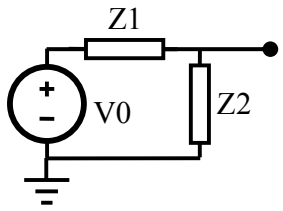
E2.2 Analogue electronics
Problem sheet 1

Q1. Calculate the Thevenin and Norton equivalent circuits of the voltage divider circuit for all the component combinations shown in the table:



V0	Z1	Z2
DC	Resistor	Resistor
AC	Resistor	Capacitor
	Capacitor	Resistor
	Resistor	Inductor
	Inductor	Capacitor

Q2. Repeat Q1 but with a current source connected in the place of the voltage source.

Q3. Calculate the small signal and the large signal Thevenin and Norton Equivalent circuits of a diode biased with a DC current of 1mA. The saturation current is 1fA. The thermal voltage is 25mV (at 17C)

Q4. A series connection of a diode and a 1kΩ resistor embedded in a big circuit develops 1V DC across it. Calculate the small signal Thevenin resistance of the resistor-diode connection. The diode saturation current is 1fA. The thermal voltage is 25mV (at 17C) (Do not include the voltage source in the calculation, only the diode and the resistor!)

Q5. In the circuit diagram above, assume both Z1 and Z2 are arbitrary complex impedances and V0 a sinusoidal source of amplitude V0 and at a frequency ω.

1. Derive an expression for the average power PZ2 dissipated in Z2.
2. Derive also an expression for the average total power PT delivered by the source V0 (which is the power dissipated in Z1 and Z2)
3. What is the power delivered to Z2 if Z1 is finite and Z2 is zero?
4. What is the power delivered to Z2 if Z1 is finite and Z2 is infinite?
5. For what value of Z2 is PZ2 maximum, if Z1 is given? What is the maximum fraction of PT that can be delivered to the load?