DUBLIN CITY UNIVERSITY

January 2006

COURSE:	APPLIED PHYSICS PHYSICS with French PHYSICS and ASTRONOMY SHSA00 ECSAX
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 at nodes A, B, C, D and E in the circuit in Figure 1. Calculate the voltage difference between nodes B and D.

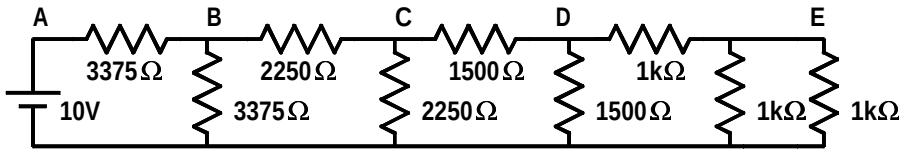

Figure 1: Question 1 (a)

(b) Calculate the current in the 7Ω resistor in the circuit shown in Figure 2

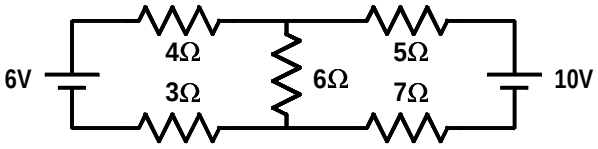

Figure 2: Question 1 (b)

(c) Give a scaled sketch of the frequency responses of the three filters shown in Figure 3.

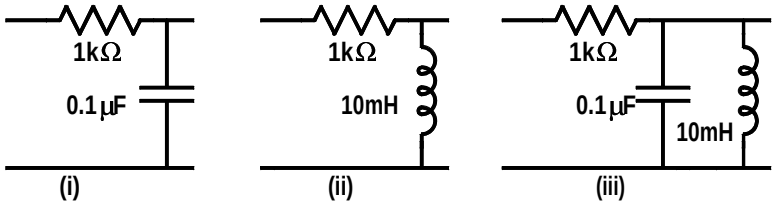

Figure 3: Question 1 (c)

(d) Calculate the Thévenin eqivalent of the circuit shown in Figure 4.

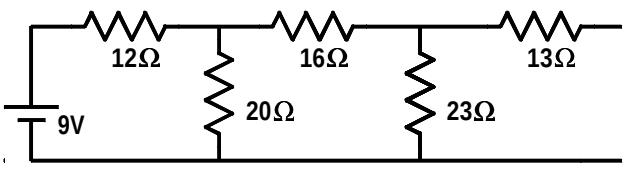

Figure 4: Question 1 (d)

(e) Give a scaled sketch of the complex impedance diagram for the circuit in Figure 5 for frequencies of 500Hz and 2.3kHz.

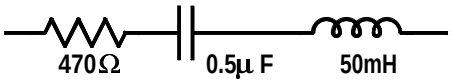

Figure 5: Question 1 (e)

(f) Calculate the voltages at nodes A, B and C for the circuit in Figure 6 for input voltages of +15V and -12V.

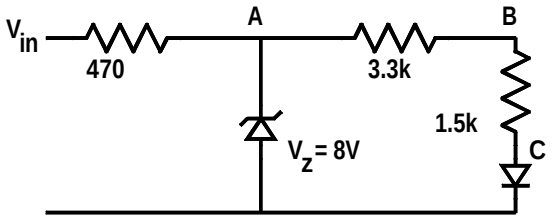

Figure 6: Question 1 (f)

(g) Calculate the current which flows in the circuit in Figure 7.
Why might the current to be less than this calculated value in practice?
How would you measure the current?

Figure 7: Question 1 (g)

(h) Calculate the emitter, base and collector voltages for the circuit in Figure 8. The current gain, β, for the transistor is 150.

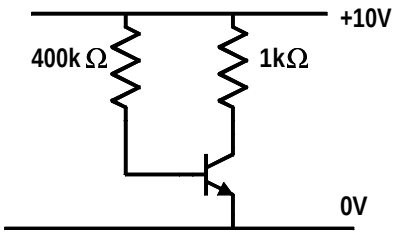

Figure 8: Question 1 (h)

Question 2. (a) A 1kHz 2.5V amplitude sinusoidal signal is applied at the input of the circuit shown in Figure 9. Calculate the amplitude and phase of the signal which you would observe on an oscilloscope connected to the output.

(b) Explain how Fourier series can be used to determine the response of a filter circuit to an arbitrary, periodic waveform.

(c) A $1V_{pp}$, 20kHz square waveform is applied to the input to the filter shown in Figure 9. Give an approximate sketch of the waveform which you would observe on an oscilloscope connected to the output of the filter. Explain your reasons for drawing the waveform in that shape.

