

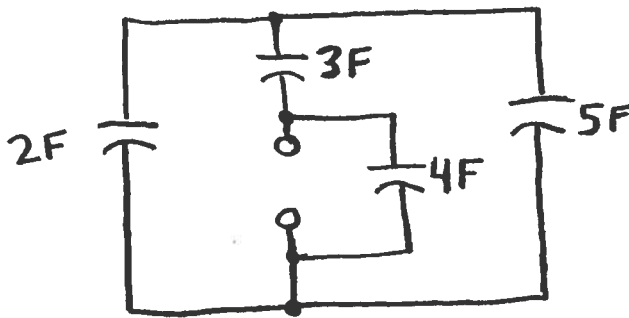
EE212 Test 2

The weighting of each problem is not necessarily the same.

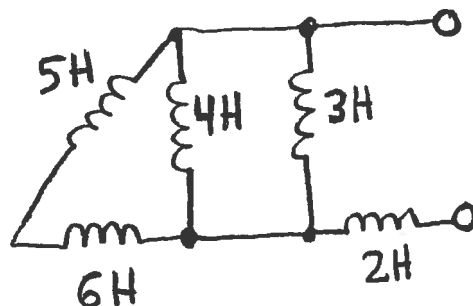
Test Instructions:

1. This is a closed book, closed notes examination. No additional tables, including integral tables, may be used.
2. Calculators, computers, and other electronic computational devices are not permitted.
3. You may work in the test booklet.
4. Provide only your final solutions on the test answer sheet.
5. Provide units on all answers.
6. The length of the examination is 2 hours.
7. For the final grade, only the answers on the answer sheet will be graded.
8. These problems are graded right or wrong. (In most cases, there is no partial credit.) If multiple solutions or intermediate work are provided, the solution is considered incorrect. Use parenthesis when needed.

1. Provide one example of a dielectric material.
2. Provide one possible negative consequence of placing two or more batteries in parallel.
3. Determine the equivalent capacitance seen by the two terminals. Do not simplify the expression. Do NOT use the symbol for two elements in parallel (e.g., $C_x \parallel C_y$).

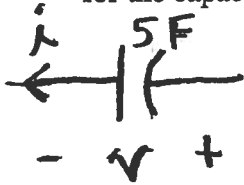


4. Determine the equivalent inductance seen by the two terminals. Do not simplify the expression. If needed, the symbol for two resistive elements in parallel (e.g., $L_x \parallel L_y$) may be used.



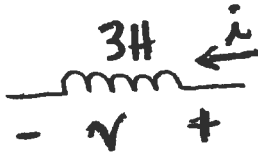
5. Given the voltage $v = 3 - 8e^{-t/9}$

for the capacitor shown, determine the current $i(t)$. Evaluate any derivatives.



6. Given the current $i = -4 + 6e^{-7t}$

for the inductor shown, determine the voltage $v(t)$. Evaluate any derivatives.



7. Sketch the voltage expression $v = 3 - 8e^{-2t/3}$

Clearly label the initial value ($t = 0$), final value, and the approximate value of the function at one time constant.

8. Determine the energy absorbed by a 6 F capacitor between 2 time constants and infinity if the voltage across the capacitor is given by

$$v = 3 + 4e^{-t/6}$$

Start from the integral definition for the energy. Evaluate all integrals. Provide the units for the energy expression.

