DUBLIN CITY UNIVERSITY

January 2003

COURSE:	APPLIED PHYSICS PHYSICS with French PHYSICS with German
YEAR:	2
SEMESTER	1
EXAMINATION:	PS203: Electronics 1
EXAMINER:	Dr B. Lawless (5300)
DURATION:	2 hours
INSTRUCTIONS:	Answer 5 parts of Question 1 (50 %) and 2 other questions (25 % each) Do not turn over this page until instructed to do so.
NUMBER OF PAGES	9 (including this cover page.)

Question 1. Answer five parts of this question.

(a) Calculate the voltages which would be measured, with respect to ground, at the nodes A, B, C, D and E in the circuit in Figure 1.

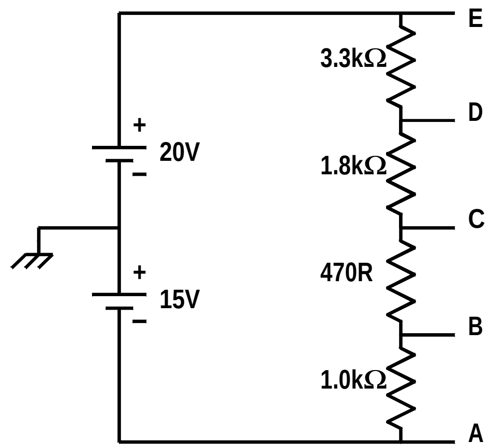

Figure 1: Question 1 (a)

(b) Calculate the voltages which would be measured , with respect to ground, at the nodes A, B, C, D and E in the circuit in Figure 2.

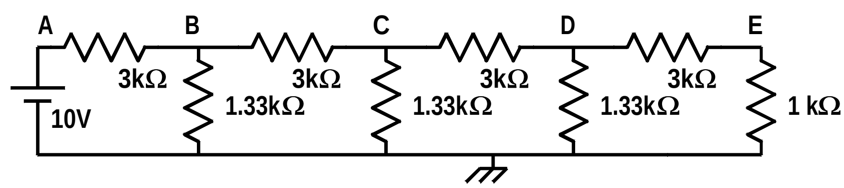

Figure 2: Question 1 (b)

(c) Calculate the current which flows in the circuit shown in Figure 3 when the waveform of the signal from the function generator is sinusoidal, the amplitude is 6 V and the frequency is 3.0 kHz.
What modifications would you make to the circuit in order to measure this current?

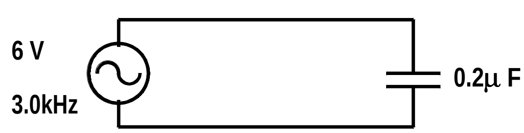

Figure 3: Question 1 (c)

(d) Calculate the complex impedance of the series circuit shown in Figure 4 and plot the impedance on a complex impedance diagram. The frequency is 2.0 kHz.

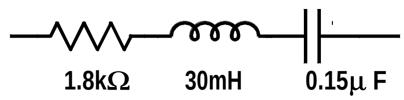

Figure 4: Question 1 (d)

(e) Calculate the complex impedance of the parallel circuit shown in Figure 5 and plot the impedance on a complex impedance diagram. The frequency is 1.5 kHz.

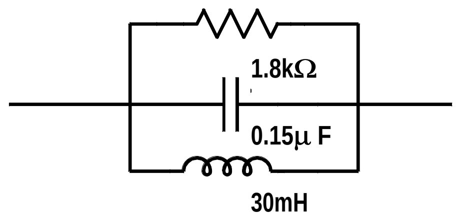

Figure 5: Question 1 (e)

(f) Give a scaled sketch of the waveform which you would observe when an oscilloscope is connected to the circuit in Figure 6 when Channel A is connected to node A and Channel B is connected to node B. The frequency of the signal from the function generator is 2 kHz and the amplitude is 2.5 V.

