DUBLIN CITY UNIVERSITY

August 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	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 node X and at V_{OUT} in the circuit shown in Figure 1. The input voltage is +8.7 V.

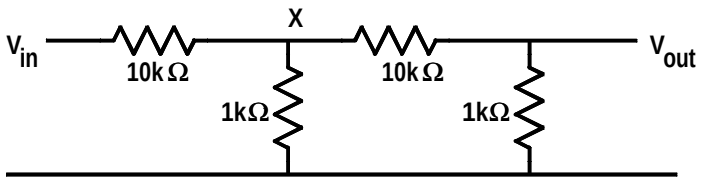

Figure 1: Question 1 (a)

(b) Calculate the resistance which would be measured between nodes A and B of the circuit shown in Figure 2. All resistors are 1 kΩ.

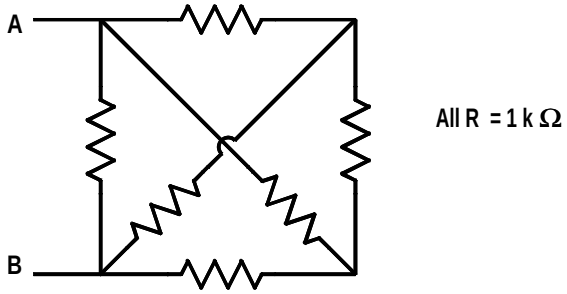

Figure 2: Question 1 (b)

(c) Calculate the voltages at each of the nodes of the circuit shown in Figure 3 for an input voltage of +20 V.

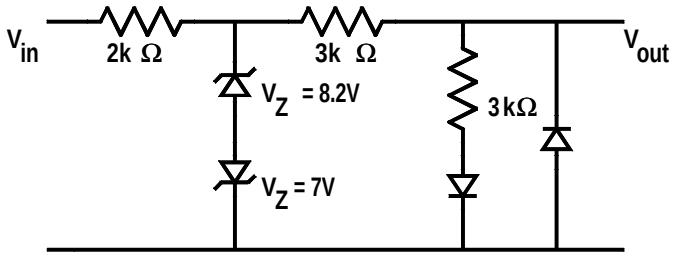

Figure 3: Question 1 (c)

(d) Calculate the voltage waveform which you would observe with an oscilloscope connected to node A of the circuit shown in Figure 4 when the voltage at node B is +15 V.

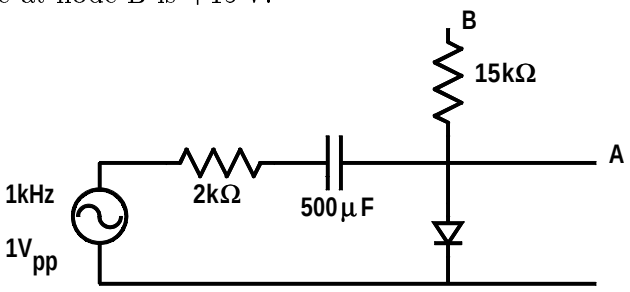

Figure 4: Question 1 (d)

(e) Calculate the voltages at the base and collector and the emitter, base and collector currents for the circuit shown in Figure 5 when the current gain of the transistor is $\beta = 170$.

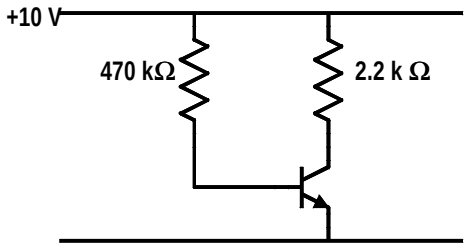

Figure 5: Question 1 (e)

(f) Calculate the output voltage from the circuit shown in Figure 6.

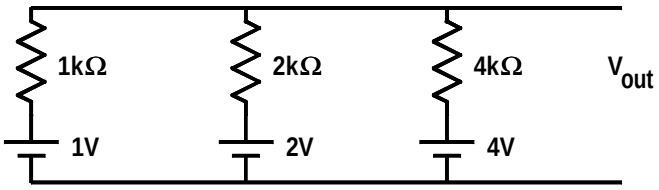

Figure 6: Question 1 (f)

(g) Calculate the amplitude of the output voltage from the circuit shown in Figure 7 when the input voltage has an amplitude is 4.7 V for input frequencies of;

i. 200 Hz
ii. 5 kHz
iii. 100 kHz

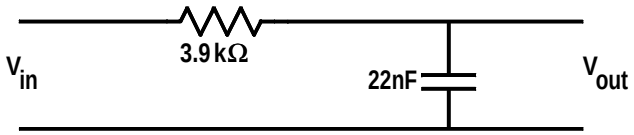

Figure 7: Question 1 (g)

(h) Calcuate the current which flows throug a 0.2 H inductor when a sinusoidal waveform voltage of amplitude 3.7 V and frequency of 800 Hz is applied across the inductor.

