8. (10%) Determine the capacitor voltage $v(t)$ in the circuit of Fig. 7 for $t > 0$. Suppose the circuit is steady before the switch closes at $t = 0$, and the switch remains closed for 1.5s before reopening.

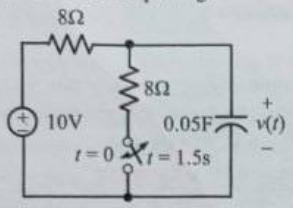

Fig. 7

9. (13%) For an arbitrary 1st order differential equation (2), please show and conduct a general solution as (3).

$$\frac{dy(t)}{dt} + ay(t) = f(t) \qquad (2)$$

$$y(t) = e^{-at}\int f(t)e^{at}dt + ke^{-at} \qquad (3)$$

where k is a constant.

(2)式兩邊同乘積分因子 e^{+at}：

$e^{+at}\frac{dy}{dt} + ay e^{+at} = f(t)e^{+at}$

$\frac{d}{dt}(e^{at}y) = f(t)e^{at}$ ——①

①兩邊積分：

$\int \frac{d}{dt}(e^{at}y)dt = \int f(t)e^{at}dt + C$

$e^{at}y = \int f(t)e^{at}dt + C$

$y = e^{-at}\int f(t)e^{at}dt + Ce^{-at}$ ⑧

Midterm Examination

Notice: Please **turn off any types of handheld devices**, and leave them far from reach. Use only standalone calculators for calculation if it is needed. The examination takes **90 minutes**.
只需繳回答案紙，題目紙請同學保留。

1. (15%) Design a circuit to represent a linear differential equation shown as (1) via operation amplifiers with resistors and capacitors. For simplicity, the elementary integrators use $C = 1\mu$F and $R = 1$MΩ, and for inverting and non-inverting amplifiers use $R_i = 20$kΩ as templates to design the circuit.

$$\frac{d^2y(t)}{dt^2} + 8\frac{dy(t)}{dt} + 2y(t) = 5f(t) \qquad (1)$$

2. (6%) Given $L_{eq} = 28$H, determine the value of the inductance L in the circuit shown in Fig. 1.

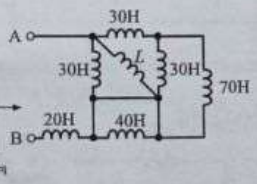

Fig. 1

3. (11%) Determine the inductor current $i(t)$ in the circuit of Fig. 2 for $t > 0$ as the circuit has already at steady state before the switch closes at $t = 0$.

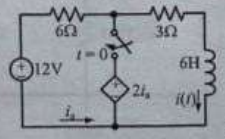

Fig. 2

4. (11%) Derive the inductor current $i(t)$ for $t \geq 0$ in the sequential switching circuit shown as Fig. 3.

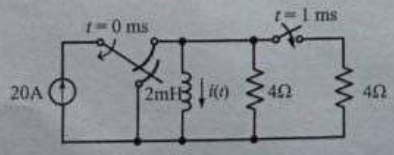

Fig. 3

5. (11%) Determine the output voltage $v_o(t)$ in the circuit of Fig.4 as the inductor current i_L and capacitor voltage v_C are given by

$$i_L(t) = 0.3(e^{-400t} + e^{-600t})\text{A, and}$$
$$v_C(t) = 15 - 125e^{-400t} + 5e^{-600t}\text{V, when } t > 0.$$

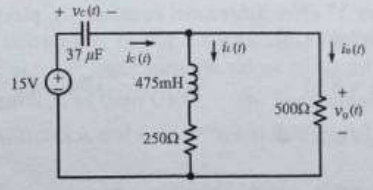

Fig. 4

6. (10%) Determine the voltage $v_o(t)$ in the circuit of Fig. 5 for $t > 0$. Suppose the circuit is in a steady state before the switch opens at time $t = 0$.

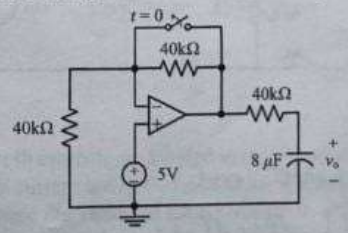

Fig. 5

7. (13%) Determine $v_o(t)$ for $t > 0$ in the circuit of Fig. 6.

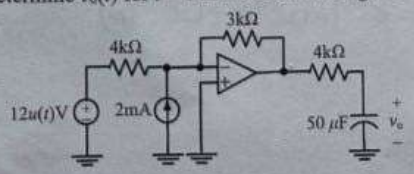

Fig. 6

背面還有題目