

## EEE123 Problem Sheet

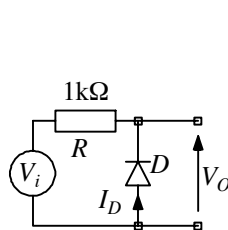
# Diode, Resistor and Capacitor Circuits.

**NOTE:** A pulse described as "long" has a width that is many times the biggest time constant in the circuit of interest. All the pulses used as inputs in this problem sheet have infinitely fast rising and falling edges.

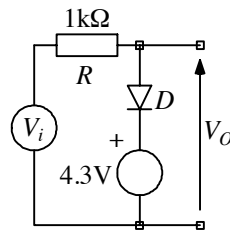
- Q1** For the circuit of figure 1, sketch the  $V_O - V_i$  and  $I_D - V_i$  characteristics that you would expect to observe over the range  $V_i = -10\text{V}$  to  $V_i = +10\text{V}$  if the diode has a forward voltage drop of  $0.7\text{V}$ .

- Q2** For the circuit of figure 2, sketch the waveshape that you would expect to observe if  $V_i$  was a triangular waveshape with a peak value of  $10\text{V}$  (ie, a positive peak of  $10\text{V}$  and a negative peak of  $-10\text{V}$ ) and the diode had a forward voltage drop of  $0.7\text{V}$ .

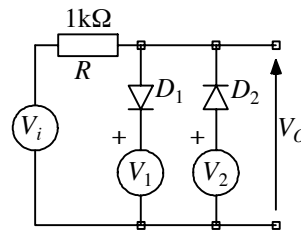
What is the largest value of forward current through the diode?



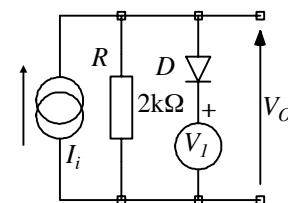
**Figure 1**



**Figure 2**



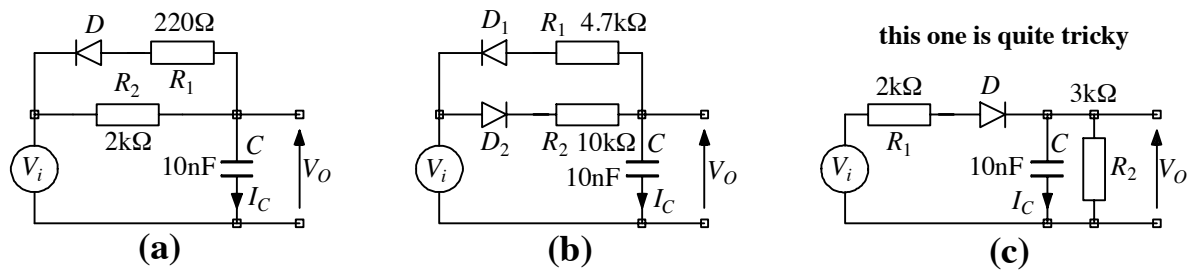
**Figure 3**



**Figure 4**

- Q3** In the circuit of figure 3,  $V_i$  is a triangular wave of  $10\text{V}$  peak whose frequency is to be measured by a system that requires its input signals to lie within the range  $0\text{V}$  to  $3.3\text{V}$  if damage to the system is to be avoided. Assuming the diodes have forward bias voltage drops of  $0.7\text{V}$ , choose values for  $V_1$  and  $V_2$  that will clip those parts of the triangular  $V_i$  that are higher in voltage than  $3.3\text{V}$  and lower in voltage than  $0\text{V}$ .

- Q4** In figure 4,  $V_1 = -2\text{V}$ . Sketch  $V_O$  as a function of  $I_i$  over the range  $I_i = -3\text{mA}$  to  $+3\text{mA}$ .



**Q5** For each of the circuits of figure 5, sketch the response of  $V_o$  and  $I_C$  to a 0V to 10V input pulse with a duration of 100 $\mu$ s. You should assume that the diodes are ideal (ie, 0V forward voltage drop) and take care to label your sketch with salient features such as time constants and aiming levels. In the case of figure 5b you will need to work out the voltage reached by  $V_o$  at the end of the pulse.

In each case write down the exponential form of the rising and falling edge responses and calculate the width of the output pulse, measured in figure 5a and 5c at half its height and measured in 5b at 5V. (*In one of the three circuits the output pulse height is not the same as the input pulse height.*)