

Electric Circuits & Electronics

Your answers must be as brief as possible. (Technical English reading is one part of this examination, however, you can answer in Chinese.)

1. Refer to Fig. 1. The Thevenin resistance at terminals a and b is: 5%
 (a) 25Ω (b) 20Ω (c) 5Ω (d) 4Ω (e) none of these
2. In Fig. 2, if $i = \cos 4t$ and $v = \sin 4t$, the element is: 5%
 (a) a resistor (b) a capacitor (c) an inductor (d) none of these
3. For the circuit in Fig. 3, voltage v_o is: 5%
 (a) -6 V (b) -5 V (c) 1.5 V (d) 0.2 V (e) none of these
4. The time constant for the RC circuit in Fig. 4 is: 5%
 (a) 106 ms (b) 30 ms (c) 6 ms (d) 65.2 ms (e) none of these
5. For the circuit in Fig. 5, the capacitor voltage at $t = 0^-$ (just before the switch is closed) is: 5%
 (a) 0 V (b) 4 V (c) 8 V (d) 12 V (e) none of these
6. The voltage V_o across the capacitor in Fig. 6 is: 5%
 (a) $5 \angle 0^\circ \text{ V}$ (b) $7.071 \angle 45^\circ \text{ V}$ (c) $7.071 \angle -45^\circ \text{ V}$ (d) $5 \angle -45^\circ \text{ V}$
7. If the load impedance is $20 - j20$, the power factor is: 5%
 (a) $\angle -45^\circ$ (b) 0 (c) 1 (d) 0.7071 (e) none of these
8. If in an acb phase sequence, $V_{an} = 100 \angle -20^\circ \text{ V}$, then V_{cn} is: 5%
 (a) $100 \angle -140^\circ \text{ V}$ (b) $100 \angle 100^\circ \text{ V}$ (c) $100 \angle -50^\circ \text{ V}$ (d) $100 \angle 10^\circ \text{ V}$
9. A three-wing transformer is connected as portrayed in Fig. 7. The value of the output voltage V_o is: 5%
 (a) 10 V (b) 6 V (c) -6 V (d) -10 V (e) none of these
10. For the single-element two-port network in Fig. 8, z_{11} is: 5%
 (a) 0Ω (b) 5Ω (c) 10Ω (d) 20Ω (e) nonexistent

Hint:
$$\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = [z] \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

11. For a diode, what is the depletion region? (10%)
12. For an npn transistor, draw its (a) circuit symbol and (b) current-voltage (I-V) characteristics (10%)
13. For a CMOS inverter implemented using N-well process, please draw its (a) circuit diagram and (b) cross section view. (10%) Hint: A CMOS inverter is composed of two transistors.
14. (a) List the four basic single-loop feedback amplifiers and (b) list five characteristics of an amplifier that are modified by negative feedback. (10%)
15. Show how a switched capacitor behaves as a resistance. (10%)

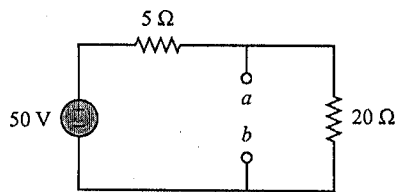


Fig. 1

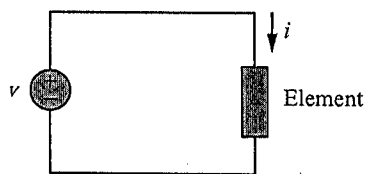


Fig. 2

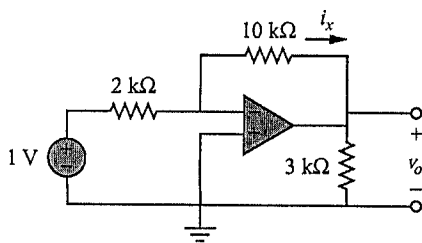


Fig. 3

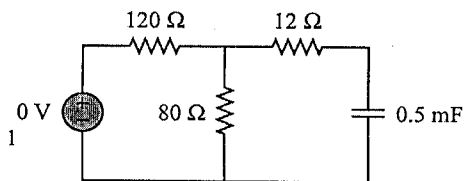


Fig. 4

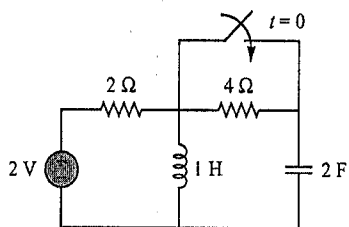


Fig. 5

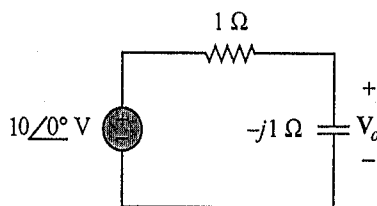


Fig. 6

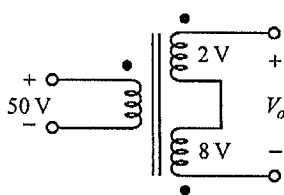


Fig. 7

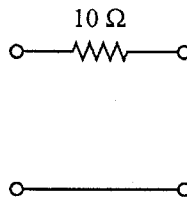


Fig. 8