V}{6mA} = 1317\,\Omega$$

2) A 1kHz, 1Vp sine wave is added to the previous diode. Assume the Q-point is at Id = 6mA.
Determine the following:

Zc: Impedance of the capacitor at 1kHz (6280 rad/sec)	Idpp: The peak-to-peak current through the diode	Vdpp: The peak-to-peak voltage across the diode
$-j530\ \Omega$	1.88mApp 0.94mAp 0.66 mArms	35mVpp 17mVp 12mVrms

+10V

0.3uF

R

1Vpp
1kHz

DC: 10mA
AC: ?
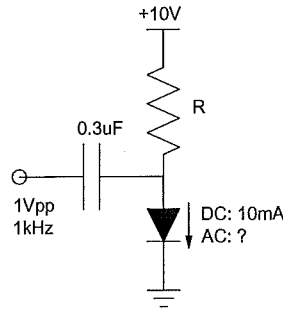
$$Z_c = \frac{1}{j\omega c} = -j530\ \Omega$$
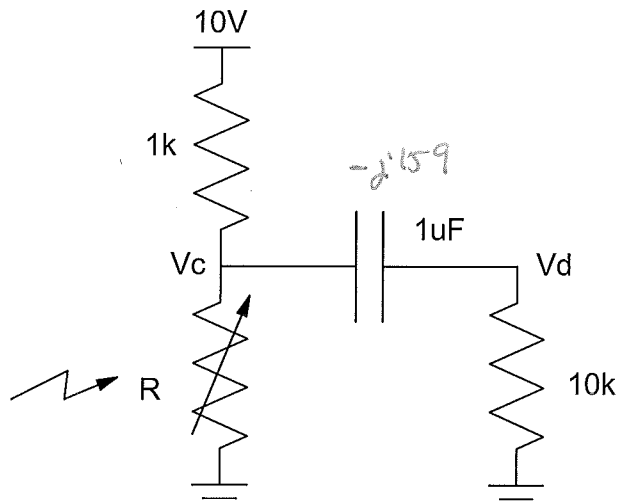
$$I_c = \frac{1Vpp}{530\Omega} = 1.88mApp$$
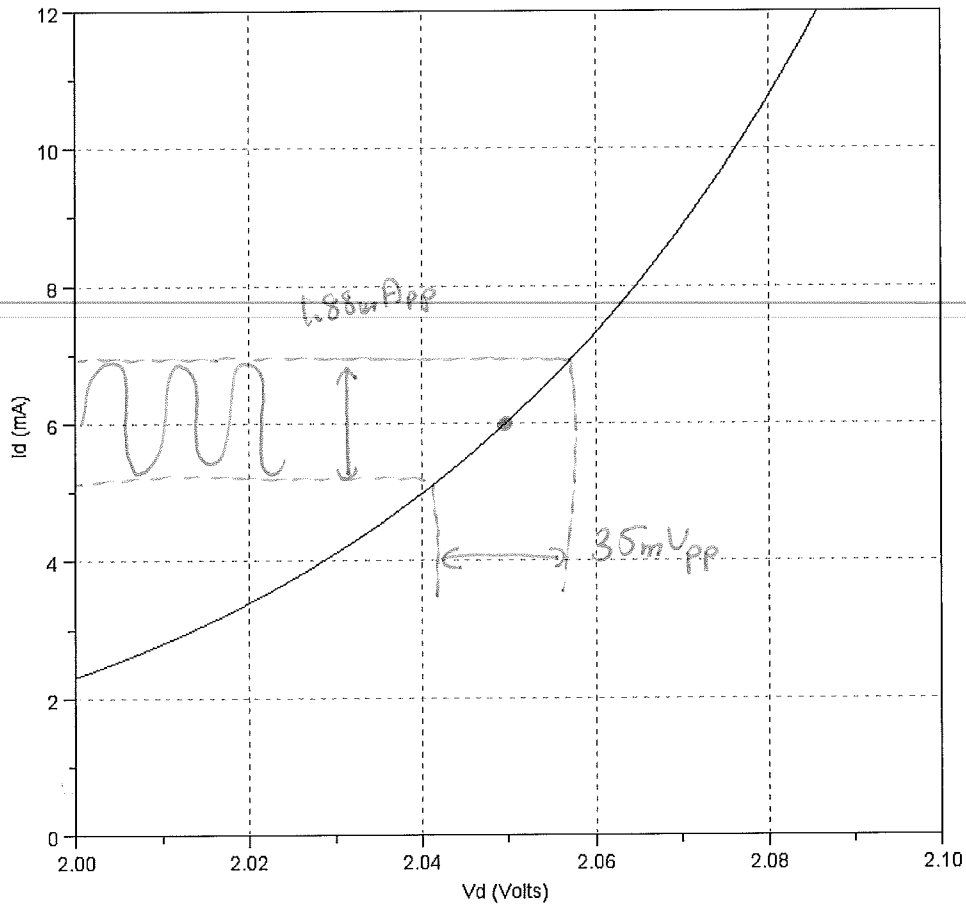
3) A light-sensitive resistor picks up the light and has a resisance of

$$R = 2000 + 10 \sin(6280t) \text{ Ohms}$$

Determine the DC and the AC voltage at Vc.

