

NOTABLE LLM RESPONSE EXAMPLES

In order to better demonstrate the strengths and weaknesses of different LLMs, especially GPT-4o and Llama 3 70B, this document provides notable examples of LLM responses in different topics. We use “♣” to denote the examples that can reflect the strengths of LLMs and “♠” to denote those that reflect the weaknesses.

Electric Circuit Variables and Elements

GPT-4o:

- ♠ q_010502_cs_7 [Final Answer]: The correct cost should be \$0.264, but your final answer is 26.4 cents (i.e., \$0.264). It seems you made an error when interpreting units (hours should have been used instead of seconds).

Note: GPT-4o fails to identify the equivalence between 26.4 cents and \$0.264.

- ♣ q_010503_cs_35 [Final Answer]: The student’s final answer of 3,333.33 s is equivalent to the official solution’s 3.33×10^3 s. This confirms that the answer is correct when considering significant figures and notational differences.

Note: GPT-4o can recognize that 3,333.33 s is equivalent to 3.33×10^3 s.

- ♣ q_010503_cs_37 [Unit]: Your notation is slightly different but acceptable (p instead of P), as you were consistent with it.

Note: GPT-4o can accommodate different notation in the student’s solution as long as the notation is used consistently.

- ♣ q_020406_cs_6 [Unit]: When calculating the power absorbed by R_1 , the student writes the intermediate result as 0.0025ω which is incorrect. It should be 0.0025 W instead. This typographical error has been correctly converted to 2.5 mW in the final step.

Note: GPT-4o points out the typo of the unit ω , which should be W, demonstrating its robustness to occasional typos.

- ♣ q_020406_ws_7 [Final Answer]:

- For v_1 , the student calculated -100 mV , which matches the correct answer -0.1 V . The conversion between volts and millivolts is appropriate.
- For v_2 , the student calculated 200 mV , which matches the correct answer 0.2 V .

Note: GPT-4o recognizes the equivalences of answers in different units.

- ♠ q_020406_ws_9 [Completeness]: The student’s solution is incomplete. While they calculated the voltage across the resistors and the power absorbed by each resistor, they did not address the direction of current and adherence to the passive sign convention.

Note: The student’s solution should be considered complete since they calculated the voltage across the resistors and the power absorbed by each resistor.

- ♠ q_020406_ws_18 [Unit]: The units for power are inconsistent and incorrect due to the sign convention error. Additionally, the answer is expected in milliwatts (mW), but the unit was given in watts (W) which adds to the confusion.

Note: GPT-4o is overly confident that the answer is expected in milliwatts. In fact, the answer given in watts is also acceptable.

- ♣ q_020501_cs_6 [Unit]: In part (b), there’s a minor typo in the student’s solution “15 vV” which should be “15 V”. This is a small error and doesn’t affect the correctness of the calculation but should be noted for precision and clarity.

Note: GPT-4o can recognize the unit typo and state that the small typo does not affect the correctness of the solution.

- ♣ q_020501_cs_11 [Method]: The power calculation method the student used $p = I \cdot V$ is correct but it is different from the official solution's method $P = Ri^2$. Both methods are valid and yield the correct result.

Note: GPT-4o correctly identifies an alternative approach as correct.

Llama 3 70B:

- ♠ q_010502_cs_7 [Final Answer]: The student's final answers are mostly correct, but with some errors:
- Part (a): The student's answer, $q = 72000\text{C}$, is incorrect. The correct answer is $q = 7.2 \times 10^4\text{C}$. The student's mistake is likely due to a typo or a misunderstanding of the unit conversion.
 - Part (b): The student's answer, $P = 1100\text{ W}$, is correct.
 - Part (c): The student's answer, $\text{cost} = 26.4\text{ cents}$, is incorrect. The correct answer is $\text{cost} = \$0.264$. The student's mistake is due to incorrect unit conversion and cost calculation.

Note: Llama 3 70B does not recognize the equivalence between 72000 and 7.2×10^4 as well as between 26.4 cents and $\$0.264$.

- ♠ q_010502_cs_27 [Final Answer]:
- Part (a): The student's answer, $q = 72,000\text{C}$, is close to the correct answer, $q = 7.2 \times 10^4\text{C}$. The student's answer is in the correct units (Coulombs) and is approximately correct, but not exactly equal to the correct answer. This might be due to a rounding error or a slight calculation mistake.
 - Part (b): The student's answer, $P = 1100\text{ W}$, is correct.
 - Part (c): The student's answer, ≈ 264 , is close to the correct answer, $\$0.264$. The student's answer is in the correct units (dollars) and is approximately correct, but not exactly equal to the correct answer. This might be due to a rounding error or a slight calculation mistake.

Note: Llama 3 70B does not recognize that 72,000 C and $7.2 \times 10^4\text{ C}$ are exactly the same value. The feedback about part (c) is also dubious, as 264 cents are not close to $\$0.264$.

- ♣ q_010503_cs_5 [Final Answer]: The student's final answer, 3333.33 seconds, is correct. It matches the official solution's answer of $\Delta t = 3.33 \times 10^3\text{ s}$.

