

University Electrical Engineering

Name: _____ Score: _____

1. A 3.7 V battery stores 3 A · h of charge. Which energy value is correct?
 - ☐ 3.7 J
 - ☐ About 4.0×10^7 J
 - ☐ About 4.0×10^4 J
 - ☐ 11.1 J
2. At a node, 4 A and 1.5 A flow in, and 2 A flows out through a third branch. What does KCL give for the fourth branch?
 - ☐ 3.5 A flowing in
 - ☐ 0.5 A flowing out
 - ☐ 3.5 A flowing out
 - ☐ 7.5 A flowing out
3. A 12 V source feeds a node through 4Ω ; a 6Ω runs from the node to ground. What is the node voltage?
 - ☐ 6.0 V
 - ☐ 9.6 V
 - ☐ 12 V
 - ☐ 7.2 V
4. A 10 V source feeds 5Ω in series with a 20Ω shunt. What are V_{th} and R_{th} at the shunt terminals?
 - ☐ 2 V and 4Ω
 - ☐ 8 V and 25Ω
 - ☐ 8 V and 4Ω
 - ☐ 10 V and 4Ω
5. The virtual-short rule says the two input voltages are equal. Why?
 - ☐ Input resistance is zero
 - ☐ It only holds without feedback
 - ☐ Infinite gain with negative feedback forces the input difference toward zero
 - ☐ The inputs are physically connected inside

6. The voltage on a 10 μF capacitor rises steadily at 100 V per second. What current flows, in mA?

_____ mA

7. A capacitor at 1 V is switched onto a 5 V supply through a resistor, with $\tau = 2$ s. What is its voltage after 2 s, in volts? Give two decimal places.

_____ V

8. The 12 V, 0.25 A lamp stays on for 5 minutes. How much energy does it take, in joules?

_____ J

9. A 12 V supply is connected across a 2.4 k Ω resistor. What current flows, in mA?

_____ mA

10. A 4 V source joins P (+) to Q. Both P and Q have 4 Ω to ground, and 2 A is injected into P. What is V_Q , in volts?

_____ V

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1. About 4.0×10^4 J

$3 \text{ A} \cdot \text{h}$ at 3.7 V gives $11.1 \text{ W} \cdot \text{h}$; $11.1 \times 3600 \approx 4.0 \times 10^4 \text{ J}$. The megajoule option forgets the hours-to-seconds step.

2. 3.5 A flowing out

Signed sum out = 0 gives $-4 - 1.5 + 2 + i_4 = 0$, so $i_4 = 3.5 \text{ A}$ out. Nothing is consumed at the node.

3. 7.2 V

The divider $12 \times 6/(4+6) = 7.2 \text{ V}$ equals the nodal answer; both branch currents then equal 1.2 A .

4. 8 V and 4Ω

$V_{\text{th}} = 10 \times 20/25 = 8 \text{ V}$; with the source shorted, $R_{\text{th}} = 5 \parallel 20 = 4 \Omega$. Adding the series resistor to R_{th} is the classic slip.

5. Infinite gain with negative feedback forces the input difference toward zero

The output can only stay inside the rails if the fed-back difference is essentially zero - $A \times (v_+ - v_-)$ finite with $A \rightarrow \infty$ requires $v_+ \approx v_-$.

6. 1 mA

$i = C \frac{dv}{dt} = 10 \times 10^{-6} \times 100 = 0.001 \text{ A} = 1 \text{ mA}$, constant because the slope is constant.

7. 3.53 V

$v = 5 + (1 - 5)e^{-1} = 5 - 4 \times 0.368 \approx 3.53 \text{ V}$. One time constant closes 63% of the 4 V gap.

8. 900 J

$p = 12 \times 0.25 = 3 \text{ W}$, and $w = pt = 3 \times 300 = 900 \text{ J}$. Convert the minutes to seconds first.

9. 5 mA

$i = \frac{v}{R} = \frac{12}{2400} = 0.005 \text{ A} = 5 \text{ mA}$.

10. 2 V

Supernode: $\frac{V_P}{4} + \frac{V_Q}{4} = 2$, so $V_P + V_Q = 8$; with $V_P - V_Q = 4$ this gives $V_P = 6 \text{ V}$ and $V_Q = 2 \text{ V}$.