$$\tau = 6 \text{ sec}$$

$$i = 6\left(-\frac{4}{6}e^{-t/6}\right) \text{ A}$$

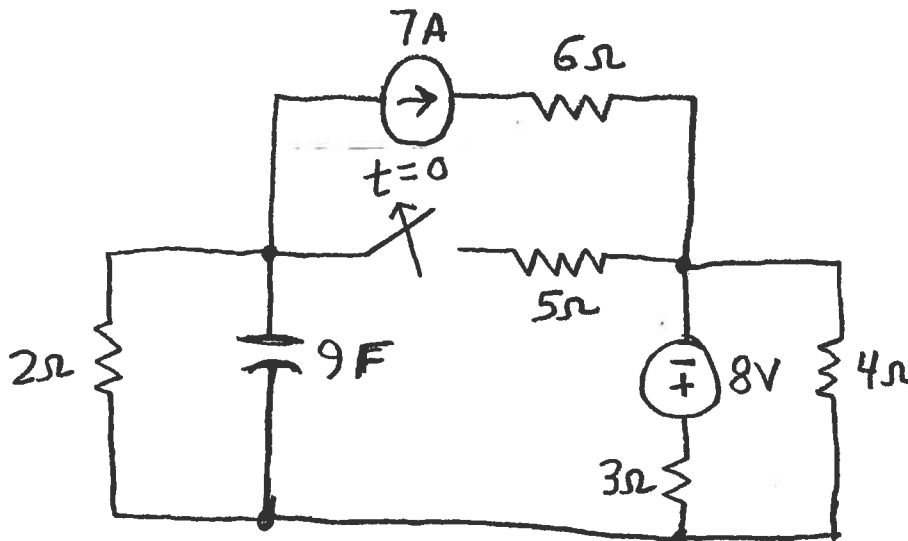
$$2\tau = 12 \text{ sec}$$

$$E = \int_{2\tau}^{\infty} 6\left(-\frac{4}{6}e^{-t/6}\right) (3 + 4e^{-t/6}) dt$$

$$= \int_{2\tau}^{\infty} -4(3e^{-t/6} + 4e^{-t/3}) dt = -4 \left[-18e^{-t/6} - 12e^{-t/3} \right]_{2\tau}^{\infty}$$

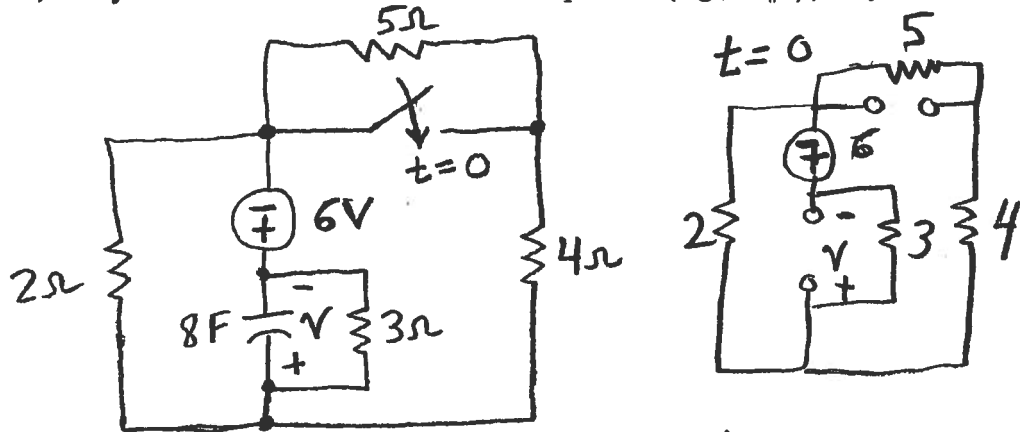
$$= +4 \left[-18e^{-2} - 12e^{-4} \right] \text{ J or W}\cdot\text{s}$$

9. The switch has been closed for a long time before opening at $t = 0$. Find the time constant for $t > 0$. Provide the units for the time constant. (The symbol used for elements in parallel, e.g., $7 \parallel 13$, may be left in the expression.)



