DUBLIN CITY UNIVERSITY

January 2002

COURSE:	APPLIED PHYSICS PHYSICS with a LANGUAGE
YEAR:	2
SEMESTER	1
EXAMINATION:	Electronics 1; PS203
EXAMINER:	Dr B. Lawless
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	8 (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, E, F and G in the circuit in Figure 1.

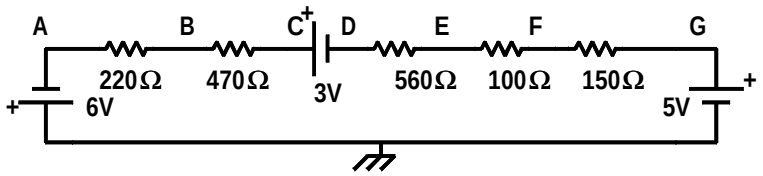

Figure 1: Question 1 (a)

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

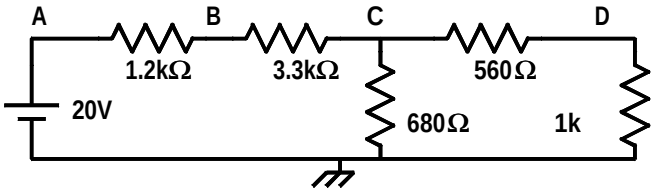

Figure 2: Question 1 (b)

(c) 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 3.

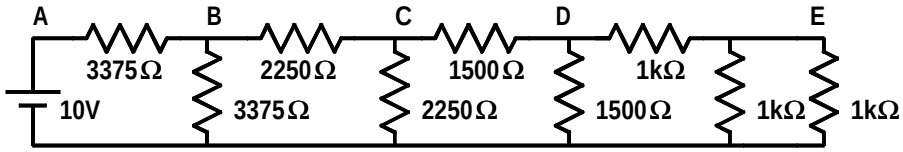

Figure 3: Question 1 (c)

(d) A sinusoidal voltage waveform of amplitude 15 V is applied across a 1μ F capacitor. A sensing resistor of value 5 Ω is used to display the current waveform on an oscilloscope. Give a scaled sketch of the voltage and current waveforms which would be displayed on the oscilloscope.

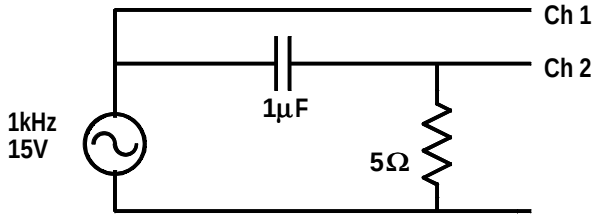

Figure 4: Question 1 (d)

(e) Give the relationship between the input and output voltages in terms of the impedances Z_1 and Z_2 for the circuit in Figure 5 (a).
Calculate the magnitude and relative phase of the current and voltage waveforms for the circuit in Figure 5 (b).

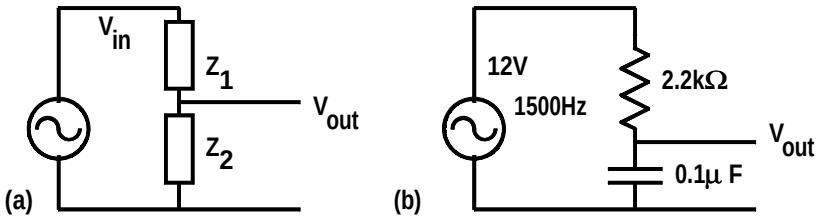

Figure 5: Question 1 (e)

(f) Sketch the Bode plot for the filter shown in Figure 6.

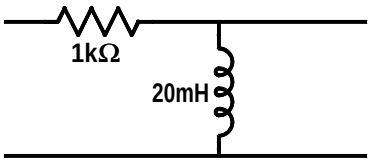

Figure 6: Question 1 (f)

(g) Calculate the current which flows in the 220 Ω resistor in the circuit shown in Figure 7.

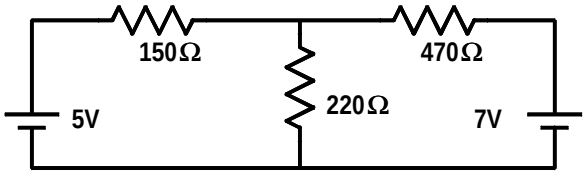

Figure 7: Question 1 (g)

(h) Calculate the voltages at nodes A, B and C in the circuit shown in Figure 8 for input voltages of -15V̇, +10 V and +50 V.

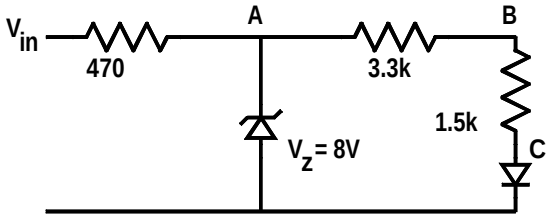

Figure 8: Question 1 (h)

Question 2. Calculate the emitter, base and collector voltages and currents for the amplifier shown in Figure 9.
Calculate the small signal voltage amplification of the circuit.
Give a scaled sketch of the output voltage from the circuit when a sinusoidal voltage waveform of 1.5 mV_{pp} and frequency 1 kHz is applied at the input.
The current gain of the transistor was measured and found to be $\beta = 230$.