Note: Llama 3 70B successfully recognizes the equivalence between 3333.33 seconds and 3.33×10^3 seconds.

- ♠ q_020406_ws_16 [Arithmetic]: There are arithmetic errors in the student's solution. For example, in calculating P_1 , the student writes -0.0025 W , which is incorrect. The correct calculation is $P_1 = -v_1 i_1 = -(-0.1)(0.025) = 2.5\text{ mW}$. Similarly, in calculating P_2 , the student writes 0.005 W , which is incorrect. The correct calculation is $P_2 = v_2 i_2 = (0.2)(0.025) = 5\text{ mW}$.

Note: Llama 3 70B does not recognize the equivalence between 0.005 W and 5 mW after the unit conversion.

Analysis of Resistive Circuits

GPT-4o:

♠ q_030404_cs_37 [Arithmetic]: There are arithmetic errors in your calculations for i_1 and i_2 .

– Correct calculation:

$$i_1 = \frac{8}{16+8}(-6) = -2 \text{ A}$$

$$i_2 = \frac{8}{8+8}(-6) = -3 \text{ A}$$

– Your incorrect calculation:

$$i_1 = \frac{1/8}{\frac{1}{8} + \frac{1}{8}} \cdot 6 \text{ A} = 3 \text{ A}$$

$$i_2 = \frac{1/16}{\frac{1}{16} + \frac{1}{8}} \cdot 6 \text{ A} = 2 \text{ A}$$

Note: GPT-4o fails to recognize that the student's solution uses a different notation system from the official solution. In this example, the currents i_1 and i_2 in the student's solution represent i_2 and i_1 , respectively, in the official solution. GPT-4o cannot recognize the exchanged variable notations. To overcome this issue, we can make the variable notations clear in future problem designs.

♠ q_030601_cs_27 [Part (c), Final Answer]: The final answer provided, $i_2 = 0.33 \text{ A}$, is not accurate and should be $\frac{1}{3} \text{ A}$.

Note: The student's final answer $i_2 = 0.33 \text{ A}$ is acceptable within a rounding error.

♣ q_030601_cs_35 [Part (c), Final Answer]:

$i_2 = \frac{1}{3} \text{ A} = 0.333 \text{ A}$: The value is correct, though it should ideally be presented as $\frac{1}{3} \text{ A}$ to match the given answers more precisely.

Note: Different from example GPT-4o-q_030601_cs_27, GPT-4o correctly identifies the value equivalence between $\frac{1}{3} \text{ A}$ and 0.333 A . This implies that the performance of GPT-4o is not stable due to its intrinsic randomness when generating responses.

♣ q_040202_cs_25 [Method]:

– The student uses Kirchhoff's Voltage Law (KVL) instead of Kirchhoff's Current Law (KCL), which is a valid alternative approach for solving the circuit problem.

– They correctly set up the equations based on the KVL approach, which is an appropriate method.

Note: Unlike GPT-4o-q_050405_cs_37, GPT-4o identifies that the method in the student's solution is correct, although the student uses KVL instead of KCL as in the official solution.

♠ q_040205_cs_24 [Final Answer]: The final answer in the student's solution is 0.022 V . While the method and intermediate steps are correct, the final answer should be expressed as 21.7 mV (0.0217 V). It appears there is an error in the final conversion or calculation of the voltage difference.

Note: GPT-4o considers the rounding error in the student's solution to be a calculation error.

♠ q_050304_cs_14 [Arithmetic]: There are errors in the arithmetic and the process leading to the calculation, primarily in their steps involving the arithmetic for current division:

– For the 9 A source:

$$i_{20A} = 9 \text{ A} \cdot \frac{1/35\Omega}{1/10\Omega + 1/35\Omega} \neq 2 \text{ A}$$

Correct method:

$$i_{20A} = 9 \text{ A} \cdot \frac{10\Omega}{10\Omega + 35\Omega} = 9 \text{ A} \cdot \frac{10}{45} = 9 \text{ A} \cdot \frac{2}{9} = 2 \text{ A}$$

– For the 6 A source:

$$i_{20B} = 6 \text{ A} \cdot \frac{1/30\Omega}{1/30\Omega + 1/15\Omega} \neq 2 \text{ A}$$

Correct method:

$$i_{20B} = 6 \text{ A} \cdot \frac{15\Omega}{15\Omega + 30\Omega} = 6 \text{ A} \cdot \frac{15}{45} = 6 \text{ A} \cdot \frac{1}{3} = 2 \text{ A}$$

Note: Although GPT-4o sometimes performs detailed mathematical calculations, the results are not necessarily correct. In this example, we should have $9 \text{ A} \cdot \frac{1/35\Omega}{1/10\Omega + 1/35\Omega} = 2 \text{ A}$ and $6 \text{ A} \cdot \frac{1/30\Omega}{1/30\Omega + 1/15\Omega} = 2 \text{ A}$.

