A total of six problems are given below.

1. **(16%)** The circuit in Fig. 1 shows a circuit for a voltage source and "potentiometer" (電位計), which is a resistor with a sliding contact. The variable "***a***" varies from 0 to 1, and the open-circuit voltage v_{out} increases in proportion with ***a***.

(a) Determine a Thevenin equivalent circuit, as indicated in the right hand side of Fig. 1, for the voltage source, with the voltage and output impedance functions of ***a***.

(b) What is the maximum output resistance if the total resistance of the potentiometer is ***R***?

(c) If the load resistor for this Thevenin equivalent circuit (i.e., connecting to v_{out}) were equal to the resistance of the potentiometer, ***R***, what would ***a*** have to be to give an output voltage of 0.5 V_s?

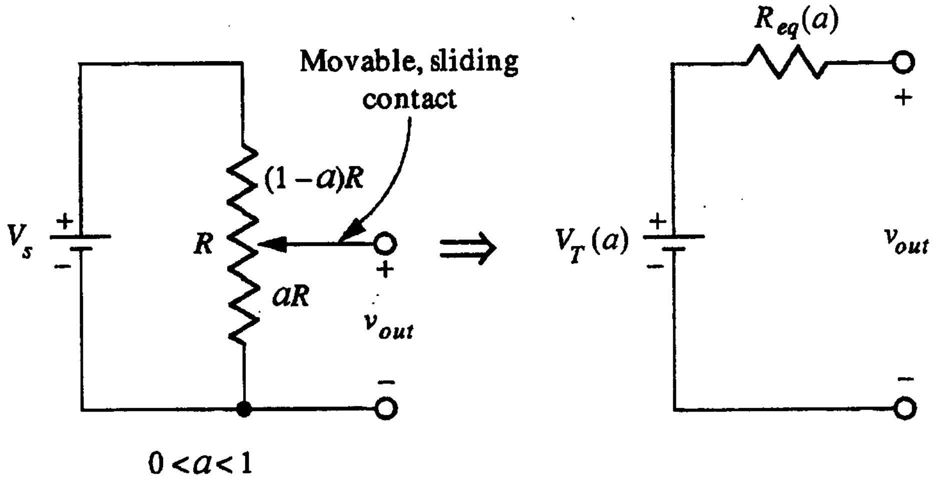


Fig. 1

2. **(16%)** The switch S_1 in Fig. 2 has been closed for a long time. At $t = 0$ s, S_1 is opened at the same instant S_2 is closed to avoid an interruption in current through the inductor.

(a) Find the general solution for i_L following the closing of S_2.

(b) Sketch i_L for positive time.

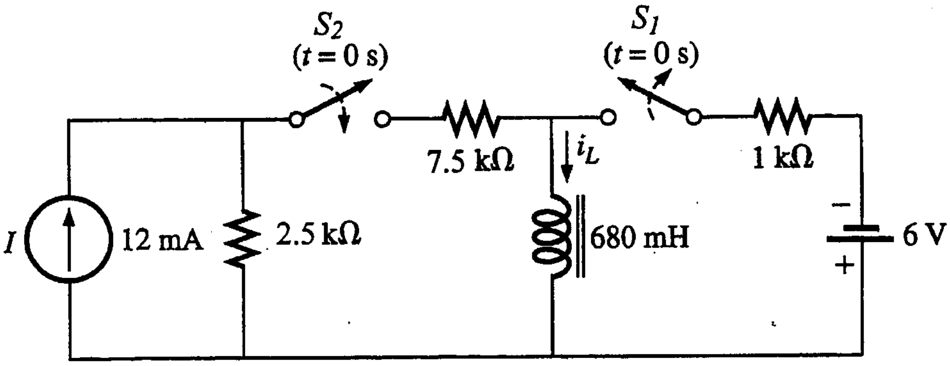


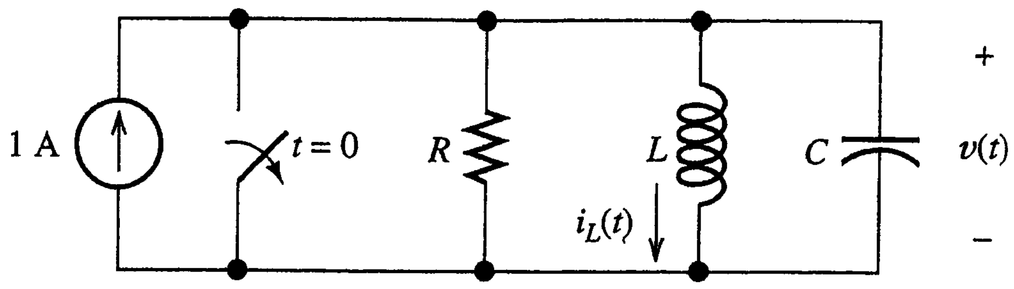
Fig. 2

(背面仍有題目,請繼續作答)

3. **(16%)** Consider the circuit shown in Fig. 3, answer the following questions:

(a) What is the undamped resonant frequency and the damping coefficient?

