DUBLIN CITY UNIVERSITY

January 2000

COURSE:	APPLIED PHYSICS PHYSICS with a LANGUAGE Applied Languages Exchange Computer Applications Exchange
YEAR:	2
SEMESTER	1
EXAMINATION:	Electronics 1; PS203
EXAMINER:	Dr B. Lawless
DURATION:	2 hours
INSTRUCTIONS:	Answer 4 parts of Question 1 (50 %) and 2 other questions (25 % each)

Do not turn over this page
until instructed to do so.

Question 1. Answer four parts of this question.

(a) A sinusoidal waveform of amplitude 1.3 V is applied to the input of the network shown in Figure 1. Calculate the amplitude of the output voltage waveform and sketch the waveforms which would be observed on an oscilloscope with the input connected to Channel A and the output connected to Channel B.
Calculate the attenuation of the circuit in dB.

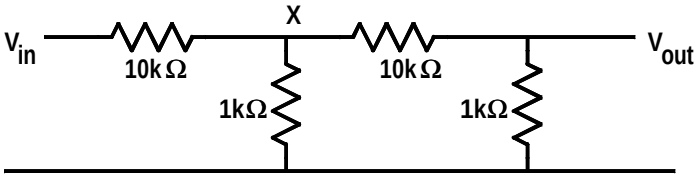

Figure 1: Question 1 (a)

(b) Calculate the attenuation of each of the filters shown in Figure 2 for a sinusoidal signal at a frequency of 2.3 kHz.
Sketch the frequency response of each filter.

Figure 2: Question 1 (b)

(c) The amplitude of a particular sinusoidal waveform is $V_0 = 3.4\,\text{V}$, the frequency is $f = 245\,\text{Hz}$ and the phase is $\phi = 0.26\,\text{rad}$.
Calculate the value of the voltage at times 0 s, 8.4 ms, 0.16 s and 3.2 s.

(d) Calculate the current which flows in each of the resistors in the circuit shown in Figure 3.

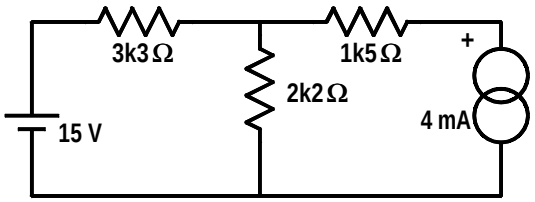

Figure 3: Question 1 (d)

(e) Estimate, by sketching, the relative amplitudes of the first three Fourier components of each of the waveforms shown in Figure 4. The period of each of the waveforms is 1 ms.

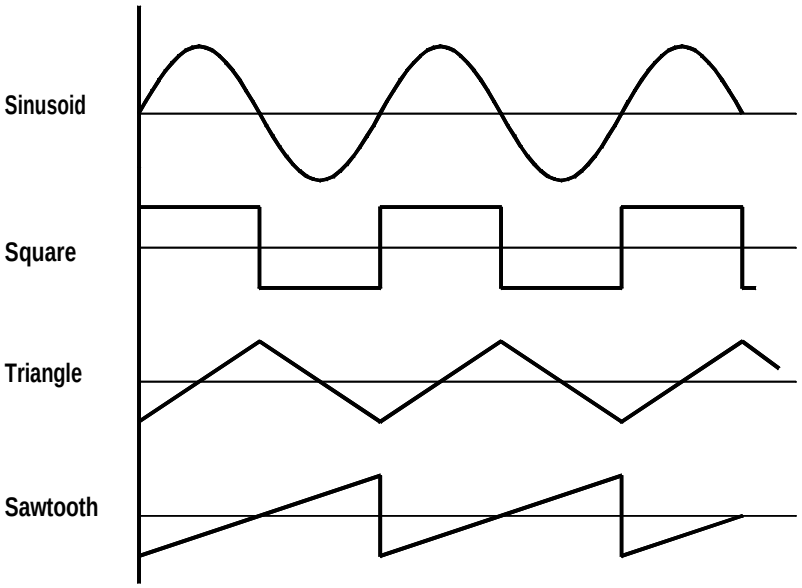

Figure 4: Question 1 (e)

(f) Calculate the voltage at each of the nodes of the circuit shown in Figure 5 when the input voltage is +17 V.