♠ q_050405_cs_7 [Final Answer]: Unfortunately, your final answer for R_t is incorrect. The official answer is $R_t = -\frac{8}{3} \Omega$, but you calculated it as $-\frac{16}{6} \Omega$.

Note: GPT-4o fails to recognize the equivalence between $-\frac{8}{3} \Omega$ and $-\frac{16}{6} \Omega$.

♠ q_050405_cs_37 [Method]: The student applies KCL to find R_t . However, the method and steps are somewhat unclear and differ from the standard approach usually taught, which directly utilizes the short-circuit current i_{sc} and open-circuit voltage v_{oc} . This might be confusing.

Note: The student's solution uses an alternative approach to find R_t . Although the method used is different from the approach in the official solution, it is also correct.

Llama 3 70B:

♣ q_030603_cs_5 [Method]: The student uses a correct method to reduce the circuit from the right side by combining series and parallel resistors. However, the student's approach is different from the official solution, which is acceptable as long as the logic is correct.

Note: Llama 3 70B correctly identifies an alternative approach as valid.

♣ q_040205_cs_2 [Final Answer]: The student's final answer, $v = 21.74 \text{ mV}$, is correct.

Note: The final answer in the official solution is 21.7 mV . Llama 3 70B does not consider the rounding error an arithmetic error.

♣ q_040205_cs_24 [Final Answer]: The student's final answer, $v = 0.022 \text{ V}$, is correct. However, it's worth noting that the problem asks for the answer in millivolts, so the student should have converted the answer to $v = 21.7 \text{ mV}$.

Note: Llama 3 70B does not consider the rounding error an arithmetic error.

♠ q_040303_ws_16 [Unit]: The student does not clearly identify the units of the variables throughout the calculation process. For example, the units of the currents i_1, i_2, i_3 are not specified.

Note: Although the student's solution has deficiencies in all the other four metrics, the student does use the correct units in the solutions. Thus, the above statement about units is incorrect in this case.

♠ q_040303_ws_28:

Completeness: The student's solution is complete, and it answers the question by providing the power supplied by each source.

Final Answers: The student's final answers for P_{12V} and P_{24V} are correct, which are 4.8 W each. However, the student does not explicitly calculate the power supplied by the current source, which is 19.2 W .

Note: Although the student does not provide the power supplied by the current source, Llama 3 70B still states that the student's solution is complete.

♣ q_040303_cs_35 [Method]: The student uses the correct method of applying KCL to node 'a' and then solving for the node voltages. However, the student's approach is slightly different from the official solution, which uses a supernode. Both approaches are valid, and the student's method is correct.

Note: Llama 3 70B correctly identifies a different approach as valid.

♣ q_040706_ws_7 [Final Answer]: The student's final answer, $P = -460.8 \text{ W}$, is incorrect. The correct answer is $P = 460.8 \text{ W}$. The student's answer has the correct magnitude but the wrong sign.

Note: Llama 3 70B identified the sign error in the student's final answer.

♠ q_050201_cs_36 [Part (c), Final Answer]: The student's final answer for i_a is incorrect, which is $-\frac{19}{12} \text{ A}$ instead of -1.58 A .

Note: Llama 3 70B does not recognize the equivalence between $-\frac{19}{12} \text{ A}$ and -1.58 A .

The Operational Amplifier

GPT-4o:

- ♠ q_060302_cs_2 [Completeness]: The student's solution is incomplete. While it attempts to find the current (i) and voltage (v_o), it lacks a detailed step-by-step explanation which includes the intermediate steps and proper application of Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL). The discussion concerning i_2 and intermediate voltages like v_a is missing.

Note: The student's solution is actually complete but misses some step-by-step explanations.

- ♠♣ q_060302_cs_5 [Arithmetic]: There is an arithmetic inconsistency in the presentation. For instance:
 - The student jumps from $12 = 5000i$ to $I = \frac{12}{5}$ mA. The correct I should be $I = \frac{12}{5000}$ A, which equals 2.4 mA. It seems like an attempt to convert units but the form is incorrect. The numbers are correct, but the portrayal could be cleaner.

Note: GPT-4o provides an overly rigorous assessment of the calculation process in the student's solution. Note that GPT-4o correctly identifies $\frac{12}{5}$ mA = 2.4 mA, which is good.

- ♣ q_060303_cs_5 [Method]: The student uses a different approach compared to the official solution. Instead of applying Kirchhoff's Current Law (KCL) at node a , the student uses the voltage drop across the 4 k Ω resistor to find the current i_o . This method is correct but less direct compared to KCL. The student's reasoning is sound and leads to the correct answer.

Note: GPT-4o correctly identifies an alternative approach as correct.

- ♣ q_060303_cs_21 [Method]:
 - You correctly identify that the voltages at the input nodes of the op-amp are equal (ideal op-amp assumption). However, the detailed steps for applying KCL at node A are not shown.
 - The second equation $\frac{V_o - V_A}{8\text{k}\Omega} + \frac{V_o}{20\text{k}\Omega} = 0$ used in your solution is incorrect for this circuit. The inclusion of the $\frac{V_o}{20\text{k}\Omega}$ term suggests there might be an incorrect assumption or a misunderstanding about the circuit configuration.

