RULES:

- **Please try to work on your own. Discussion is permissible, but identical submissions are unacceptable! See "上海科技大学学生学术诚信规范与管理办法", http://sist.shanghaitech.edu.cn/cn/NewsDetail.asp?id=782.**
- **Please show all intermediate steps: a correct solution without an explanation will get zero credit.**
- **Please submit on time. NO late submission will be accepted.**
- **Please prepare your submission in English only. No Chinese submission will be accepted.**

1. [8%] Use the circuit in Fig. 1:
   a) Find the total energy delivered to the inductor by the 25V voltage source in the time period $[0, \infty]$.
   b) Find the total energy delivered to the capacitor by the 25V voltage source in the time period $[0, \infty]$.

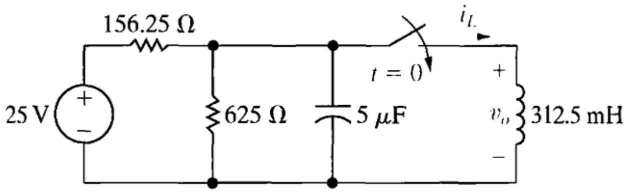

Fig. 1

2. [12%] In the circuit of Fig. 2, the switch has been in position 1 for a long time but moved to position 2 at t=0. Find:

(a) $v(0^+), \frac{dv(0^+)}{dt}$

(b) $v(t)$ for $t \geq 0$.

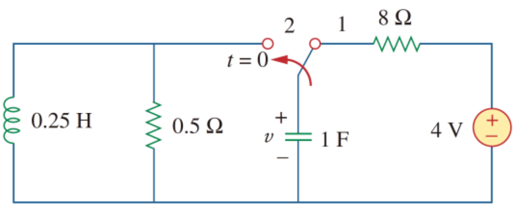

Fig. 2

3. [9%] The switch in the circuit in Fig. 3 has been open a long time before closing at $t = 0$. Find $i_L(t)$ for $t \geq 0$.

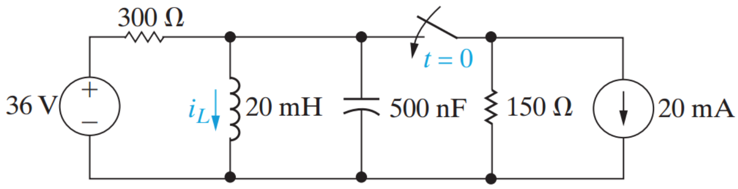

Fig. 3

4. [8%] The switch in the circuit has been in position a for a long time. At $t = 0$ the switch moves instantaneously to position b. Find $v_0(t)$ for $t \geq 0$.

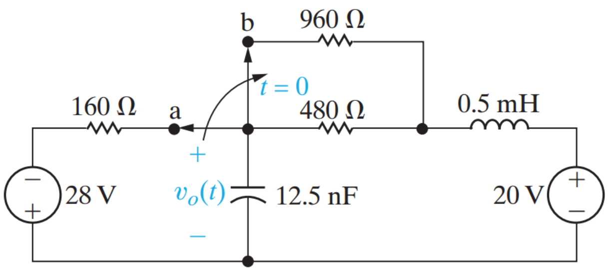

Fig. 4

5. [10%] The two switches in the circuit seen in Fig. 5 operate synchronously. When switch 1 is in position a, switch 2 is in position d for t<0. At t=0, the switches move to their alternate positions. Find $V_0(t)$ for $t \geq 0$.

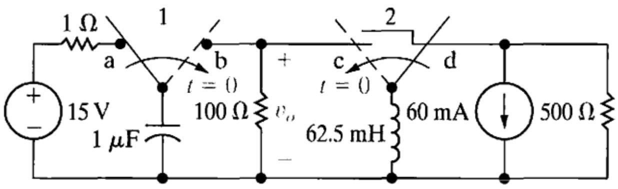

Fig. 5

6. [10%] Switches 1 and 2 in the circuit are synchronized in Fig. 6. When switch 1 is opened, switch 2 closes and vice versa. Switch 1 has been open a long time before closing at $t = 0$. Find $i_L(t)$ for $t \geq 0$.

