Problem 1:
Assign a voltage to the resistor and do KVL:

KVL: (clockwise, starting at top)
5 - 6 + 8 + x = 0
x = 6 - 8 - 5 = -7 V

So \( I = \frac{-7V}{1k} = -7mA \)

So positive current flows clockwise thru the circuit.
Positive current flows + to - thru 6V battery;
6V battery is charging (absorbing power).
Positive current flows - to + thru 5 + 8 V batteries;
5 + 8 V batteries are discharging (releasing).

Problem 2:

12V positive current
Lamp 10 W = \(0.28 P\) total power absorbed by lamp
\( P_{total} = 35.7 W \)
\( P_{total} = VI \quad I = \frac{P_{total}}{V} = \frac{35.7}{12} \)

\( I = 2.975 A \)
Problem 3:

A
B
C

A, B, C

1 and 2 (A and C) have the same graph:

T

3 (B C)

F (A + B C)

T 2T 3T
Problem 4:

Both are consequences of DeMorgan's Law.

Problem 5:

a) $V_{out}(V) \quad \tau T = RC = 500\text{ns} = 0.5 \mu\text{s}$

b) $V_{out}(t) = V_{in} + (V_{out}(t=0) - V_{in}) e^{-\frac{t}{RC}}$

$= 3 e^{-\frac{t}{500\text{ns}}} \text{ V}$
c) 2 ways:

\[ i(t) = C \frac{dV_{out}}{dt} \text{ or } \]

\[ i(t) = \frac{V_{R(t)}}{R} = \frac{V_{in} - V_{out(t)}}{R} \]

\[ i(t) = -3e^{-\frac{t}{5000}} \text{ mA} \]

\[ E = \int_{0}^{\infty} R(i(t))^2 \, dt = \int_{0}^{\infty} 10 \times 10^3 (0.3 \times 10^{-3} e^{-\frac{t}{5000}})^2 \, dt \]

\[ E = \int_{0}^{\infty} 0.9 \times 10^{-3} e^{-\frac{t}{5000}} \, dt \]

\[ = (250 \times 10^{-9}) (0.9 \times 10^{-3}) e^{-\frac{t}{5000}} \bigg|_{0}^{\infty} \]

\[ = (250 \times 10^{-9}) (0.9 \times 10^{-3}) = 225 \times 10^{-12} \text{ J} = 225 \text{ pJ} \]

\[ E = 225 \text{ pJ} \]

The resistor dissipated the energy that was stored in the capacitor.

f) energy produced by capacitor = \( \frac{1}{2} C V_{out(0)}^2 \)

\[ = \frac{1}{2} \times 50 \times 10^{-12} \times 3^2 = 225 \times 10^{-12} = 225 \text{ pJ} \]

Same as resistor dissipated!