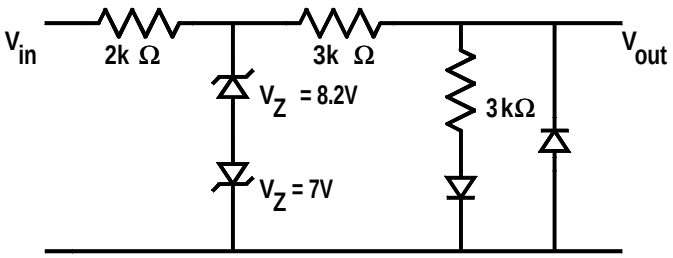

Figure 5: Question 1 (f)

Question 2. Calculate the DC voltages at the emitter, base and collector of the transistor in the circuit of Figure 6 when a transistor having a current gain of $\beta = 200$ is used.
Calculate the small signal voltage gain.
A small signal of 2.4 mV sinusoidal waveform at a frequency of 900 Hz is applied at the input. Sketch the voltage waveforms which would be observed on an oscilloscope connected to the input, the base, the collector and the output of the circuit.

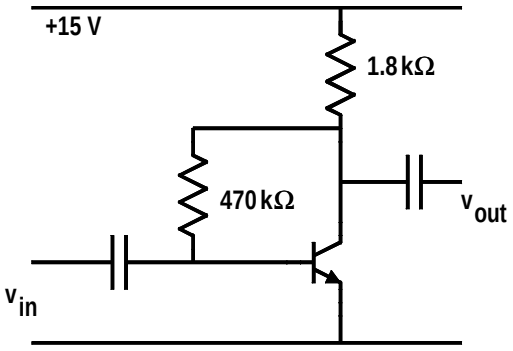

Figure 6: Question 2

Question 3. Give an account of the construction of a Junction Field Effect Transistor.
Sketch the important characteristic curves for an n channel JFET and discuss how the parameters $V_{GS(off)}$, V_P, I_{DSS} and g_m are obtained from these characteristic curves.
Calculate suitable values for the resistors in the circuit shown in Figure 7 if the circuit is to have a small signal voltage gain of -9 given that the JFET used has $V_{GS(off)} = -3.2\,\text{V}$, $I_{DSS} = 5.6\,\text{mA}$ and $g_m = 3000\,\mu\text{S}$.

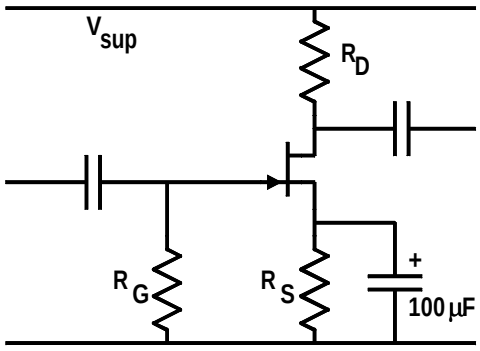

Figure 7: Question 3

Question 4. (a) Derive an expression for the gain of the amplifier circuit shown in Figure 8i and select suitable component values so that the circuit has a voltage gain of $A_V = -30$ and an input resistance of 5.6 KΩ. What is the significance of the $-$ sign in $A_V = -30$?

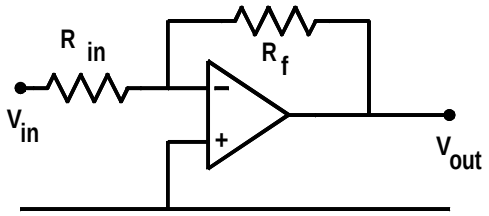

Figure 8: Question 4(a)

(b) Derive an expression for the output from the circuit in Figure 9. Calculate the output for a sinusoidal input signal of amplitude 10 mV at a frequency of 820 Hz when $R_f = 100\,\text{k}\Omega$ and $C = 0.1\,\mu\text{F}$.
What changes will occur when the input frequency is increased from 820 Hz to 1500 Hz?

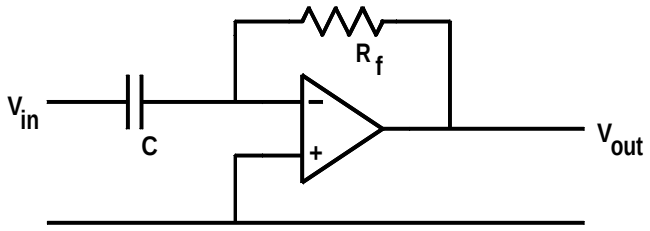

Figure 9: Question 4(b)