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. [10%] A 80KHz sinusoidal voltage has zero phase angle and a maximum amplitude of 25mV. When this voltage is applied across the terminals of a capacitor, the resulting steady-state current has a maximum amplitude of 628.32μA.
   a) What is the frequency of the current in radians per second?
   b) What is the phase angle of the current?
   c) What is the capacitive reactance of the capacitor?
   d) What is the capacitance of the capacitor in microfarads?
   e) What is the impedance of the capacitor?

2. [8%] Use the concept of the phasor to combine the following sinusoidal functions into a single trigonometric expression:
   a) $y = 50\cos(500t + 60°) + 100\cos(500t - 30°)$,
   b) $y = 200\cos(377t + 50°) - 100\sin(377t + 150°)$,
   c) $y = 80\cos(100t + 30°) - 100\sin(100t - 135°) + 50\cos(100t - 90°)$
   d) $y = 250\cos(\omega t) + 250\cos(\omega t + 120°) + 250\cos(\omega t - 120°)$.

3. [8%] At $\omega = 1000\text{rad/s}$, find the input admittance of each of the circuits in Fig.1.

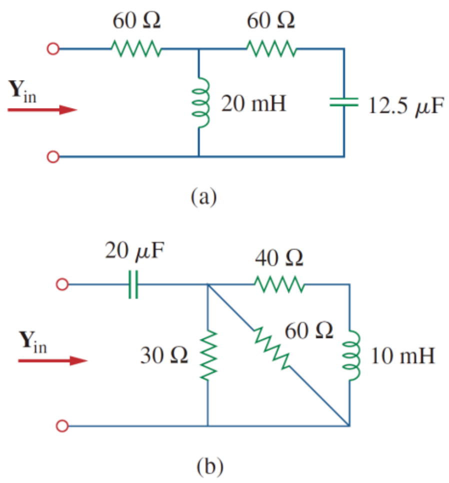

Fig. 1

4. [10%] Find Z_{ab} for the circuit shown in Fig.2.

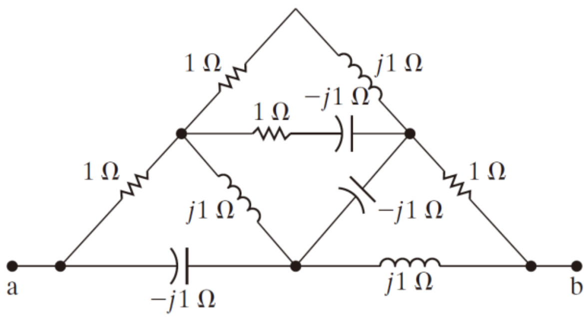

Fig. 2

5. [8%] Using node analysis to determine V_o and I_o in the circuit shown in Fig. 3.

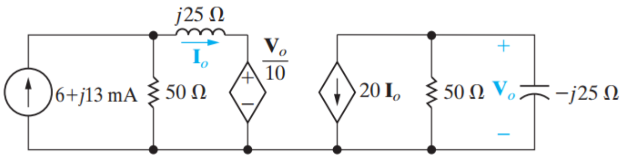

Fig. 3

6. [8%] Using mesh analysis to determine V_o and I_o in the circuit below.

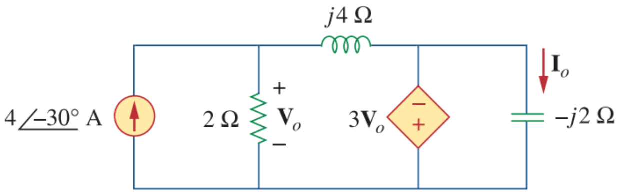

Fig. 4

7. [8%] Use the method of source transformation to find I_x in the circuit of Fig. 5.

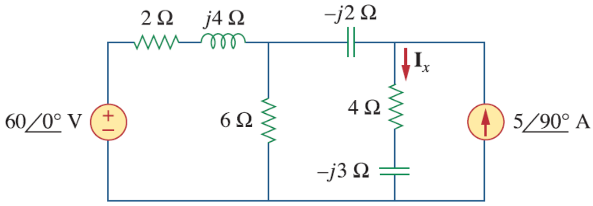

Fig. 5

8. [10%] Find the Norton equivalent circuit with respect to the terminals a,b for the circuit shown in Fig. 6 when $V_s = 5\angle 0^0 V$.

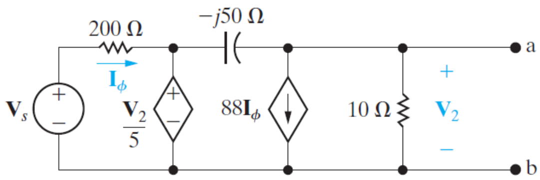

Fig. 6

9. [12%] The circuit shown in Fig. 7 is operating at a frequency of 10 rad/s. Assume α is real and lies between -10 and +10, that is, $-10 \leq \alpha \leq 10$.
   a) Find the value of α so that the Thevenin impedance looking into the terminals a,b is purely resistive.
   b) What is the value of the Thevenin impedance for the α found in (a).
   c) Can α be adjusted so that the Thevenin impedance equals $500 - j500\ \Omega$? If so, what is the value of α?
   d) For what values of α will the Thevenin impedance be inductive?

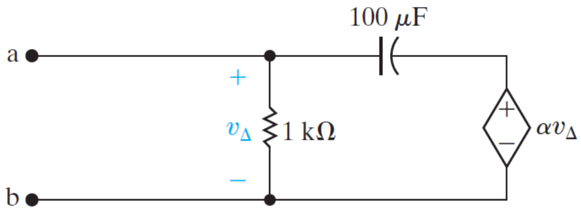

Fig. 7

10. [8%] For the op amp circuit in the figure below, obtain $V_o(t)$. Assume the op amp is ideal.

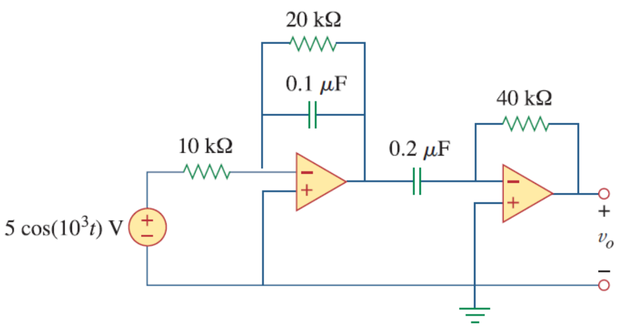

Fig. 8

11. [10%] The oscillator circuit in the figure below uses an ideal op amp.
    (a) Calculate the minimum value of R_0 that will cause oscillation to occur.
    (b) Find the frequency of oscillation.
    Hint: refer to Section 10.9.2 of reference
    [1] Charles K. Alexander and Matthew N. O. Sadiku, *Fundamentals of Electric Circuits*, 5^{th} edition, McGraw Hill, 2012.

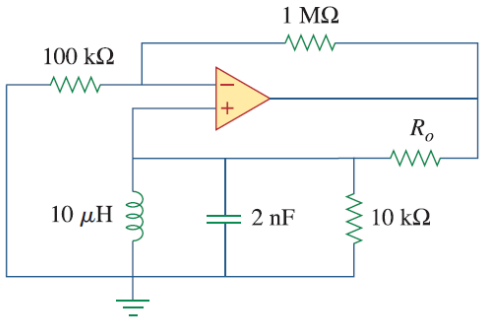

Fig. 9