DC Value of Vc	AC Value of Vc (1kHz term)
6.25V	19.5mVpp 9.76mVp

6.908mVrms

10V

1k

−j159

1uF

Vc   Vd

R

10k

2010Ω   2000Ω   1990Ω

2010 || 10000−j159 = 1673Ω   Zcoll 10k = 1667Ω   →1659Ω

$\left(\dfrac{1673}{1673+1000}\right) 10 = 6.2597V$ $\left(\dfrac{1667}{1667+1000}\right) 10V = 6.25V$ 6.24V

DC value

6.2597 - - -

6.25V

6.2402 - - -
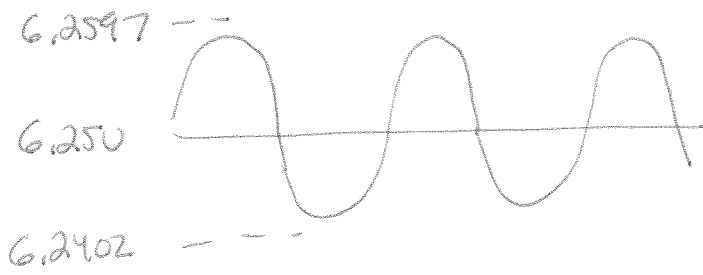
4) Assume

$$V_c(t) = 5 + 2\cos(6280t)$$

Determine Vd(t)

DC Value of Vd	AC value of Vd (@ 100 rad/sec)
~~5V~~ 0V	$= 1.9997 Vp$ $= 1.414 V_{rms}$

10V

1k

-j159

1uF

Vc

Vd

R

10k
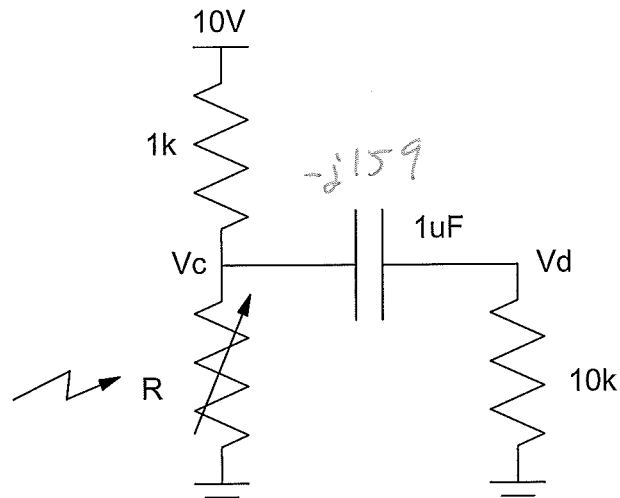
DC

gain = 0

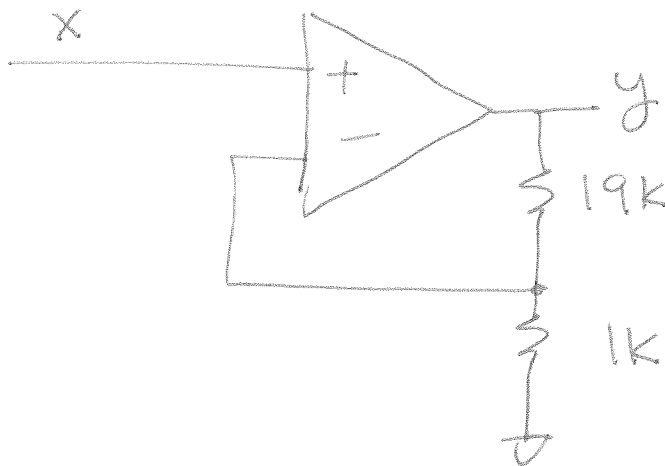AC

$= \left(\dfrac{10k}{10k - j159} \right) \cdot 2v$

$= 1.9997V$

5) Assume Vd is
   - 0V DC
   - 0.1Vpp @ 1kHz

Design a circuit to amplify this signal to 2Vpp

gain = 20

Bonus! The Permian extinction (251 million years ago) wiped out 97% of all life forms on Earth and left a planet that was nearly devoid of life for 10 million years. Scientists are pretty sure this mass extinction was triggered by climate change caused by CO_2 emissions from the Siberian Traps (a massive volcano).

How much was this temperature increase?   10°C