DUBLIN CITY UNIVERSITY

January 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) Calculate the resistance which would be measured between points A and B in the circuit. All resistors are 1 kΩ.

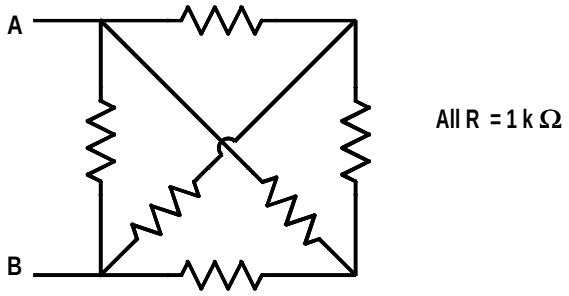

Figure 1: Question 1 (a)

(b) Sketch the Bode plot for the filter shown in Figure 2. Calculate the ratio of output to input signal for a sinusoidal signal at 2 kHz.

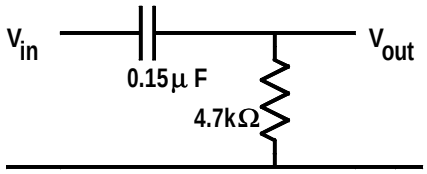

Figure 2: Question 1 (b)

(c) Three circuits, having the responses shown in Figure 3, are connected in series. Sketch the response of the composite circuit. Estimate the response, in dBs, at a frequency of 2 kHz.

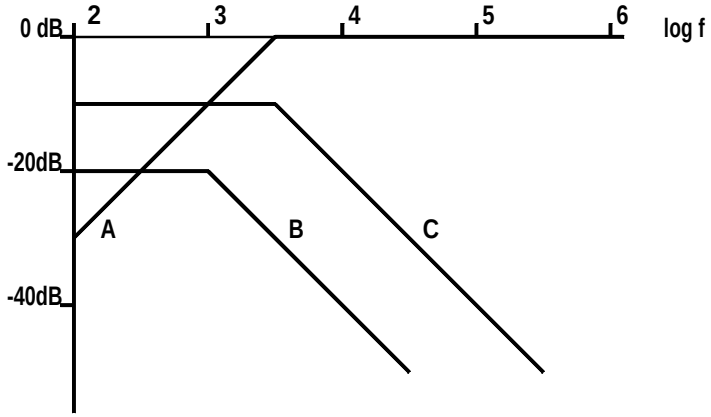

Figure 3: Question 1 (c)

(d) Calculate the voltages at each of the nodes marked A, B, C, D and E in Figure 4.

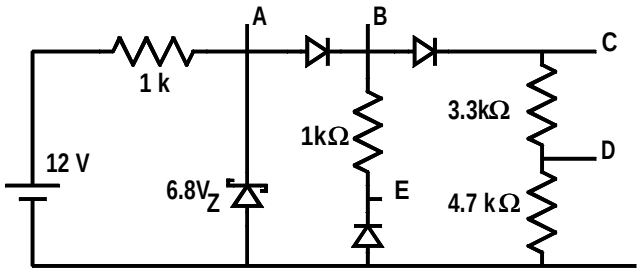

Figure 4: Question 1 (d)

(e) The voltage at the collector in Figure 5 was measured with respect to ground and was $V_B = 6.2\,V$. Calculate the current gain, β, for the transistor.

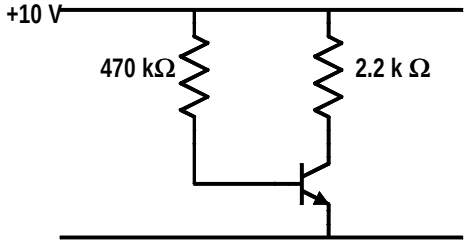

Figure 5: Question 1 (e)

(f) Plot the output voltage from the circuit in Figure 6 as a function of input voltage. Identify the different regions of the plot. The op-amp is powered from $\pm 10\,V$ supplies.

