DUBLIN CITY UNIVERSITY

September 1998

COURSE:	APPLIED PHYSICS PHYSICS with a LANGUAGE
YEAR:	2
SEMESTER	1
EXAMINATION:	Electronics 1; PS203
EXAMINER:	Dr B. Lawless
DURATION:	2 hours
INSTRUCTIONS:	Answer 4 parts of Question 1 (50 %) and 2 other questions (25 % each)

Question 1. (a) State the Principle of Superposition.
Explain how the principle can be used to determine the current in a circuit in which there are both voltage sources and current sources present.

(b) Sketch the Bode plot for the filter shown in Figure 1. Calculate the ratio of output to input signal for a sinusoidal signal at 1 kHz.

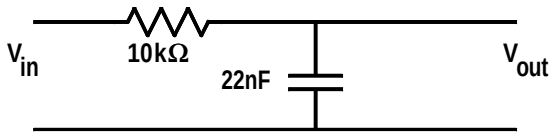

Figure 1: Question 1 (b)

(c) Calculate the complex impedance of

i. A resistor of 1.5 kΩ.

ii. A capacitor of 0.4 μF at 750 Hz

iii. An inductor of 44 mH at 10 kHz.

and plot each of these impedances on a complex impedance diagram.

(d) Calculate the voltages at each of the nodes marked A, B, C, and D in Figure 2.

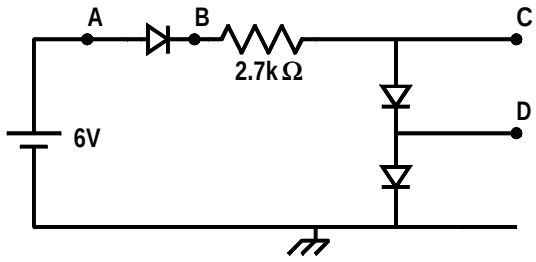

Figure 2: Question 1 (d)

(e) The voltage at the collector in Figure 3 was measured with respect to ground and was $V_C = 4.6$ V. Calculate the current gain, β, for the transistor.

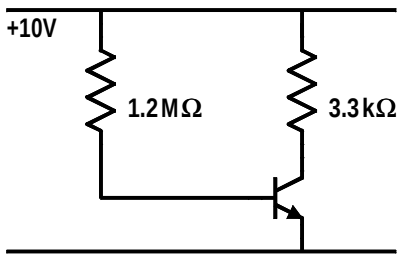

Figure 3: Question 1 (e)

(f) Plot the output voltage from the circuit in Figure 4 as a function of input voltage for input voltages from -3 V to +3 V. Identify the different regions of the plot. The op-amp is powered from ±10 V supplies.

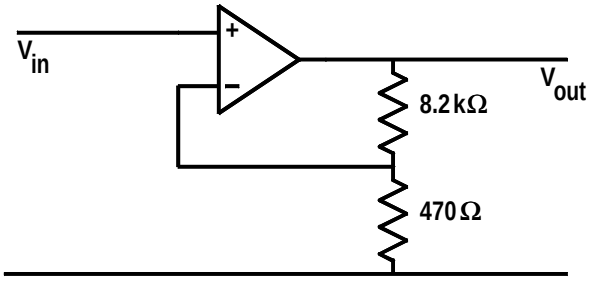

Figure 4: Question 1 (f)

Question 2. Give an account of the operation of a NPN bipolar transistor using diagrams where appropriate.
Explain how a circuit such as that shown in Figure 5 gives small signal gain. Give sketches of the voltage waveforms which you would expect to observe with an oscilloscope, in turn, to the input, the base, the collector and the output of this circuit.

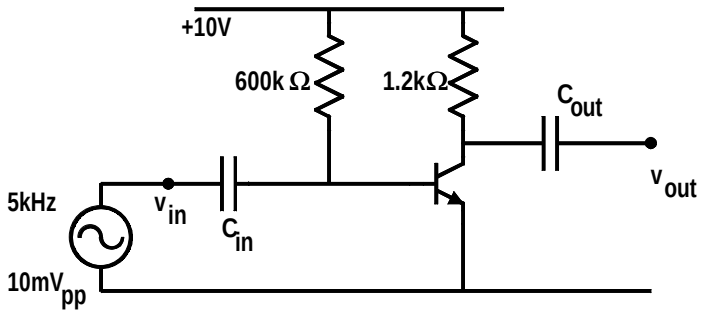

Figure 5: Question 2

Question 3. (a) Explain what is meant by "Negative feedback" and show how negative feedback is used to determine the amplification in amplifier circuits.

(b) Calculate suitable component values such that the circuit shown in Figure 6 will have an output whch is given by:

$$V_{out} = -2.3V_1 - 4.6V_2 - 5.6V_3$$

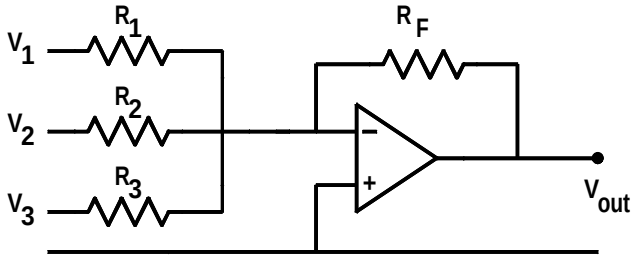

Figure 6: Question 3

Question 4. (a) Explain the operation of a junction diode. What is meaant by the term "knee voltage"? Sketch the I-V characteristics for a silicon diode.

(b) Explain the operation of the bridge rectifier circuit shown in Figure 7. What will be the output voltage from the rectifier circuit?

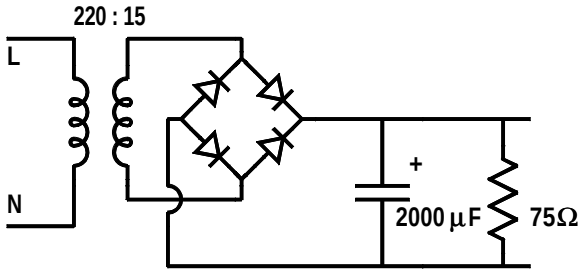

Figure 7: Question 4(b)