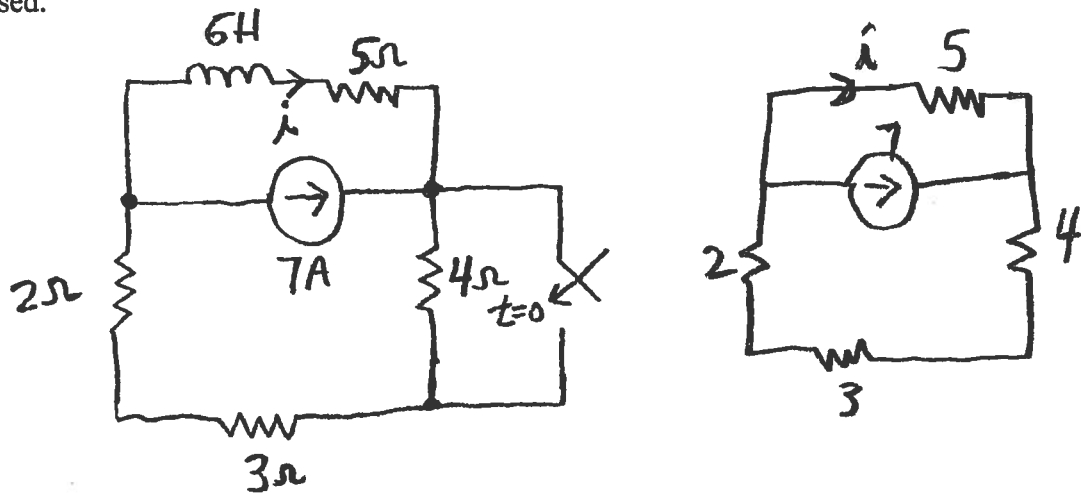
10. The switch has been open for a long time. At $t = 0$, the switch is closed. Find
- the initial voltage for $v(t)$
 - the final voltage for $v(t)$
 - the time constant for $v(t)$ $t > 0$
 - the complete expression for $v(t)$ $t > 0$

If needed, the symbol for two resistive elements in parallel (e.g., $R_x \parallel R_y$) may be used.



11. The switch has been open for a long time. At $t = 0$, the switch is closed. Find
- the initial current for $i(t)$
 - the final current for $i(t)$
 - the time constant for $i(t)$ $t > 0$
 - the complete expression for $i(t)$ $t > 0$

If needed, the symbol for two resistive elements in parallel (e.g., $R_x \parallel R_y$) may be used.



Printed Name: SOLN

Signature: _____

21 pts + 2 pts = 23 pts total
 ↑
 units

Answer Sheet (Provide Units)

1 1. glass

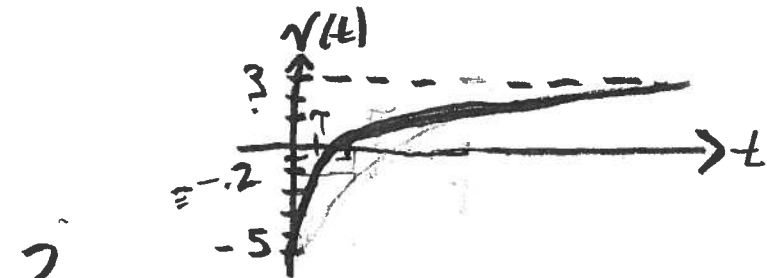
1 2. explosion!

1 3. $\frac{(2+5)3}{2+5+3} + 4 \text{ F}$

1 4. $[(5+6) // 4 // 3] + 2 \text{ H}$

1 5. $5\left(\frac{8}{9}e^{-4/9}\right) \text{ A}$

1 6. $3(-42e^{-7t}) \text{ V}$



$$\begin{aligned} v(\tau) &= 3 - 8/(4) \\ &= 3 - 3/2 \\ &= 3 - 1.5 \\ &= 1.5 \text{ V} \\ \tau &= 3/2 \text{ s} \end{aligned}$$

2 7. _____

2 8. $-4[18e^{-2} + 12e^{-4}] \text{ J or W}\cdot\text{s}$

1 9. 2 x 9 sec

13
14
15
18

1/32

$$2 \quad 10(a). \quad -6 \times \frac{3}{3 + [(4+5)/2]} \quad \text{OR} \quad \frac{-6}{[(4+5)/2] + 3} \times 3 \quad \checkmark$$

$$1 \quad 10(b). \quad -6 \times \frac{3}{3 + (4/2)} \quad \text{OR} \quad \frac{-6}{(4/2) + 3} \times 3 \quad \checkmark$$

$$1 \quad 10(c). \quad [2/4/3] 8 \quad \text{sec.} \quad \left(\frac{12}{13}\right) 8$$

$$1 \quad 10(d). \quad -6 \times \frac{3}{3 + (4/2)} + \left[-6 \frac{3}{3 + [(4+5)/2]} + 6 \times \frac{3}{3 + (4/2)} \right] e^{-t/\tau} \quad \checkmark$$

