DUBLIN CITY UNIVERSITY

Autumn 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	5 (including this cover page.)

Question 1. Answer five parts of this question.

(a) Calculate the required value of resistor, R, if the input voltage to the circuit in Figure 1 is 9.3 V and the output voltage is to be 2.3 V.

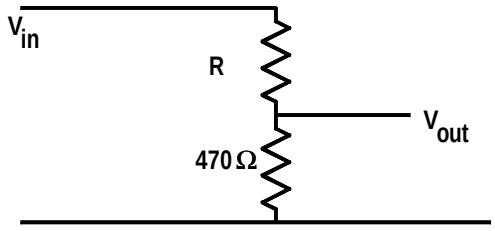

Figure 1: Question 1 (a)

(b) Calculate the ratio of the outout to input voltage for the circuit in Figure 2.
Convert the calculated voltage ratio to dBs.

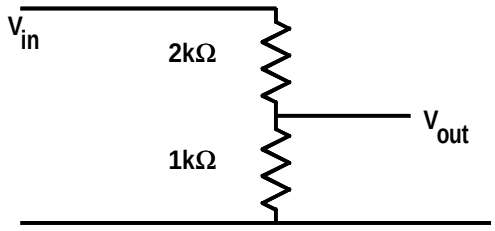

Figure 2: Question 1 (b)

(c) An alternating current having a sinusoidal waveform at a frequency of 420 Hz and amplitude 29 mA flows through a 250 mH inductor. Calculate the voltage across the inductor.
Will the voltage be in phase with the current?

(d) Calculate the complex impedance when 220 Ω, 0.3 H and 1.0 μF are connected in series and the frequency is 500 Hz.

(e) Calculate the amplitude of the output voltage from the circuit in Figure 3 when the input has an amplitude of 3.6 V and the frequency is

i. 300 Hz

ii. 10 kHz

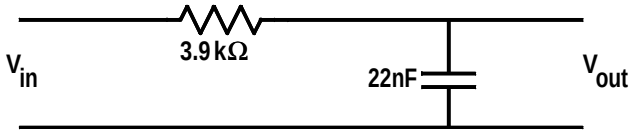

Figure 3: Question 1 (e)

(f) Calculate the voltage at each of the nodes of the circuit shown in Figure 4. The input voltage is 25 V.

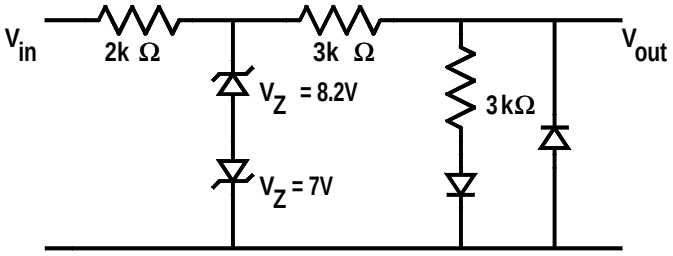

Figure 4: Question 1 (f)

(g) State Thévenin's theorem.
Calculate the voltage which will be measured across a 1 kΩ resistor which is connected across a battery which has an open circuit voltage of 9.2 V and an internal resistance of 150 Ω.

(h) Calculate the current gain, β, of the transistor in the circuit shown in Figure 5 if a voltage of 4.1 V is measured between the emitter and the collector.

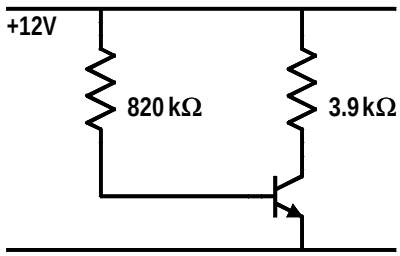

Figure 5: Question 1 (h)

Question 2. Calculate the emitter, base and collector voltages for the circuit shown in Figure 6.
The current gain of the transistor used in the circuit was $\beta = 180$.
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.

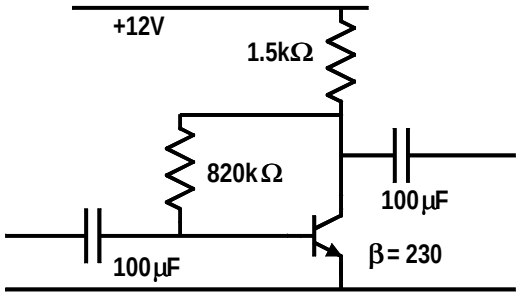

Figure 6: Question 2

Question 3. Give an account of the construction and operation of a Junction Field Effect Transistor (JFET) using diagrams where appropriate.
Explain the meaning of the standard symbols, I_{DSS}, V_{GS}, I_D and g_m.
A circuit for a small signal JFET amplifier is shown in Figure 7. Explain the operation of the circuit. Give rough values for the voltages which you would expect to measure at the source, gate and drain of the JFET in the circuit.

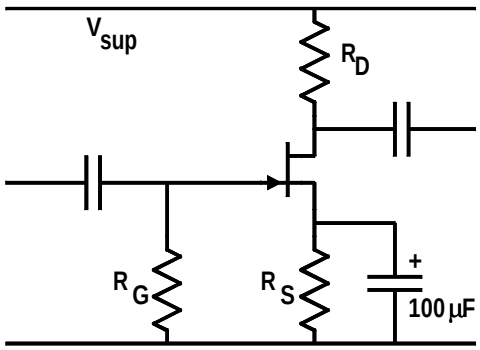

Figure 7: Question 3

Question 4. (a) Explain the operation of the inverting amplifier shown in Figure 8. Calculate the voltage gain when $R_f = 800\,\mathrm{k}\Omega$ and $R_{in} = 7.5\,\mathrm{k}\Omega$.

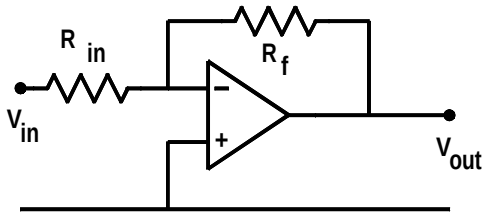

Figure 8: Question 4(a)

(b) Derive the equation relating the input and the output voltage for the integrator circuit shown in Figure 9.

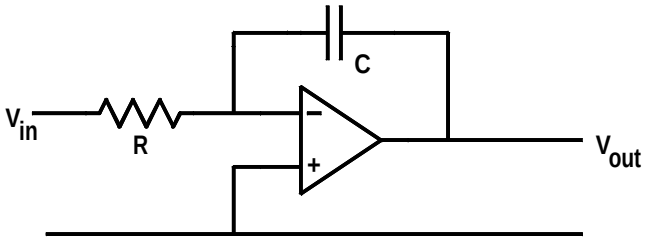

Figure 9: Question 4(b)

Question 5. Give an account of the various stages which occur in the process of designing and manufacturing a printed circuit board.
Give an account of the photolithographic process which occur in the manufacture of transistors and integrated circuits.