Note: The equation $\frac{V_o - V_A}{8\text{k}\Omega} + \frac{V_o}{20\text{k}\Omega} = 0$ is indeed incorrect since it implicitly assumes that the output of an operational amplifier always has zero current. Although the final answers in the student's solution are correct, GPT-4o still pointed out this issue.

- ♠ q_060402_cs_7 [Arithmetic]: There are no significant arithmetic errors that affect the final result. However, there is a sign issue to note:
 - In the equation for KCL@ V_b , you have correctly identified the expression $\frac{-V_3}{6000} - \frac{V_o}{6000} = 0$, but then you incorrectly simplified it to $-4 - V_o = 0$. The correct simplification should be $-\frac{4}{6000} - \frac{V_o}{6000} = 0$ which equates to $-4 - V_o = 0$, so this appears to be more of a transcription error than an arithmetic error.

Note: The response of GPT-4o is redundant since it is completely fine to derive $-4 - V_o = 0$ directly from $\frac{-V_3}{6000} - \frac{V_o}{6000} = 0$, given $V_3 = 4$ V.

- ♠♣ q_060404_cs_37:

Arithmetic: The student's final expression for V_o is:

$$V_o = \frac{R_1(V_1 - V_2) - R_3(V_2 - V_1)}{R_2} + V_1 - V_2$$

Simplifying this,

$$V_0 = \frac{R_1(V_1 - V_2) + R_3(V_1 - V_2)}{R_2} + V_1 - V_2$$

$$V_0 = \frac{(R_1 + R_3)(V_1 - V_2)}{R_2} + V_1 - V_2$$

This does not match the official solution:

$$v_0 = \frac{R_1 + R_2 + R_3}{R_2}(v_1 - v_2)$$

Thus, the student's final answer is incorrect. The steps might have errors that cause the final discrepancy.

Unit: The units are not explicitly addressed in the student's LaTeX representation, but they use standard electrical notations assuming all V_x terms are in volts and R_x terms are in ohms. No obvious unit discrepancies are evident.

Note: From this example, we can see that GPT-4o has some level of calculation ability. However, it does not fully simplify the original equation for V_0 and thus made an incorrect conclusion that the student's final expression does not match the official solution. Additionally, since this problem involves only the calculation of variable notations, we do not need to explicitly list the units. GPT-4o does not consider the omission of units as an error, which is good.

Llama 3 70B:

- ♠ q_060302_ws_28 [Unit]: The student's solution lacks clear notation and units. For example, the student uses V_1 , V_2 , and V_0 without clearly defining what they represent. Additionally, the units of the variables are not consistently identified throughout the calculation process.

Note: This is not the case since the student's solution uses the units consistently.

- ♠ q_060303_cs_21 [Method]: The student uses the correct method, applying KCL at node A and Ohm's law to the $8k\Omega$ resistor.

Note: The Llama 3 70B model does not correctly identify the incorrect assumption in the methodology.

- ♣ q_060404_cs_37:

Final Answer: The student's final answer is correct, which is $V_0 = \frac{R_1 + R_2 + R_3}{R_2}(V_1 - V_2)$. Although the student's expression looks different from the official solution, it can be simplified to match the official solution.

Units: The student does not explicitly identify the units of the variables throughout the calculation process. However, since the problem does not provide specific values for the resistances and voltages, it is assumed that the student is working with consistent units.

Note: Llama 3 70B successfully indicates that the student's final answer is correct, although it is in a different form from the official final answer. However, unlike GPT-4o, Llama 3 70B does not show the detailed mathematical calculation process. Additionally, Llama 3 70B recognizes that it is acceptable to omit the units explicitly since the problem does not provide specific values for the circuit variables.

- ♠ q_060405_ws_8 [Unit]: The student does not identify the units of the variables clearly and correctly throughout the calculation process.

Note: The solution involves only the notations of variables, not their values, so the units of the variables are implicit. Therefore, it is appropriate that the units are not explicitly defined.

The Complete Response of Circuits With Energy Storage Elements

GPT-4o:

♠♣ q_070202_cs_2:

Correct Final Answer:

- The student's final answer $i(t) = -3 \sin(2t + 30^\circ)$ is not in the correct form. The official solution is given by $i(t) = 3 \cos(2t + 120^\circ)$. There is an error in converting the trigonometric function from sine to cosine form.

Arithmetic Error:

- The differentiation and multiplication steps are performed correctly. However, there is an error in converting the sine function to the desired cosine function. Specifically, $\sin(x) = \cos(x - 90^\circ)$, thus transforming $-3 \sin(2t + 30^\circ)$ into $3 \cos(2t + 120^\circ)$.
- This is an important trigonometric identity that must be correctly applied to reach the problem's final solution form.