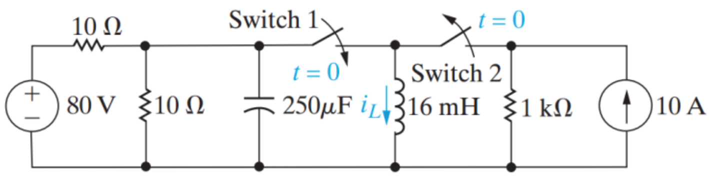

Fig. 6

7. [8%] The two switches in the circuit seen in the figure below operate synchronously. When switch 1 is in position a, switch 2 is closed. When switch 1 is in position b, switch 2 is open. Switch 1 has been in position a for a long time. At t=0, it moves instantaneously to position b. Find $V_c(t)$ for t >= 0.

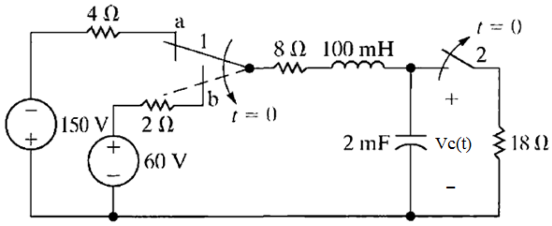

Fig. 7

8. [12%] Determine the differential equation for the op amp circuit in Fig. 8. If $v_1(0^+) = 2V$ and $v_2(0^+) = 0V$, find v_0 for $t > 0$. Let $R = 100\text{k}\Omega$ and $C = 1\mu\text{F}$.

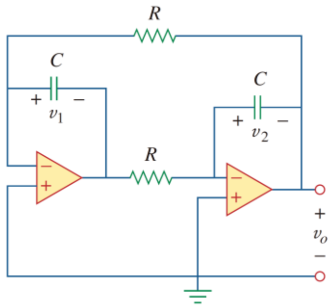

Fig. 8

9. [12%] The voltage signal of the figure below is applied to the cascaded integrating amplifiers shown after that. There is no energy stored in the capacitors at the instant the signal is applied.
   a) Derive the numerical expressions for $V_{o1}(t)$ and $V_o(t)$ for the time intervals $0 < t < 0.5$ s and $0.5 \text{ s} < t < t_{sat}$.
   b) Compute the value of t_{sat}.

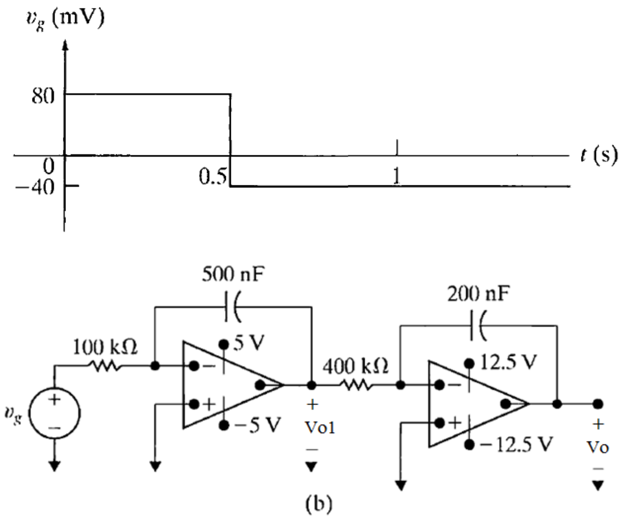

Fig. 9

10. [12%] Fig. 10 shows a typical tunnel-diode oscillator circuit. The diode is modeled as a nonlinear resistor with $i_D = f(v_D)$ i.e., the diode current is a nonlinear function of the voltage across the diode. Derive the differential equation for the circuit in terms of v and i_D.

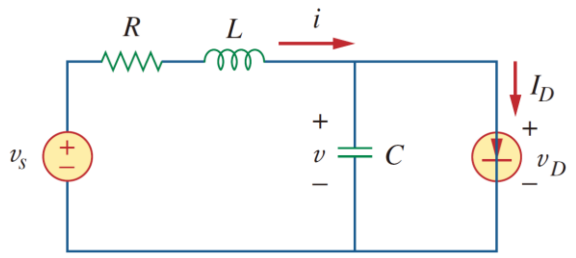

Fig. 10