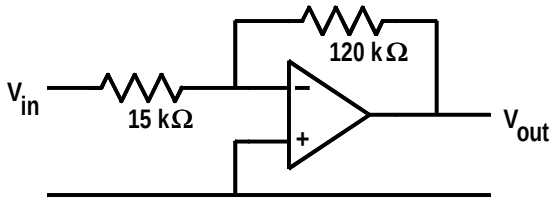

Figure 6: Question 1 (f)

Question 2. State Thévenin's theorem and explain the concept of a voltage source.
State the Principle of Superposition and explain how voltage and current sources are treated in applying the principle to electronic circuits.
Calculate the current that flows in the 120 Ω resistor in Figure 7.

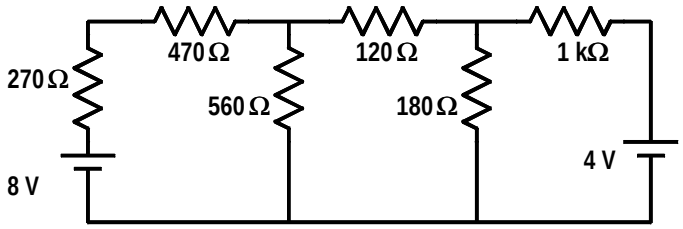

Figure 7: Question 2

Question 3. (a) Explain why the circuits shown in Figure 8 can be used to measure the I_{DSS} and $V_{GS(off)}$ for a JFET.

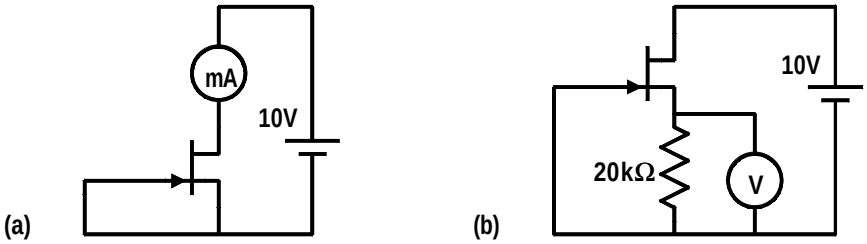

Figure 8: Question 3 (a)

(b) Explain what is meant by "small signal voltage gain".
Calculate the component values and the supply voltage for the circuit in Figure 9 such that the amplifier will have a small signal gain of -7.
The JFET has $g_m = 3000\,\mu$S, $I_{DSS} = 6$ mA and $V_{GS(off)} = 3.3$ V.

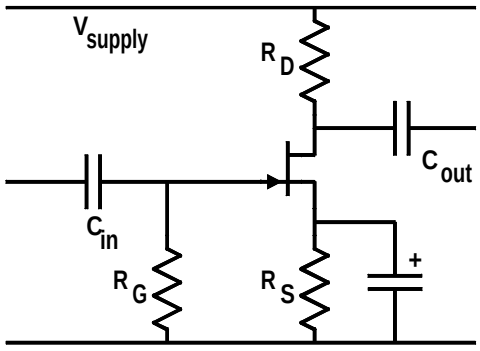

Figure 9: Question 3 (b)

Question 4. (a) Derive the equation $A_V = 1 + \frac{R_1}{R_2}$ which gives the voltage gain of a noninverting amplifier employing an op-amp. Explain any rules which you may use in your derivation. Sketch the circuit.

(b) Analyse the operation of the Differential amplifier shown in Figure 10 and obtain an equation for the output voltage in terms of the input voltages and the circuit resistors.

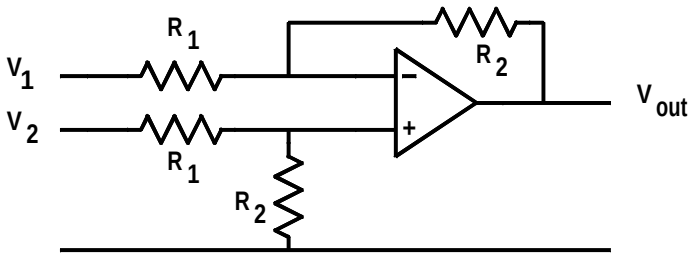

Figure 10: Question 4(b)