(b) Find the general solution for ***v(t)***, giving the numerical values of all parameters. Assume that the initial conditions are $v(0^+)=0$ and $i_L(0^+)=0$.



$R = 25\ \Omega \quad L = 10\ \mu H \quad C = 1000\ pF$

Fig 3

4. **(16%)** The switch shown in Fig. 4 is in position ***a*** for negative time, moved to ***b*** at $t = 0$, and to ***c*** at $t = 5$ ms.

(a) Sketch v_C for $0 < t < 20$ ms.

(b) At what time should the switch be switched to ***c*** for no "transient"? (無暫態)

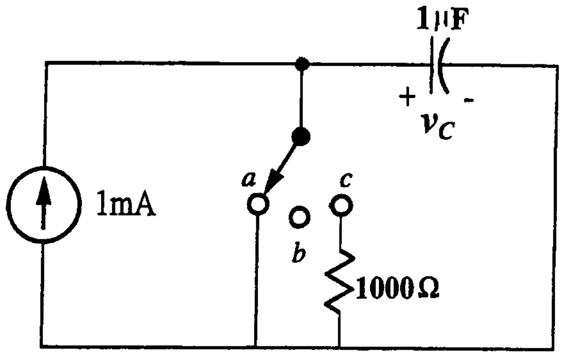


Fig. 4

5. **(20%)** Complex frequency is used to solve a circuit problem. The circuit impedance has the pole-zero patter shown in Fig. 5 and has an impedance magnitude of 10 **Ω** at s = 1 s^{-1}. The circuit is excited by a voltage source that is zero for negative time and has a value of ***v*(t)** = **5cos(3t)** for positive time.

(a) Find the impedance **Z(s)** for the circuit.

(b) Determine the total response of the current into the circuit for positive time, assuming zero for the initial value and initial derivative of the current.

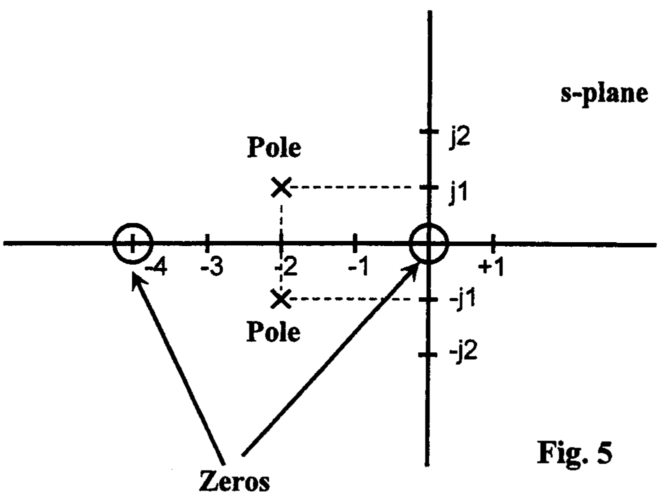


Fig. 5

6. **(16%)** By proper choice of X_C and X_L, the 10-**Ω** resistance in Fig. 6 can be transformed to "look" like a 50-**Ω** resistor (i.e., the impedance $Z = 50 + j0\ \Omega$) at a specified frequency. Find X_C and X_L and, from them, C and L to accomplish this transformation at 1 kHz.

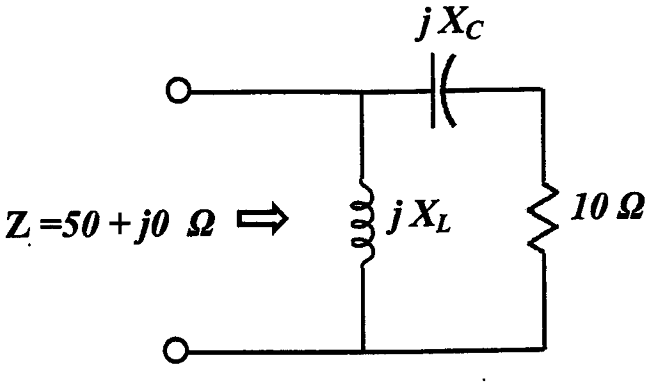


Fig. 6