$$2 \quad 11(a). \quad -7 \times \frac{2+3+4}{2+3+4+5} \quad \text{OR} \quad -7 \times [(2+3+4)/5] / 5 \quad A$$

$$1 \quad 11(b). \quad -7 \times \frac{2+3}{2+3+5} \quad \text{OR} \quad -7 \times [(2+3)/5] / 5 \quad A$$

$$1 \quad 11(c). \quad 6 / (2+3+5) \quad \text{sec.}$$

$$1 \quad 11(d). \quad -7 \times \frac{2+3}{2+3+5} + \left[-7 \times \frac{2+3+4}{2+3+4+5} + 7 \times \frac{2+3}{2+3+5} \right] e^{-t/\tau} \quad A$$

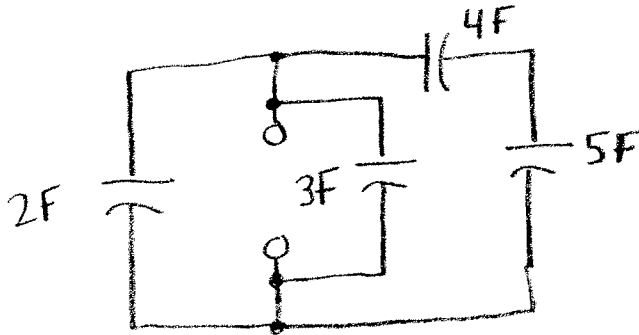
EE212 Test 2

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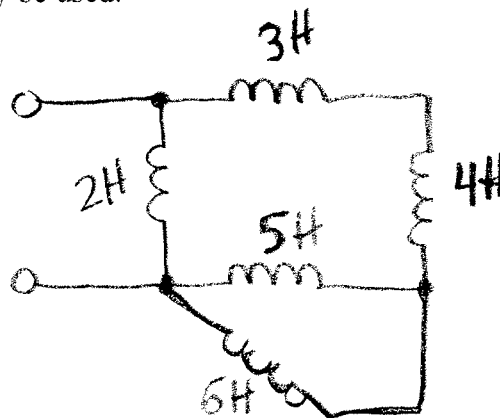
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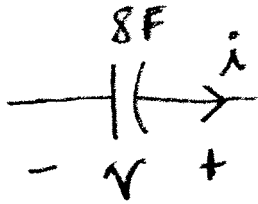


4. Determine the equivalent inductance seen by the two terminals. Do not simplify the expression. If needed, the symbol for two resistive elements in parallel (e.g., $L_x \parallel L_y$) may be used.



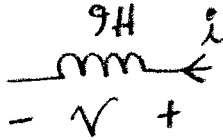
5. Given the voltage $v = -2 - e^{-4t}$ V

for the capacitor shown, determine the current $i(t)$. Evaluate any derivatives.



6. Given the current $i = 3 + 2e^{-t/7}$ A

for the inductor shown, determine the voltage $v(t)$. Evaluate any derivatives.



7. Sketch the voltage expression $v = -2 + 3e^{-2t}$ V

Clearly label the initial value ($t = 0$), final value, and the approximate value of the function at one time constant.

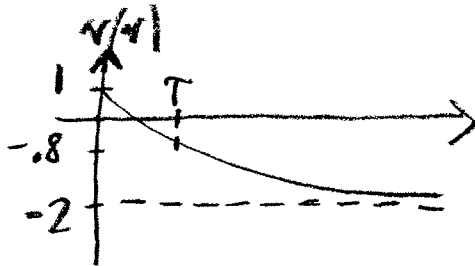
$$\begin{aligned} \tau &= 1/2 \\ v(\tau) &= -2 + 3e^{-1} \\ &\doteq -2 + 3(.4) = -2 + 1.2 \\ &= -.8 \end{aligned}$$

Printed Name: SOLN

Signature: _____

21 pts + 2 pts = 23 pts total
↑
units

Answer Sheet (Provide Units)