Detailed Feedback:

- The major issue lies in the final conversion of the trigonometric function. You derived the expression correctly up to $i(t) = -3 \sin(2t + 30^\circ)$. However, to match the standard cosine form, you need to apply the identity $\sin(x) = \cos(x - 90^\circ)$. Hence, $-3 \sin(2t + 30^\circ) = 3 \cos(2t + 30^\circ + 90^\circ) = 3 \cos(2t + 120^\circ)$.
- Ensure that you carefully handle trigonometric identities, especially when converting between sine and cosine functions to present your final answer in the required form.

Note: In the response about the final answer, GPT-4o indicates that there is an error in converting the trigonometric function from $-3 \sin(2t + 30^\circ)$ to $3 \cos(2t + 120^\circ)$. However, GPT-4o also demonstrates how to use the relevant trigonometric identities to correctly convert $-3 \sin(2t + 30^\circ)$ to $3 \cos(2t + 120^\circ)$ in the following analysis.

♠ q_070202_cs_5 [Arithmetic]: The derivative of the current is also incorrect; it should be $-750e^{-250t}$ not $-750e^{(-250t)}$.

Note: GPT-4o is sensitive to the format of mathematical equations.

♣ q_070302_ws_24 [Final Answer]: The student's final answers have some slight differences, but they are generally correct.

- $i_c(10 \text{ ms}) = 8.45 \times 10^{-19} \text{ A}$ is slightly different from the provided official solution, $8.5 \times 10^{-19} \text{ A}$. This can be due to rounding but should be consistent with significant figures.
- $W(t = 10 \text{ ms}) = 0.125 \text{ mJ}$ which is the same as $1.25 \times 10^{-4} \text{ J}$.

Note: In this example, GPT-4o successfully identifies the rounding error and recognizes the equivalence between two values with different units.

♠ q_080301_cs_36 [Final Answer]: Your final expressions for τ and $v(t)$ are incorrect. These should match the given solutions, $\tau = 0.75 \text{ s}$ and $v(t) = 6 - 2e^{-1.33t} \text{ V}$ for $t > 0$. Your exponent in $v(t)$ should be $-\frac{t}{\tau}$, where $\tau = 0.75 \text{ s}$, not $-\frac{4t}{3}$.

Note: The expression $-\frac{t}{\tau}$ is exactly $-\frac{4t}{3}$ when $\tau = 0.75 \text{ s}$.

♠ q_080401_cs_5 [Arithmetic]: There are a few arithmetic inaccuracies:

- You calculated $v(1.5) = 5.0027 \text{ V}$ instead of the correct $v(1.5) = 5 \text{ V}$.
- You used $v(1.5) = 5.0027 \text{ V}$ for the subsequent calculations, which caused a slight deviation in your final expression for $t > 1.5 \text{ s}$.

Note: GPT-4o considers the small discrepancy between 5 V and 5.0027 V an arithmetic inaccuracy rather than a rounding error.

♣ q_080401_cs_11 [Arithmetic]: The initial calculation of $V(1.5^-) = 5 + 5e^{-5 \cdot 1.5}$ seems approximately correct. However, rounding to 5.003 V is unnecessary and should ideally be kept as 5 V based on typical conventions.

Note: GPT-4o considers the small discrepancy between 5 V and 5.003 V to be a rounding error.

♣ q_090201_cs_7 [Final Answer]: No, the student's final answers have some issues. The final solution derived is:

$$10^8 V_s = \frac{d^2 V}{dT^2} + 3000 \frac{dV}{dT} + 1.02 \times 10^8 V$$

However, the correct final answer is:

$$1 \times 10^8 v_s = 1.02 \times 10^8 v + 3000 \frac{dv}{dt} + \frac{d^2 v}{dt^2}$$

Notably, the order and coefficients of terms in the student's final equation match, but there are discrepancies in the variables used (V vs. v and T vs. t).

Note: Although GPT-4o identifies that the coefficients of the terms in the student's final equation match, it still indicates that the student's final answer is incorrect due to discrepancies in the variables used.

♣ q_090201_cs_19 [Final Answer]: Correctness of Final Answer:

- The final equation $1 \times 10^8 v_s = \frac{d^2 v}{dt^2} + 3000 \frac{dv}{dt} + 1.02 \times 10^8 v$ the student reaches is incorrect primarily because of coefficient and term sign errors throughout the derivation.
- This divergence from the correct answer $1 \times 10^8 v_s = 1.02 \times 10^8 v + 3000 \frac{dv}{dt} + \frac{d^2 v}{dt^2}$ indicates a need to revisit algebraic and differential handling within this setup.

Note: GPT-4o fails to recognize the equivalence between two differential equations in which the terms are arranged in different orders.

♣ q_090303_cs_5 [Final Answer]: The student's final answers for the roots of the characteristic equation are $s = -3031.260$ and $s = -98969.740$. These values are close to the correct answers of $s = -3031$ and $s = -98969$, but the precision given is slightly different. The correct roots are indeed theoretically rounded to these values, but the more precise values provided by the student suggest a deeper discrepancy in the calculation steps.

Note: GPT-4o successfully recognizes the small deviations in the student's final answers as rounding errors. However, it incorrectly suggests a deeper discrepancy in the calculation steps.

