**Short Questions:**

1. **What does Thevenin’s theorem state?** Thevenin’s theorem states that any linear circuit with multiple sources and resistances can be replaced by a single voltage source (VTHV\_{TH}) in series with a single resistance (RTHR\_{TH}).
2. **How does Norton’s theorem simplify complex circuits?** Norton’s theorem simplifies a circuit by converting it into an equivalent circuit with a single current source (INI\_N) in parallel with a single resistance (RNR\_N).
3. **Why are Thevenin and Norton equivalent circuits useful in circuit analysis?** These equivalents simplify complex circuits, making calculations easier when analyzing load variations.
4. **What is the significance of the Maximum Power Transfer theorem?** It states that the maximum power is delivered to a load when its resistance equals the Thevenin/Norton resistance of the source.
5. **Define Thevenin voltage and Thevenin resistance.**
   * Thevenin voltage (VTHV\_{TH}) is the open-circuit voltage across load terminals.
   * Thevenin resistance (RTHR\_{TH}) is the equivalent resistance seen from the load terminals with independent sources replaced.
6. **What is the Norton equivalent circuit?** A Norton circuit consists of a current source (INI\_N) in parallel with a resistance (RNR\_N), which is equivalent to a Thevenin circuit.
7. **How do you determine Thevenin resistance in a circuit?** Remove the load resistance and replace independent sources appropriately, then measure the resistance across terminals.
8. **Describe the steps to find Norton’s equivalent current source.**
   * Remove the load.
   * Short the load terminals and measure the current (INI\_N).
   * Find RNR\_N using the same method as RTHR\_{TH}.
9. **What happens when the load resistance does not match the Thevenin/Norton resistance?** Less than the maximum power is transferred, leading to inefficient power usage.
10. **Why do we replace voltage sources with short circuits when finding Thevenin resistance?** To eliminate the effect of voltage sources and analyze resistance contribution independently.

**Theoretical Questions:**

1. **Explain the procedure for verifying Thevenin’s theorem experimentally.**
   * Measure and record the load voltage and current.
   * Remove the load and find VTHV\_{TH}.
   * Find RTHR\_{TH} by replacing sources.
   * Construct the equivalent Thevenin circuit and compare results.
2. **Discuss the steps required to experimentally determine Norton’s equivalent circuit.**
   * Measure INI\_N by shorting load terminals.
   * Find RNR\_N using Thevenin’s method.
   * Construct Norton’s equivalent circuit and compare experimental and theoretical values.
3. **Derive the formula for maximum power transfer from a Thevenin equivalent circuit.** Maximum power is transferred when RL=RTHR\_L = R\_{TH}, giving:

Pmax=VTH24RTHP\_{max} = \frac{V\_{TH}^2}{4 R\_{TH}}

1. **Explain why impedance matching is important for maximum power transfer.** Matching ensures that the source delivers the maximum possible power to the load without excessive losses.
2. **Compare and contrast Thevenin’s and Norton’s theorems.** Thevenin uses voltage and series resistance; Norton uses current and parallel resistance. They are dual representations.
3. **What are the limitations of Thevenin’s and Norton’s theorems?** They apply only to linear circuits and do not consider reactive components like inductance and capacitance.
4. **How does changing the load resistance affect power dissipation in a circuit?** If the load resistance increases or decreases beyond RTHR\_{TH}, the power dissipated reduces.

**Calculation-Based Questions:**

1. **Given a circuit with a 10V source and resistances, calculate the Thevenin equivalent voltage and resistance.**
   * Find VTHV\_{TH} by calculating the open-circuit voltage at the terminals.
   * Remove sources and measure the resistance at the terminals to get RTHR\_{TH}. (Specific values would be required for further computation.)
2. **If Norton’s current source is measured at 2mA with a 5kΩ resistor, determine the Norton equivalent resistance.** Since RN=RTHR\_N = R\_{TH}, Norton’s resistance is 5kΩ5kΩ.
3. **In a given circuit, if** VTH=12VV\_{TH} = 12V **and** RTH=6kΩR\_{TH} = 6kΩ**, find the maximum power that can be transferred to the load.** Using the maximum power transfer formula:

Pmax=VTH24RTHP\_{max} = \frac{V\_{TH}^2}{4 R\_{TH}}

=1224×6000= \frac{12^2}{4 \times 6000}

=14424000=6mW= \frac{144}{24000} = 6mW