Instructions: Mark your answers on your Scantron form (Form No. 882-E) and hand it in when you are finished. You can keep the exam question sheets.

1. The net charge through a cross section of a circuit element is \( q(t) = 30 + 15t^2 + 5e^{-2t} \) C, \( t \) is in seconds. Find the current through the element in amperes.

   A: \( 30 + 30t + 10t^2 \) A
   B: \( 30t + 10e^{-2t} \) A
   C: \( 30 + 30t - 10e^{-2t} \) A
   D: \( 30t - 10e^{-2t} \) A
   E: none of the above

2. The voltage across the resistor in the figure below is \( U = 10 \) V, and the current through it is \( I_1 = e^{-t} \). Find the energy absorbed over the time interval \( t = 0 \) to \( t = \infty \).

   A: 10 J
   B: 20 J
   C: 30 J
   D: 40 J
   E: none of the above

3. Find \( \frac{V_o}{V_s} \) in the circuit below.

   A. 1/4
   B. 1/3
   C. 1/2
   D. 2/3
   E. 3/4
4. Find \( \frac{I_o}{I_s} \) in the circuit below.

A. 1/4  
B. 1/3  
C. 1/2  
D. 2/3  
E. 3/4

5. The current \( i \) is measured in two experiments which are performed on a Thevenin equivalent circuit as shown. What is the Thevenin equivalent resistance?

A. 0 \( \Omega \)  
B. 1 \( \text{k}\Omega \)  
C. 2 \( \text{k}\Omega \)  
D. 10 \( \text{k}\Omega \)  
E. \( \infty \) \( \text{k}\Omega \)
6. A battery, which can be modeled by a Thevenin equivalent circuit, has an open circuit voltage of 2 volts. When a 500Ω resistor is connected to the battery, the terminal voltage drops to 1 volt. How much power is dissipated in the Thevenin equivalent resistance of the battery under this condition?

A. 0.002 W  
B. 0.005 W  
C. 0.5 W  
D. 2 W  
E. 5 W

7. Find $V_o$ in the circuit below.

A. $-3/2$ V  
B. $-1/2$ V  
C. 0 V  
D. $1/2$ V  
E. $3/2$ V

8. What is the current through the resistor below?

A. 1 A  
B. 2 A  
C. 0 A  
D. cannot determine  
E. none of the above
9. How many KVL equations can be written for this circuit?

A. 3  
B. 4  
C. 5  
D. 6  
E. 7

10. Determine the current I in the circuit below.

A. 1 A  
B. 5 A  
C. −1 A  
D. −5 A  
E. none of the above

11. For the three conductances connected as shown on the network below, the equivalent conductance $G_{AB}$ is computed with the formula.

A. $G_{AB} = \sqrt{G_1 + G_2 + G_3}$  
B. $G_{AB} = \sqrt{G_1^2 + G_2^2 + G_3^2}$  
C. $G_{AB} = \frac{G_1 G_2 G_3}{G_1 + G_2 + G_3}$  
D. $\frac{1}{G_{AB}} = \frac{1}{G_1} + \frac{1}{G_2} + \frac{1}{G_3}$  
E. none of the above
12. In the network shown below, when $R = 4 \, \Omega$, the voltage $v_R = 6 \, V$. When $R = 0 \, \Omega$, $i_R = 2 \, A$. When $R = \infty$, $v_R$ is

\begin{align*}
\text{A.} & \quad 6 \, V \\
\text{B.} & \quad 24 \, V \\
\text{C.} & \quad 8 \, V \\
\text{D.} & \quad 16 \, V \\
\text{E.} & \quad \text{none of the above}
\end{align*}

13. The node voltages shown in the partial network below are relative to some reference node not shown. The value of the voltage $v_X$ is

\begin{align*}
\text{A.} & \quad -6 \, V \\
\text{B.} & \quad 16 \, V \\
\text{C.} & \quad 0 \, V \\
\text{D.} & \quad 10 \, V \\
\text{E.} & \quad \text{none of the above}
\end{align*}

14. The voltage across the $2 \, \Omega$ resistor in the circuit below is

\begin{align*}
\text{A.} & \quad 6 \, V \\
\text{B.} & \quad 16 \, V \\
\text{C.} & \quad -8 \, V \\
\text{D.} & \quad 32 \, V \\
\text{E.} & \quad \text{none of the above}
\end{align*}
15. The current $i$ in the circuit below is

![Circuit Diagram]

A. $-2 \, A$
B. $5 \, A$
C. $3 \, A$
D. $4 \, A$
E. none of the above

16. The value of the voltage $v$ for the circuit below is

![Circuit Diagram]

A. $4 \, V$
B. $6 \, V$
C. $8 \, V$
D. $12 \, V$
E. none of the above

17. For the network below, the equivalent resistance $R_{TH}$ to the right of terminals $a$ and $b$ is

![Circuit Diagram]

A. $1$
B. $2$
C. $5$
D. $10$
E. none of the above
18. For the network below, the Thevenin equivalent voltage $V_{TH}$ across terminals $a$ and $b$ is

A. $-3 \text{ V}$
B. $-2 \text{ V}$
C. $1 \text{ V}$
D. $5 \text{ V}$
E. none of the above

19. For the network below, the Norton equivalent current source $I_N$ and equivalent parallel resistance $R_N$ across terminals $a$ and $b$ are

A. $1 \text{ A}, 2 \Omega$
B. $1.5 \text{ A}, 25 \Omega$
C. $4 \text{ A}, 2.5 \Omega$
D. $0 \text{ A}, 5 \Omega$
E. none of the above

20. In applying the superposition principle to the circuit below, the current $i$ due to the 4 V source acting alone is

A. $8 \text{ A}$
B. $-1 \text{ A}$
C. $4 \text{ A}$
D. $-2 \text{ A}$
E. none of the above