♣ q_090303_cs_7 [Arithmetic]: Specifically, right before solving for the characteristic equation, you have inaccurately arrived at $1.02 \times 10^5 s$ instead of the correct $102000s$.

Note: GPT-4o does not recognize the equivalence between $1.02 \times 10^5 s$ and $102,000 s$.

♣ q_090303_cs_23 [Final Answer]:

- The final numerical solutions for s_1 and s_2 are incorrect. The official correct answers are $s_1 = -3031$, $s_2 = -98969$.
- The student has $S_1 = -3031.26$ and $S_2 = -98968.74$. Despite small deviations, these values are incorrect due to errors in prior steps. Additionally, the discrepancy here would not be considered rounding errors.

Note: GPT-4o does not recognize the small deviations in the student's final answers as rounding errors.

Llama 3 70B:

- ♠ q_070202_cs_2 [Final Answer]: The student's final answer is incorrect. The correct final answer is $i(t) = 3 \cos(2t + 120^\circ)$ A, but the student's answer is $i(t) = -3 \sin(2t + 30)$.

Note: Llama 3 70B does not identify the equivalence between $3 \cos(2t + 120^\circ)$ and $-3 \sin(2t + 30)$.

- ♠ q_070204_cs_5 [Final Answer]:

- The unit of voltage is incorrect in some places. For example, in the first interval, the voltage should be -10^{-3} V, not -1 mV.
- The coefficient of t in the second interval is incorrect. It should be 2×10^6 , not 2,000,000.
- The coefficient of t in the third interval is incorrect. It should be -10^6 , not $-1,000,000$.

Note: In this example, Llama 3 70B does not identify the equivalence between different forms of a value, indicating its unstable performance in this aspect.

- ♠♣ q_070302_cs_2:

Arithmetic: There is a small arithmetic error in the calculation of $i(10 \text{ ms})$. The correct value is 8.5×10^{-19} A, but the student gets 8.45×10^{-19} A. This is a minor error and does not affect the overall correctness of the solution.

Unit: The units for all variables are identified clearly and correctly throughout the calculation process, except for the energy at $t = 10 \text{ ms}$, where the unit should be J instead of mJ.

Note: Llama 3 70B seems to recognize the rounding errors in the final answer since it states that the minor error does not affect the overall correctness of the solution. However, it is overly rigorous about the units, as both J and mJ are acceptable for the final answer.

- ♠♣ q_070302_ws_24 [Final Answer]: The student's final answers are mostly correct. They correctly find the current $i_c(0) = 0.2$ A and $i_c(10 \text{ ms}) = 8.45 \times 10^{-19}$ A, which matches the official solution. However, there is a minor issue with the energy calculation. The student finds the energy at $t = 10 \text{ ms}$ to be 0.125 mJ, which is correct, but they should have written it in scientific notation as 1.25×10^{-4} J to match the official solution.

Note: Llama 3 70B successfully recognizes the equivalence between 0.125 mJ and 1.25×10^{-4} J. However, it provides overly rigorous feedback, as the final answer does not have to be written in scientific notation.

- ♠ q_070504_cs_5 [Final Answer]: The student's final answer is almost correct. The correct final answer is $v(t) = 15 \sin(500t + 60^\circ)$ V, while the student's answer is $v(t) = 15 \sin(500t + \frac{\pi}{3})$. The phase angle in the student's answer is incorrect.

Note: Llama 3 70B does not identify the equivalence between the degree 60° and radian $\frac{\pi}{3}$.

- ♣ q_080301_cs_35 [Arithmetic]: There is a small arithmetic error in the calculation of the time constant τ . The student writes $\tau = 3 \times 250 \times 10^{-3} = 0.75$ s, which is correct. However, in the final answer, the student uses $e^{-\frac{t}{\tau}}$ instead of $e^{-\frac{t}{\tau}} = e^{-1.33t}$. This is a minor mistake, but it does not affect the overall correctness of the solution.

Note: Llama 3 70B seems to recognize that there is a typo in $e^{-\frac{t}{\tau}}$, which should correctly be expressed as $e^{-\frac{t}{\tau}}$.

- ♠ q_080301_cs_36 [Final Answer]: The student's final answer is incorrect. The correct final answer is $v(t) = 6 - 2e^{-1.33t}$ V for $t > 0$, whereas the student's answer is $v(t) = 6 - 2e^{-4t/3}$ V.

Note: Llama 3 70B fails to identify the equivalence between $v(t) = 6 - 2e^{-1.33t}$ V and $v(t) = 6 - 2e^{-4t/3}$ V.

- ♠ q_080401_cs_5 [Arithmetic]: There are some arithmetic errors in the student's solution. For example, $V(1.5) = 5.0027$ V is an approximation, but the student should have used the exact value $V(1.5) = 5$ V. This error propagates to the second part of the solution, resulting in an incorrect coefficient in the exponential term.

Note: Llama 3 70B identifies the rounding error in the student's solution as an arithmetic error.