1 1. ceramic1 2. boom!1 3. $\frac{4.5}{4+5} + 2 + 3$ F1 4. $[(5/6) + 4 + 3] / 2$ H1 5. $-8(4e^{-4t})$ A1 6. $9(-\frac{2}{7}e^{-t/7})$ V

2 7. _____

2 8. $-5(15) \left[\frac{2e^{-4}}{3} + \frac{5e^{-8}}{6} \right]$ J or W-s1 9. $8 / (3/4/5)$ sec

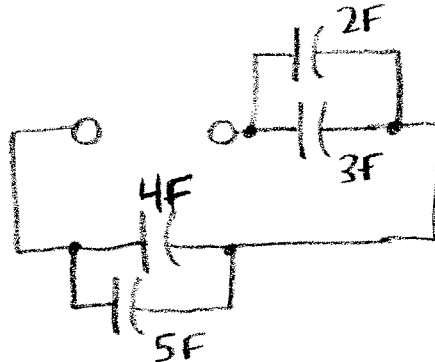
EE212 Test 2

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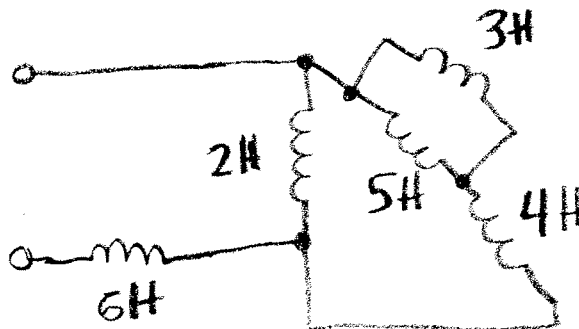
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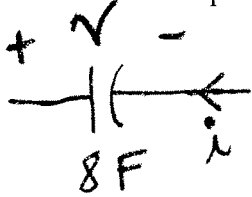


4. Determine the equivalent inductance seen by the two terminals. Do not simplify the expression. If needed, the symbol for two resistive elements in parallel (e.g., $L_x \parallel L_y$) may be used.



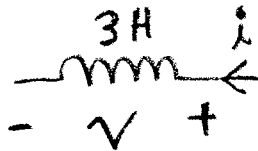
5. Given the voltage $v = 3 - 2e^{-t/3}$ V

for the capacitor shown, determine the current $i(t)$. Evaluate any derivatives.



6. Given the current $i = -5 + e^{-7t}$ A

for the inductor shown, determine the voltage $v(t)$. Evaluate any derivatives.



7. Sketch the voltage expression $v = 3 - 2e^{-7t}$ V

Clearly label the initial value ($t = 0$), final value, and the approximate value of the function at one time constant.

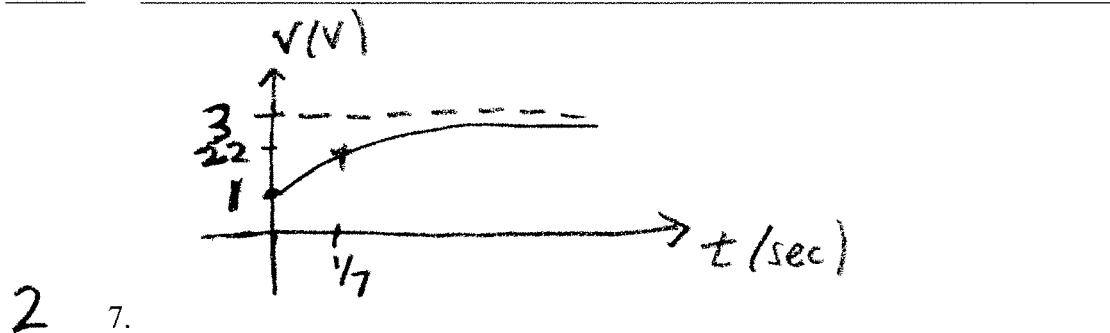
$$\begin{aligned} \tau &= \frac{1}{7} \text{ sec} \\ v(\tau) &= 3 - 2e^{-1} \\ &\approx 3 - 2(0.4) \\ &= 3 - 0.8 \\ &= 2.2 \end{aligned}$$