Question 2. Calculate the emitter, base and collector voltages for the circuit shown in Figure 8. The current gain, β for the transistor is $\beta = 230$.
What is meant by "small signal voltage gain" of the amplifier?
Calculate the small signal voltage gain for the amplifier.
Sketch the voltage waveforms which would be observed on an oscilloscope connected to points A, B, C, and D in the circuit when an input sinusoidal signal of amplitude 1 mV and frequency 1 kHz is applied to the input.

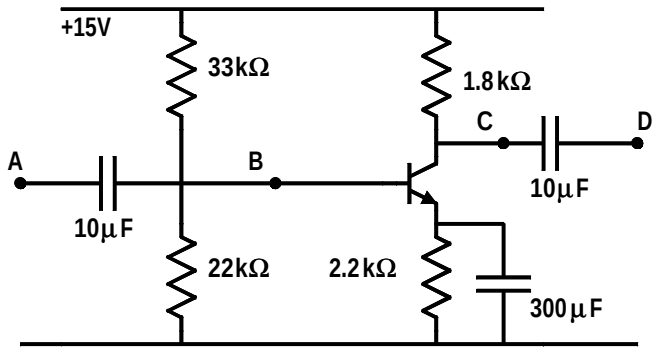

Figure 8: Question 2

Question 3. What do the terms I_{DSS} and $V_{GS(off)}$ represent for a FET?
Explain how the circuits shown in Figure 9 can be used to measure the I_{DSS} and $V_{GS(off)}$ for a FET.
Draw a circuit for a common source FET amplifier and explain how you would bias the FET into the mid point of its operating range.
Calculate component values for s JFET amplifier which has a gain of -5 and which uses a 2N3819 n channel JFET having a $g_m = 2500\,\mu$S and an $I_{DSS} = 6$ mA.

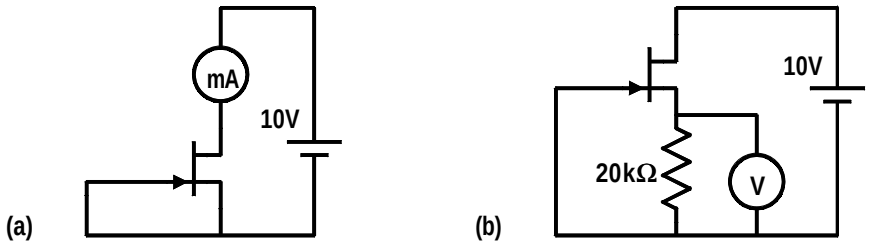

Figure 9: Question 3

Question 4. (a) Explain the operation of the inverting amplifier shown in Figure 10. Calculate the voltage gain when $R_f = 800\,\text{k}\Omega$ and $R_{in} = 7.5\,\text{k}\Omega$.

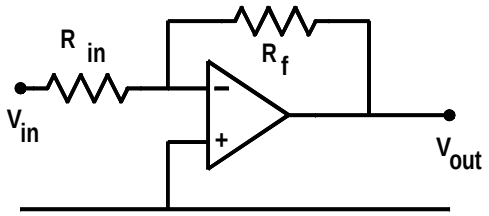

Figure 10: Question 4(a)

(b) Derive the equation relating the input and the output voltage for the integrator circuit shown in Figure 11.

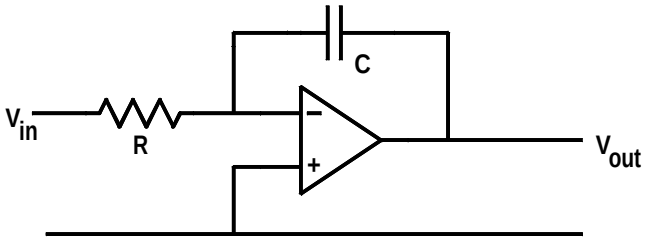

Figure 11: Question 4(b)

Question 5. (a) Explain the operationof the inverting adder circuit shown in Figure 12. Derive the equation for the output voltage in terms of the input voltages and the resistors.

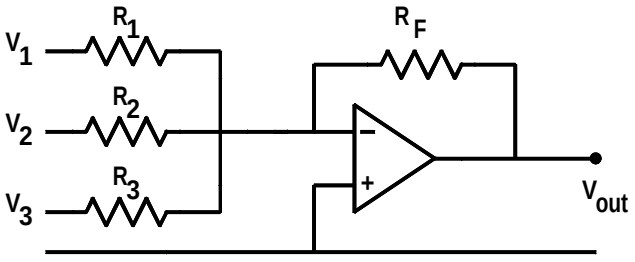

Figure 12: Question 5

(b) Calculate the output voltage from this adder circuit when:
$V_1 = +0.3\,\text{V}$, $V_2 = -0.35\,\text{V}$, $V_3 = +0.22\,\text{V}$ and
$R_1 = 5.6\,\text{k}\Omega$, $R_2 = 3.3\,\text{k}\Omega$, $R_3 = 3.9\,\text{k}\Omega$, $R_F = 10\,\text{k}\Omega$.