♣ q_090201_cs_7 [Final Answer]: The student's final answer is correct: $10^8 V_s = \frac{d^2 V}{dT^2} + 3000 \frac{dV}{dT} + 1.02 \times 10^8 V$, which matches the official solution.

Note: The differential equation provided in the official solution is $1 \times 10^8 v_s = 1.02 \times 10^8 v + 3000 \frac{dv}{dt} + \frac{d^2 v}{dt^2}$. Llama 3 70B successfully identified the equivalence between the two differential equations.

♣ q_090201_cs_19 [Final Answer]: The student's final answer is correct, although it is written in a slightly different form than the official solution. The student's answer is: $1 \times 10^8 v_s = \frac{d^2 v}{dt^2} + 3000 \frac{dv}{dt} + 1.02 \times 10^8 v_a$, which is equivalent to the official solution: $1 \times 10^8 v_s = 1.02 \times 10^8 v + 3000 \frac{dv}{dt} + \frac{d^2 v}{dt^2}$.

Note: Llama 3 70B successfully identified the equivalence between the two differential equations.

♣ q_090303_cs_23 [Final Answer]: The student's final answers, $s_1 = -3031.26$ and $s_2 = -98968.74$, are correct, considering the rounding errors. The official solution has $s_1 = -3031$ and $s_2 = -98969$, which are very close to the student's answers.

Note: Llama 3 70B correctly identified the rounding errors in the student's final answers.

Sinusoidal Steady-State Analysis

GPT-4o:

- ♠ q_100302_ws_11 [Completeness]: Unfortunately, the student's solution is not complete as it fails to arrive at the correct final answer and some intermediate steps are either skipped or improperly detailed.

Note: The student's solution is complete as it answers the question posed by the problem.

- ♠ q_100302_cs_21:

Final Answer: The student's final answer is:

$$V(t) = \sqrt{74} \cos(8t - 9.462^\circ)$$

While the correct answer should be:

$$v(t) = 8.602 \cos(8t - 9.462^\circ) \text{ V}$$

It can be observed that the student's amplitude calculation is incorrect, and hence the final answer deviates from the correct one.

Units: Throughout the calculation, it is important to note that voltages are correctly identified with the units 'V' and specified parameters like angles are correctly in degrees.

Note: Since $\sqrt{74} \approx 8.602$, the student's final answer matches the official solution up to a rounding error. Additionally, the student did not consistently use units for all variables.

- ♠ q_100406_cs_23 [Completeness]: The student's solution is incomplete. While the student performs some calculations and finds the voltage across the 40 Ω resistor, there are crucial mistakes, and the final answer does not match the required format. The student fails to clearly convert the phasors back to the time domain correctly and correct the unit errors.

Note: The student's solution is complete since it answers the question posed by the problem.

- ♠ q_100601_cs_24 [Final Answer]: The student's final answer $14.69 \angle 5.55^\circ$ is close but not correct. The correct answer is $14.67 \angle 5.6^\circ$.

Note: GPT-4o does not recognize the value discrepancies in the student's final answer as rounding errors.

- ♠♣ q_100604_cs_24 [Final Answer]: The final answers given by the student for the currents are almost correct but slightly off:

- $I_1 = 0.794 \angle 111^\circ$
- $I_2 = 0.789 \angle -61.7^\circ$ (official answer is 0.790, the angle matches though)
- $I_3 = 0.228 \angle 176.3^\circ$ (official answer is 0.229 $\angle 176^\circ$)

These minor discrepancies suggest either small arithmetic errors or possibly rounding issues. They should recalculate these to ensure accuracy.

Note: GPT-4o identifies the small discrepancies in the final answers as possible rounding errors. However, these values can be considered correct and do not need to be recalculated.

- ♠ q_100701_ws_5 [Unit]:

- Consistently use proper notation for complex numbers and phasors.
- Provide final results in correct units—Volts for V_{oc} and Ohms for Z_t .

Note: The student, in effect, did not consistently use units for all variables.

♠ q_100801_cs_25 [Final Answer]: Your final expression for $i(t)$ is:

$$i(t) = 0.036 \cos(4000t - 26.57^\circ) + 0.036 \cos(2500t - 153.43)$$

This is incorrect. The official solution's final answer is:

$$i(t) = 35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ) \text{ mA}$$

Note: GPT-4o does not recognize the equivalence between the student's final expression and the official final expression.

Llama 3 70B:

♠ q_100302_cs_21 [Unit]: The student correctly identifies the units of the variables throughout the calculation process.

Note: The student did not consistently use units throughout the calculation process.

♣ q_100401_ws_8 [Final Answer]: $Z_C = -j2.4 \Omega$ (student's answer is correct, but it should be written in the form of $-j2.4 \Omega$ instead of $\frac{2.4}{j}$).

Note: Llama 3 70B effectively identified that $-j2.4 = \frac{2.4}{j}$.

