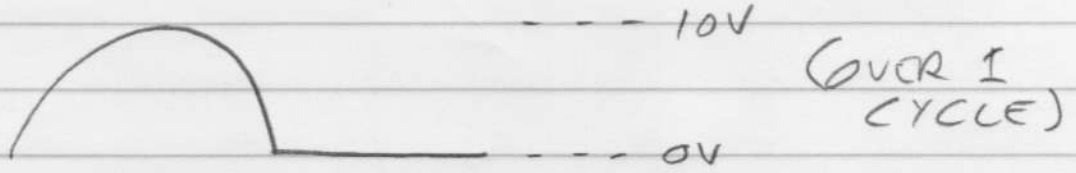
PHYS 334 WINTER QUARTER 2012
HOMEWORK 2 SOLUTIONS VER 1.0

1. HALF-WAVE RECTIFIER OUTPUT:



(a) THE VOLTAGE-AVERAGES OVER THE TWO HALF-CYCLES ARE $10\,V.\frac{2}{\pi}$ AND 0V. HENCE, THE VOLTAGE TIME-AVERAGE OVER A FULL CYCLE IS $10\,V./\pi$

(b) THE RMS ("SQUARE-ROOT OF THE MEAN OF THE SQUARED-VALUE") VOLTAGE FOR THE TWO HALF CYCLES ARE $10\,V./\sqrt{2}$ AND 0V. HENCE THE RMS VOLTAGE OVER A FULL CYCLE IS $10\,V./2$

2. I LOOKED UP PROPERTIES OF 30AWG COPPER WIRE IN THE CRC HANDBOOK: DENSITY 0.045 g/m, SPECIFIC HEAT 0.01 CAL/g·°C, MELTING POINT AROUND 1300 °C.

START WITH THE WIRE AT ROOM TEMPERATURE. THE HEAT NEEDED TO MELT IT IS:

$Q = CM\Delta T = 0.1 \times 0.4 \times (1300-25)\,^{\circ}C$
$\approx 0.1\ J.$

THE ENERGY STORED IN THE CAPACITOR IS $\frac{1}{2}CV^2 = \frac{1}{2} \cdot 4\times10^{-6}(200)^2 \approx 0.1\ J.$

HENCE, THE WIRE MAY OR MAY NOT MELT: YOU'D DEFINITELY WANT TO "HEAT SINK" THE WIRE IF YOU DON'T WANT IT TO MELT.

3. "EYEBALLING" THE STEEP ZENER CURVE AT THE LEFT:

$$R_{DYN} = \Delta V/\Delta I \approx \frac{2V}{45mA} = 45\Omega$$

a. WE NEED A CURRENT THAT PUTS THE I-V CURVE IN THE STEEP PART OF THE ZENER CURVE. TOO LITTLE CURRENT AND R_{DYN} IS TOO BIG. TO MUCH CURRENT AND THE POWER DISSIPATED IN THE DIODE IS TOO MUCH AND IT FAILS.

LOOKING AT THE CURVE, 30MA SEEMS OK. WE CAN NOW FIND THE CURRENT-LIMITING RESISTOR R

$$R = \frac{50V - 30V}{30mA} \approx 700\Omega$$

How GOOD IS THIS CIRCUIT?

$$\delta V_{OUT} = \pm 5V \frac{45\Omega}{700\Omega + 45\Omega} \simeq 60mV.$$

NOT TOO BAD.