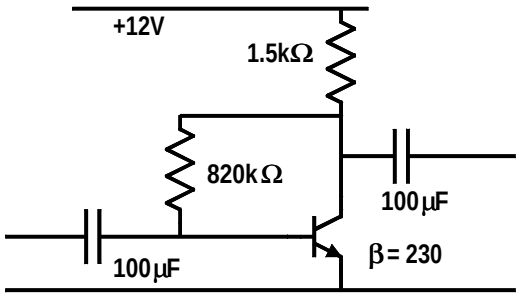

Figure 9: Question 2

Question 3. Calculate the voltage at each of the collectors of the differential amplifier circuit shown in Figure 10.
A DC voltage of 2.5 mV is applied to Input 1 and a sinusoidal voltage of amplitude 1.3 mV and frequency 1 kHz is applied to Input 2. Give a scaled sketch of the voltage which would be observed using an oscilloscope connected to colector 2 (Vout) as shown in Figure 10.

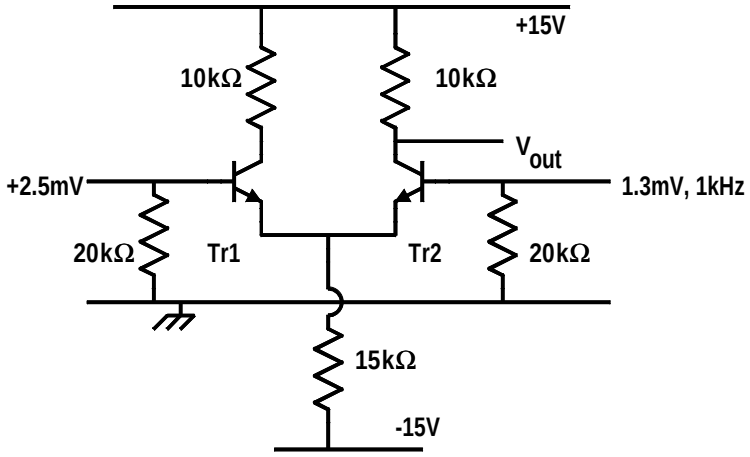

Figure 10: Question 3

Question 4. Explain the operation of the Inverting Adder circuit shown in Figure 11.
Derive the equation which relates the output voltage to the input voltages V_1, V_2 and V_3.
Give a scaled sketch of the output voltage waveform which would be observed on an oscilloscope when $V_1 = +0.2\,V$, $V_2 = -1.5\,V$ and $V_3 = 2.0\sin(2\pi 500t)\,V$.

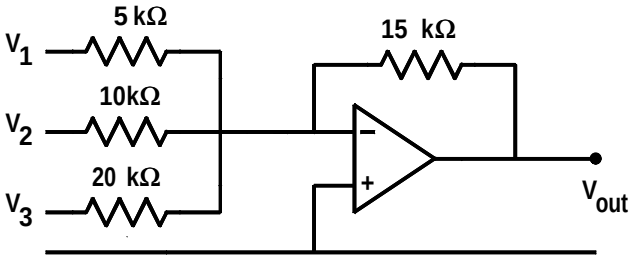

Figure 11: Question 4

Question 5. Explain how the circuits in Figure 12 (a) and (b) allow the values of I_{DSS} and $V_{GS(off)}$ for a JFET to be easily measured.

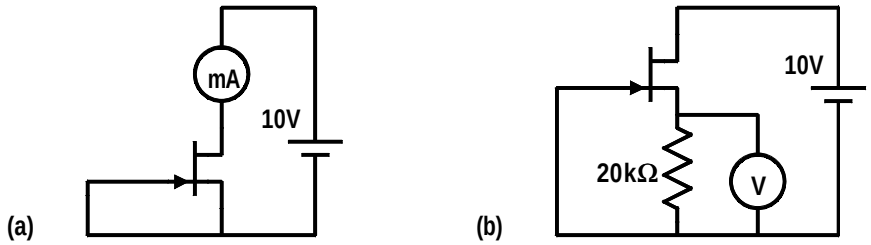

Figure 12: Question 5

Calculate the component values if the amplifier shown in Figure 13 is to have a gain of -5.
The JFET used has $IDSS = 7.5\,\text{mA}$ and $V_{GS(off)} = 3.5\,\text{V}$.

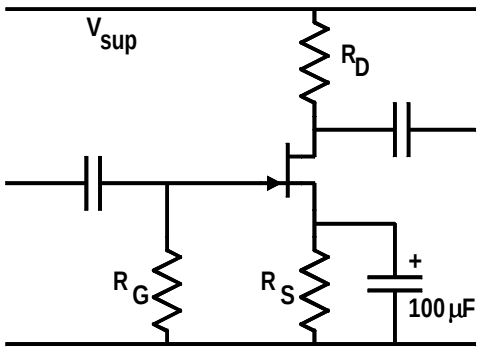

Figure 13: Question 5