DUBLIN CITY UNIVERSITY

Autumn 1999

COURSE:	APPLIED PHYSICS PHYSICS with a LANGUAGE
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)

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until instructed to do so.

Question 1. Answer four parts of this question.

(a) Calculate the voltage difference between the nodes marked A and B, B and C, C and D, D and E,and E and F in the circuit in Figure 1.

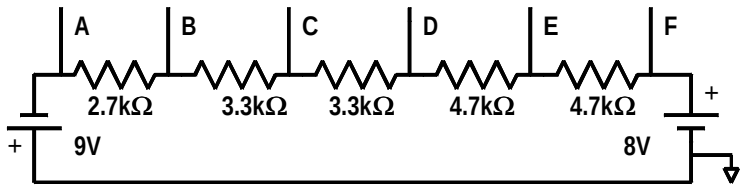

Figure 1: Question 1 (a)

(b) What is meant by "resonant frequency"?
Calculate the resonant frequency for the filter circuit shown in Figure 2 and sketch the response of the filter for the frequency range from 100 kHz to 10 MHz.

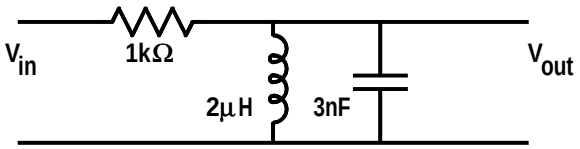

Figure 2: Question 1 (b)

(c) Calculate the voltage which appears between the output terminals of the circuit shown in Figure 3.
Calculate the new voltage which would be present across the output terminals when a 1 kΩ resistor is connected across the output terminals of the circuit of Figure 3.

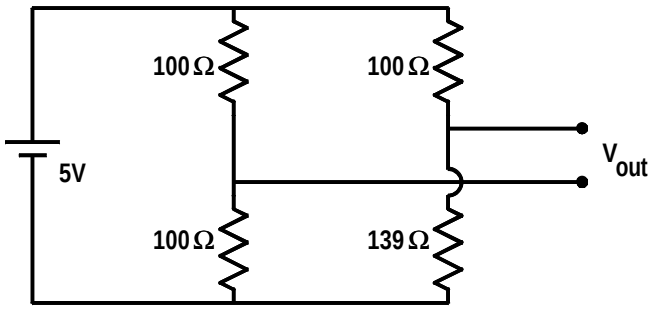

Figure 3: Question 1 (c)

(d) Three filter circuits, A, B and C, having the responses shown in Figure 4 are connected in series. Calculate and sketch the frequency response of the composite circuit for a frequency range from 100 Hz to 100 kHz.

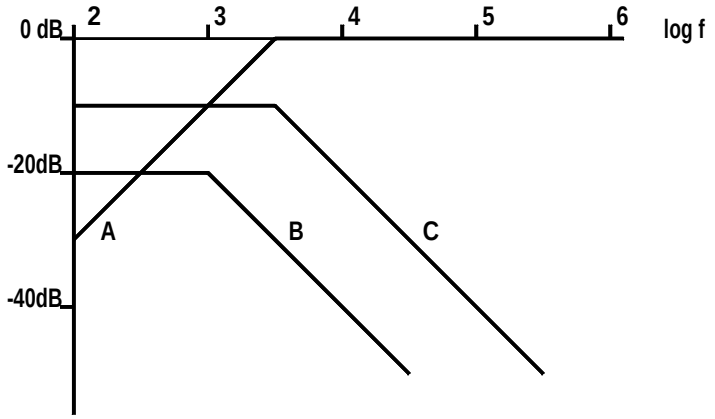

Figure 4: Question 1 (d)

(e) Calculate the voltages at the points A, B and C in the circuit shown in Figure 5.

