國立臺灣科技大學

九十一學年度碩士班招生考試試題

系所組別： 電機工程系甲組

科　目： 電路學

總分 100 分

1. The circuit in Fig. 1 has $\mathbf{V}=1\angle 0^\circ$ V, $\omega L_1=25\Omega$, $\omega L_2=4\Omega$, $\omega M=10\Omega$ and $R=3\Omega$. (a) Find $\mathbf{Z}_{in}$ and $\mathbf{I}_2/\mathbf{I}_1$ when the impedance of element A is $\mathbf{Z}_A=0\Omega$. (b) Find $\mathbf{Z}_{in}$ when the impedance of element A is $\mathbf{Z}_A=j5\Omega$. (20 points)

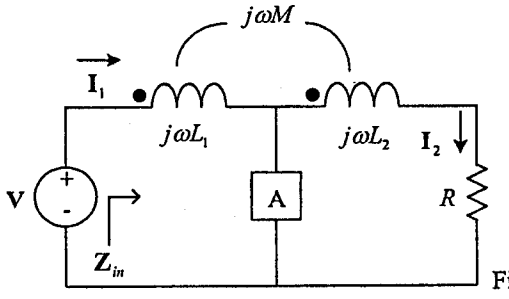

Fig. 1

2. Fig. 2(a) shows a circuit connected to a nonlinear load. (a)If the V-I characteristic of the nonlinear load is specified as $v=3i^2$, calculate the current i through the nonlinear load. (b)If the V-I characteristic of the nonlinear load is now specified as the curve shown in Fig. 2(b), determine and show the current i through the nonlinear load graphically. (20 points)

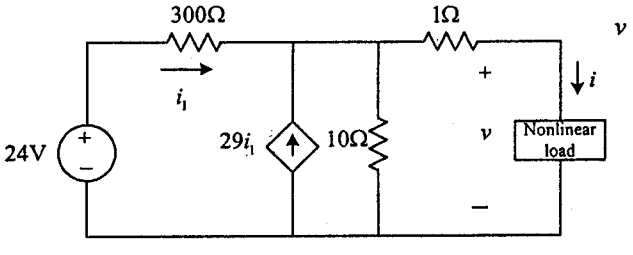

Fig. 2(a)

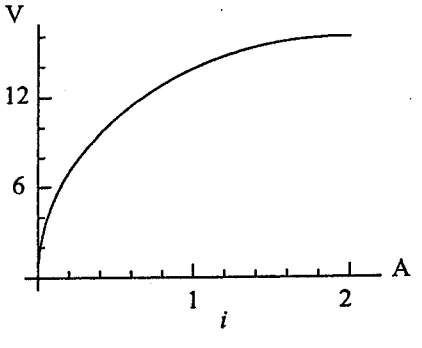

Fig. 2(b)

3. Fig. 3 shows a first-order circuit with a switch. After having been open for a very long time, the switch is closed at $t=0$. Let $v_a=16\cos(t)$ V and $v_b=16$ V. (a) Determine current i through the inductor for $t>0$. (b) Calculate the average power absorbed by the resistor R_2 when the circuit reaches steady state. (20 points)

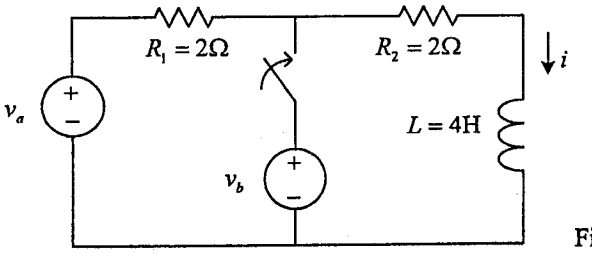

Fig. 3

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4. Two ac networks, A and B, are connected together through two different methods as shown in Fig.4 (a) and (b) respectively. The associated terminal currents and voltages of each connection are as follows : $\mathbf{I}_{ab} = 1\angle 0°$ A and $\mathbf{V}_{aa'} = 2\angle -45°$ V for Fig. 4(a); $\mathbf{I}_{ab'} = 3\angle 0°$ A and $\mathbf{V}_{aa'} = 2\angle 45°$ V for Fig. 4(b). (a)Find $\mathbf{V}_{aa'}$ and $\mathbf{I}_{bb'}$ as indicated in Fig. 4(c). (b) Find $\mathbf{I}_{ab}$ as indicated in Fig. 4(d). (30 points)

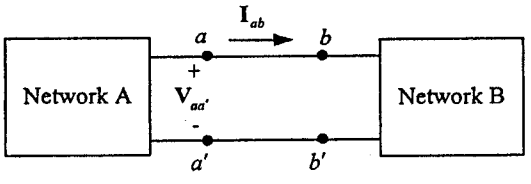

Fig. 4(a)

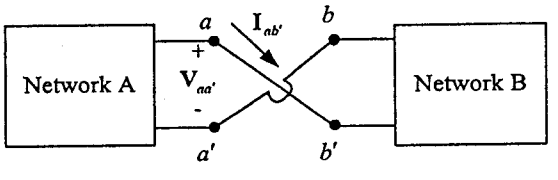

Fig. 4(b)

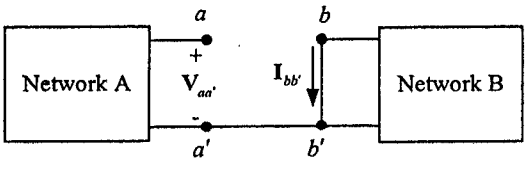

Fig. 4(c)

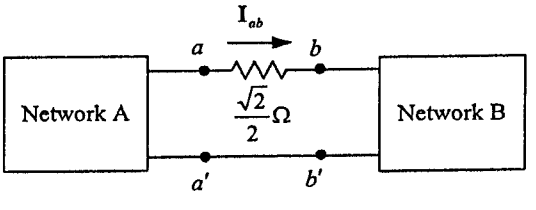

Fig. 4(d)

5. Fig. 5 shows a difference amplifier using two ideal operational amplifiers. Determine the voltage gain $v_o/(v_2 - v_1)$ of this difference amplifier. (10 points)

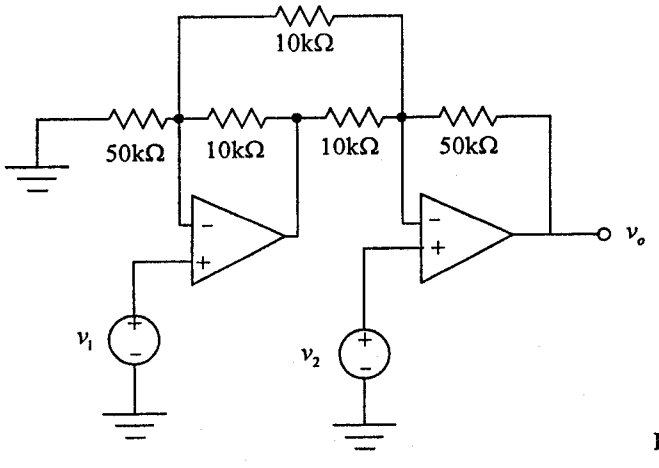

Fig. 5