Printed Name: SOLN

Signature: _____

19 pts + 2 pts = 21 pts total
UNITS

Answer Sheet (Provide Units)

1 1. glass1 2. boom!1 3. $\frac{(2+3)(4+5)}{2+3+4+5}$ F1 4. $\{[(3/5) + 4] / 2\} + 6$ H1 5. $-8 \left(\frac{2}{3} e^{-t/3} \right)$ A1 6. $3(-7e^{-7t})$ V2 8. $-5(15) \left[\frac{2e^{-4}}{5} + \frac{3e^{-8}}{10} \right]$ J or W-s1 9. $\{[(3/5) + 2] / 4\} 9$ sec

EE212 Test 2

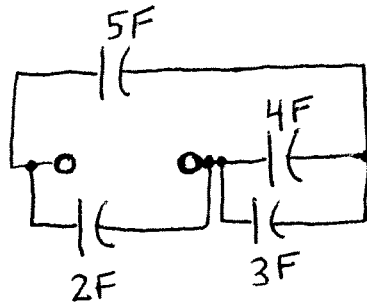
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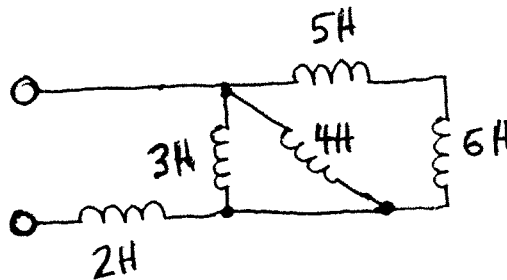
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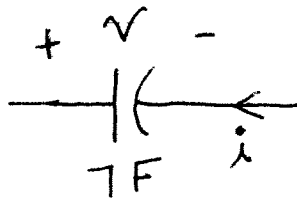
3. Determine the equivalent capacitance seen by the two terminals. Do not simplify the expression. Do NOT use the symbol for two elements in parallel (e.g., $C_x \parallel C_y$).



4. Determine the equivalent inductance seen by the two terminals. Do not simplify the expression. If needed, the symbol for two resistive elements in parallel (e.g., $L_x \parallel L_y$) may be used.

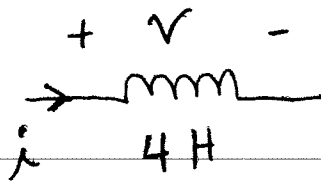


5. Given the voltage $v = -2 + 3e^{-12t}$ V for the capacitor shown, determine the current $i(t)$. Evaluate any derivatives.



$$i = -C \frac{dv}{dt} \\ = -7 \left[-36e^{-12t} \right]$$

6. Given the current $i = 5 - 3e^{-\frac{t}{8}}$ A for the inductor shown, determine the voltage $v(t)$. Evaluate any derivatives.



$$v = L \frac{di}{dt} \\ = 4 \left[\frac{3}{8} e^{-\frac{t}{8}} \right]$$

7. Sketch the voltage expression $v = -5 + 3e^{-\frac{t}{2}}$ V. Clearly label the initial value ($t = 0$), final value, and the approximate value of the function after one time constant.

$$e^{-t/2} \text{ at } t = 2 (\tau) \\ \approx -5 + 3(.4) = -5 + 1.2 = -3.8$$

Printed Name: SOLUTION

Signature: _____

Answer Sheet (Provide Units)

1 1. teflon, polyester, polypropylene, mylar, ceramic

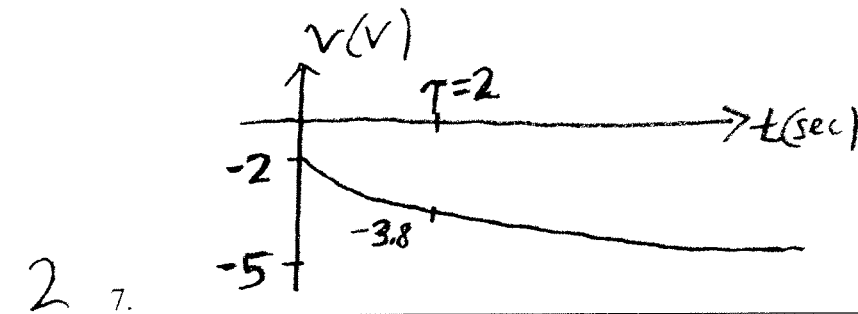
1 2. one battery could charge the other - explanation?