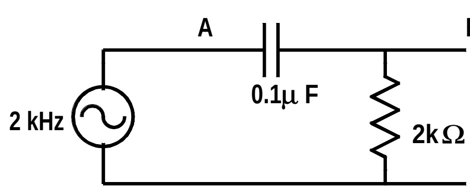

Figure 6: Question 1 (f)

(g) Calculate and sketch the frequency response curves for the filter circuits shown in Figure 7 (a) and (b). Explain the response curve which is obtained when these filters are combined as shown in Figure 7 (c). Note that C = 0.1μF and R = $1.0\text{k}\Omega$

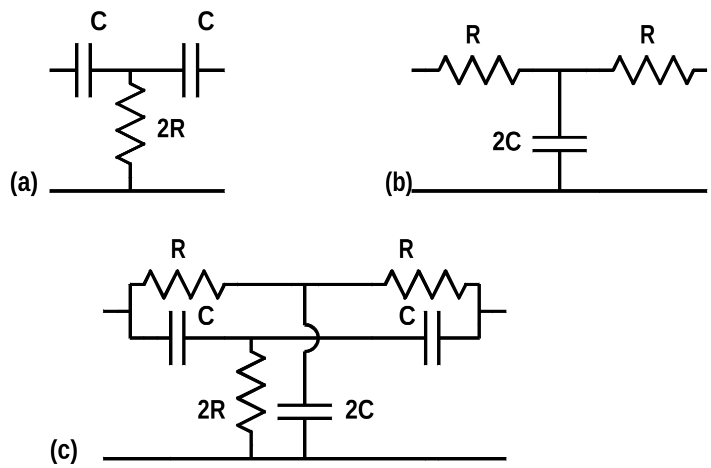

Figure 7: Question 1 (g)

(h) Calculate the voltages, measured with respect to ground, at nodes A, B, C, D and E in the circuit shown in Figure 8

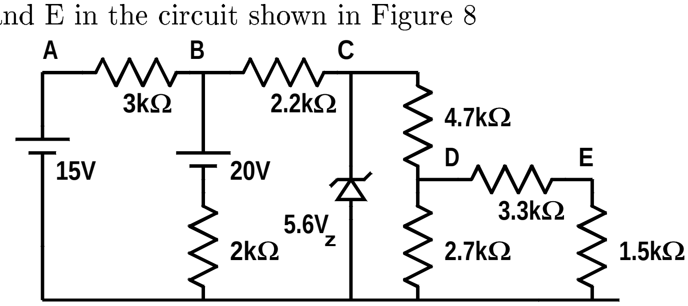

Figure 8: Question 1 (h)

Question 2. Calculate the emitter, base and collector voltages and currents for each of the two amplifiers shown in Figure 9.
Calculate the small signal voltage gain of the circuits.
The current gain of the transistors is $\beta = 250$.

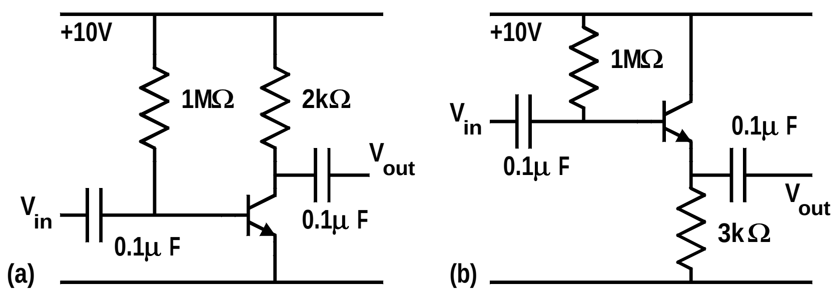

Figure 9: Question 2

Question 3. Give an account of the construction and operation of a junction field effect transistor (JFET).
Explain one method of choosing the supply voltage, the resistor values and the capacitor values in the circuit shown in Figure 10 so that the amplifier has a gain of -6.
The JFET used in the circuit has $g_m = 2000\,\mu$S, $V_{GS(off)} = 3.5$ V and $I_{DSS} = 5$ mA