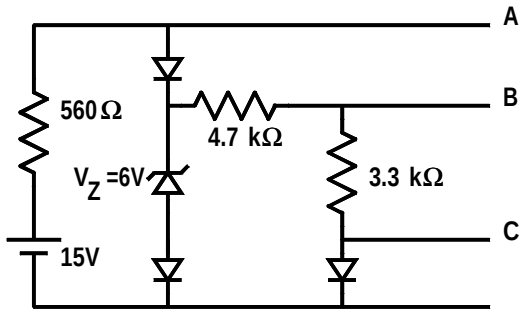

Figure 5: Question 1 (e)

(f) State Thévenin's theorem. Explain the concept of "output impedance". Explain how you would measure the output impedance and the Thévenin voltage of a circuit.
What is the approximate output impedance of

i. A small PP3 type battery.
ii. A car battery.
iii. A 220 V mains output socket.

Question 2. Calculate the emitter, base and collector voltages for the circuit shown in Figure 6. 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.

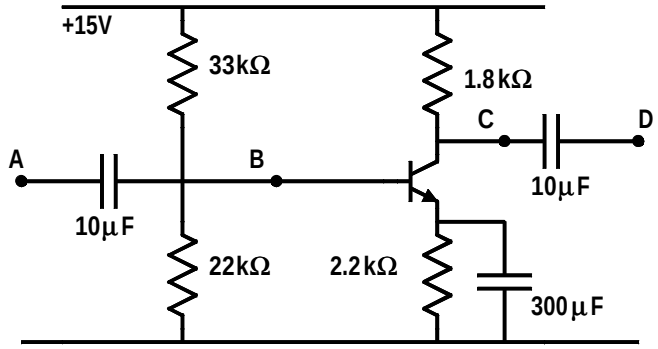

Figure 6: Question 2

Question 3. What do the terms I_{DSS} and $V_{GS(off)}$ represent for a FET?
Explain how the circuits shown in Figure 7 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.

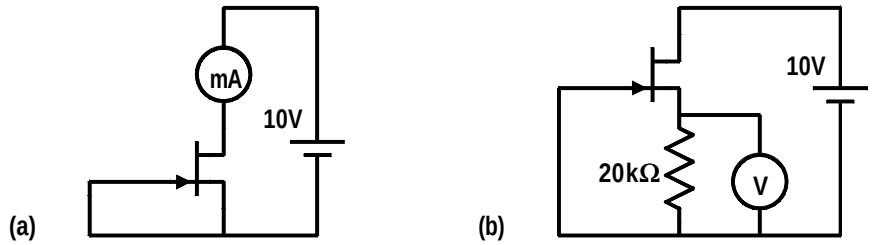

Figure 7: Question 3

Question 4. (a) Derive the equation for the gain of the noninverting amplifier whose circuit is shown in Figure 8.
Select component values for a noninverting amplifier which has a voltage gain of 17 and sketch the circuit showing the required power supplies.

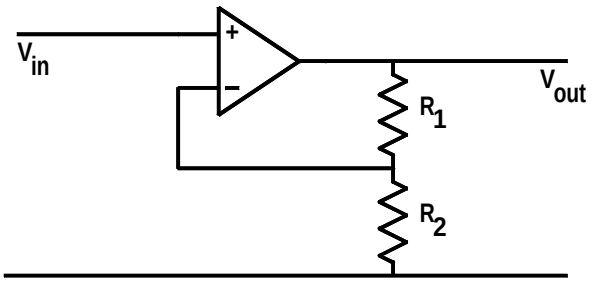

Figure 8: Question 4 (a)

(b) Calculate the output from the inverting differentiator circuit shown in Figure 9 when a sinusoidal signal of amplitude 5 mV and frequency 2 kHz is supplied from the function generator (FG).

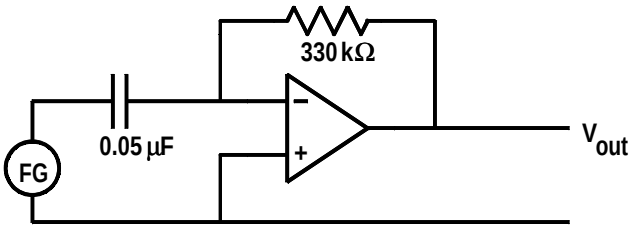

Figure 9: Question 4 (b)