1 3. $\frac{(3+4)5}{3+4+5} + 2 \text{ F}$

1 4. $[(5+6)//4//3] + 2 \text{ H}$

1 5. $7 \times 36e^{-12t} \text{ A}$

1 6. $4 \times \frac{3}{8} e^{-4t/8} \text{ V}$



2 8. $-\frac{3.7^2(13)}{26} e^{-26(3)} \text{ J or W-5}$

1 9. $[(3//6) + 4] 5 \text{ sec}$

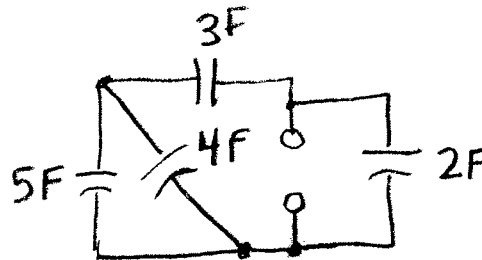
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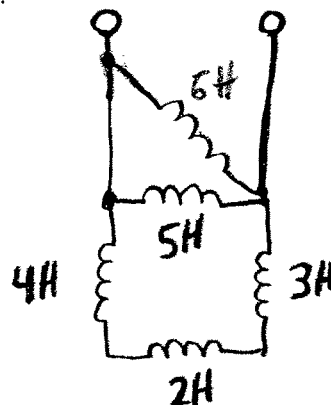
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4. Determine the equivalent inductance seen by the two terminals. Do not simplify the expression. If needed, the symbol for two resistive elements in parallel (e.g., $L_x \parallel L_y$) may be used.

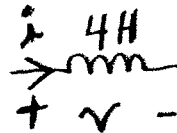


5. Given the voltage $v = 3 - 5e^{-\frac{t}{4}}$ V for the capacitor shown, determine the current $i(t)$. Evaluate any derivatives.



$$i = -C \frac{dv}{dt} \\ = -6 \left[-5^{-\frac{1}{4}} e^{-\frac{t}{4}} \right]$$

6. Given the current $i = -5 + 2e^{-3t}$ A for the inductor shown, determine the voltage $v(t)$. Evaluate any derivatives.



$$v = L \frac{di}{dt} \\ = 4(2(-3)e^{-3t})$$

7. Sketch the voltage expression $v = -3 - 5e^{-4t}$ V. Clearly label the initial value ($t = 0$), final value, and the approximate value of the function after one time constant.

$$\text{@ } t = \tau = 1/4 \\ v \approx -3 - 5(0.4) = -3 - 2 = -5$$

Printed Name: SOLUTION

Signature: _____

Answer Sheet (Provide Units)

19 pts + 2 pts
units = 21 pts
total

1 1. glass

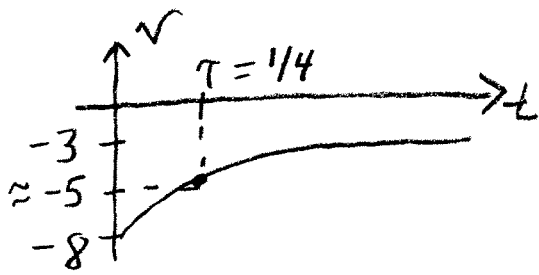
1 2. explosion!

1 3. $\frac{(4+5)3}{4+5+3} + 2$ F

1 4. $(2+3+4) // 5 // 6$ H

1 5. $-\frac{30}{4} e^{-4t}$ A

1 6. $-24 e^{-3t}$ V



2 7.

$$7(-12) \left[\frac{e^{-4}}{4} - \frac{3e^{-8}}{8} - \frac{1}{4} + \frac{3}{8} \right] \text{ J, W-5}$$

2 8.

1 9. $4 / (5+6+8)$ sec