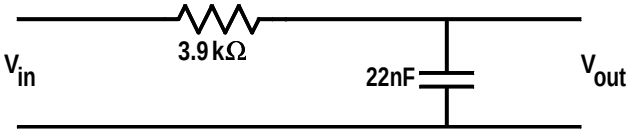

Figure 9: Question 2

Question 3. A 10mV amplitude, 5kHz sinusoidal signal is applied in turn to each of the inputs of the two circuits shown in Figure 10. Calculate the amplitude of the output signal in each case and sketch the waveform which would be observed on an oscilloscope connected to the output. Use $\beta = 100$.

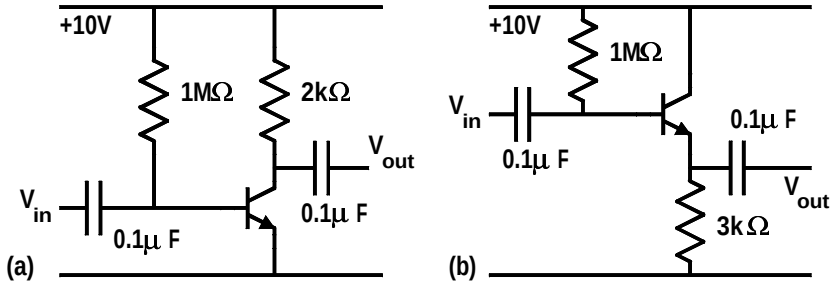

Figure 10: Question 3

Question 4. (a) Explain how the circuits shown in Figure 11 can be used to determine the Drain Saturation Current, I_{DSS}, and the Pinch Off Voltage, $V_{GS(off)}$, for the JFET.

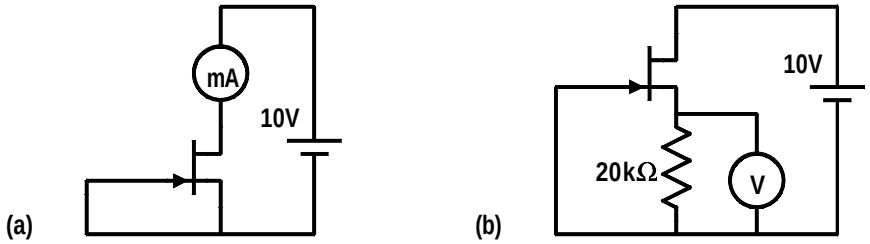

Figure 11: Question 4 (a)

(b) Calculate the voltage gain of the amplifier shown in Figure 12. Take $I_{DSS} = 4\text{mA}$ and $V_{GS(off)} = -3.5\text{V}$.

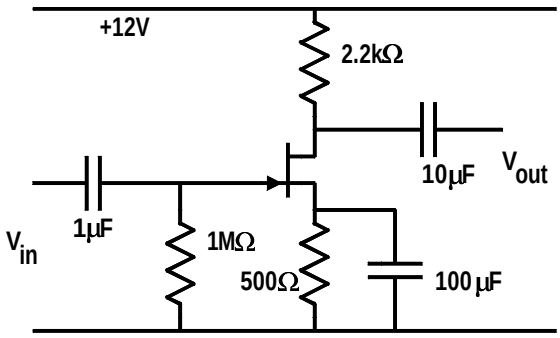

Figure 12: Question 4 (b)

Question 5. (a) Derive the equation for the gain of the inverting amplifier shown in Figure 13.

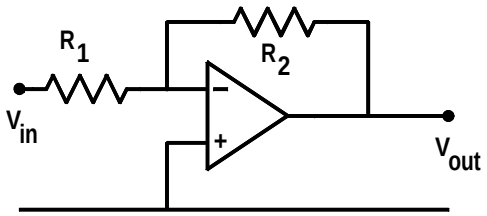

Figure 13: Question 5 (a)

(b) Give a scaled sketch of the output from the circuit of Figure 14 when $V_1 = +0.3\,V$, $V_2 = -2.0\,V$ and $V_3 = 1.5\sin(6000t)\,V$.

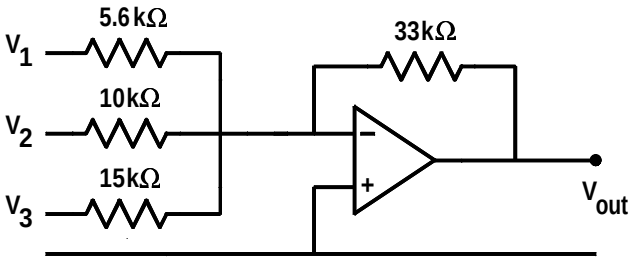

Figure 14: Question 5 (b)