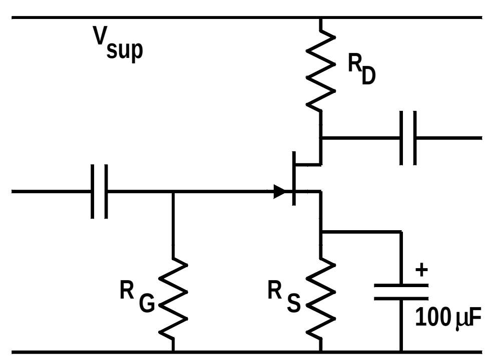

Figure 10: Question 3

Question 4. (a) Show that the gain of a negative feedback system such as that shown in Figure 11 is given by $A_V = \frac{1}{\beta}$ where β is the feedback fraction.

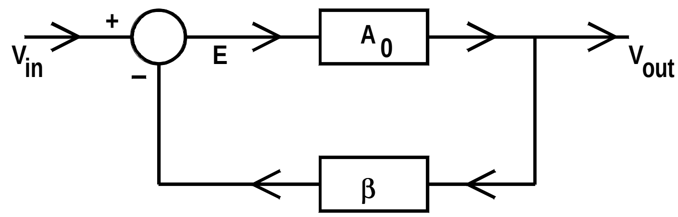

Figure 11: Question 4 (a)

(b) Apply this general principle and show that the gain of the amplifier in Figure 12 is given by $A_V = 1 + \frac{R_1}{R_2}$

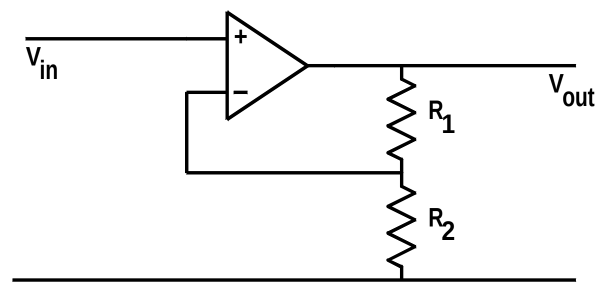

Figure 12: Question 4 (b)

(c) Determine suitable values of R_1 and R_2 so that the amplifier has a gain of +21.

Question 5. (a) Give sketches of opamp circuits for each of the following applications and explain the operation of the circuits.

i. Voltage adder

ii. Voltage integrator

iii. Voltage differentiator

(b) Explain the operation of the circuit shown in Figure 13 and obtain the mathematical expression which gives the output voltage in terms of the input voltage.

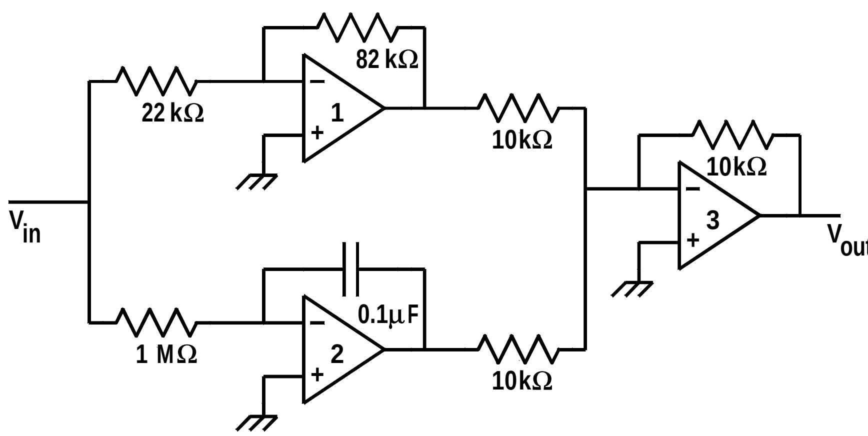

Figure 13: Question 5