♣ q_100406_ws_2 [Final Answer]: The student's final answer is correct: $v(t) = 0.9662 \cos(4000t - 140^\circ) \text{ V}$. Although the student's solution is written in terms of current ($I_{40\Omega}$) instead of voltage (V), the calculation is correct, and the final answer can be easily obtained by multiplying the current by the resistance ($R = 40\Omega$).

Note: The student's solution only reaches $I_{40\Omega} = 24.15 \angle -139.89^\circ \text{ mA}$, but not the required voltage $v(t) = 0.9662 \cos(4000t - 140^\circ) \text{ V}$. Llama 3 70B correctly identifies that the final answer for $v(t)$ can be easily obtained by multiplying the current by the resistance ($R = 40\Omega$), which is good.

♣ q_100601_cs_24:

Final Answer: The student's final answer for V_o is close to the correct answer, but not exactly equal. The student's answer is $14.69 \angle 5.55^\circ$, while the correct answer is $14.67 \angle 5.6^\circ$. This is a minor error, but it is still an error.

Arithmetic: There are no obvious arithmetic errors in the student's solution. However, there might be some minor calculation errors that led to the slight difference in the final answer.

Note: Llama 3 70B does not consider the slight difference in the final answer, which is due to the rounding error during the calculation process, as a significant calculation error.

♠ q_100701_ws_21 [Unit]: The units of all variables are identified clearly and correctly throughout the calculation process.

Note: The student did not consistently use units throughout the calculation process.

♠ q_100801_ws_5 [Final Answer]: The student's final answer is incorrect. The correct final answer is $i(t) = i_1(t) + i_2(t) = [35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ)] \text{ mA}$. The student's answer has different values for the amplitude and phase angles.

Note: The correct final answer is $i_o(t) = \frac{2}{25\sqrt{5}} \cos(2500t + 26.57^\circ) + \frac{2}{25\sqrt{5}} \cos(4000t - 26.57^\circ) \text{ A}$. Thus, the student's answer has the correct values for the amplitudes because $\frac{2}{25\sqrt{5}} \text{ A} \approx 35.8 \text{ mA}$.

♣ q_100801_ws_21 [Final Answer]: The student's final answer is incorrect. The student's answer is in amperes (A), but it should be in milliamperes (mA). Additionally, the student's answer has a typo in the cosine arguments, where 2500ω should be $2500t$ and 4000ω should be $4000t$.

Note: Llama 3 70B explicitly pointed out the important typo in the student's solution.

♠ q_100801_cs_25 [Final Answer]: The student's final answer is almost correct, but there is a unit error. The student's answer is in amperes (A), whereas the correct unit is milliamperes (mA). The correct final answer is:
 $i(t) = 35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ) \text{ mA}$.

Note: Llama 3 70B is overly rigorous about the units. The student's final answer of $i(t) = 0.036 \cos(4000t - 26.57^\circ) + 0.036 \cos(2500t - 153.43) \text{ A}$ is also fully correct.

♠ q_100806_cs_5 [Unit]: The units of all variables are identified clearly and correctly throughout the calculation process.

Note: The student did not consistently use units throughout the calculation process.

Frequency Response

GPT-4o:

- ♣ q_130203_cs_5 [Final Answer]: Your answer $H(\omega) = \frac{3}{5} \times \frac{1}{1+j\omega\frac{4}{5}}$ translates to $H(\omega) = \frac{0.6}{1+j\omega 0.8}$, which is algebraically equivalent to the correct final answer $H(\omega) = \frac{0.6}{1+j(0.8)\omega}$. While your final answer is mathematically accurate, it should ideally match the official solution's format for clarity.

Note: GPT-4o successfully identified the equivalence between $\mathbf{H}(\omega) = \frac{0.6}{1+j(0.8)\omega}$ and $\mathbf{H}(\omega) = \frac{3}{5} \cdot \frac{1}{1+j\omega\frac{4}{5}}$.

- ♣ q_130209_ws_24 [Final Answer]: The student's expression for the gain magnitude is incorrect.

- Student's expression: $|H(\omega)| = 5 \frac{\sqrt{1+16 \times 10^{-4} \omega}}{\sqrt{1+1 \times 10^{-2} \omega}}$

- Correct expression: $|H(\omega)| = 5 \frac{\sqrt{1+\frac{\omega^2}{625}}}{\sqrt{1+\frac{\omega^2}{100}}}$

- Error: The student incorrectly simplifies the squared ω terms.

Note: GPT-4o correctly indicates that there are incorrect simplifications for the squared ω terms.

Llama 3 70B:

- ♠ q_130201_cs_10:

Final Answer: The student's final answer is not correct. The student's answer is $\frac{10}{50+200\omega j}$, whereas the correct answer is $\frac{0.2}{1+j4\omega}$. The student's answer has a different numerator and denominator compared to the official solution.

Unit: The units of the variables are not clearly identified throughout the calculation process. For example, the student uses $\omega C j$ in the expression for $V_0(\omega)$, but the units of C are not specified. Similarly, the units of ω are not specified. In the official solution, it is clear that C is in Farads and ω is in radians per second.

Note: Similar to example Llama-3-70B-q_130203_cs_5, Llama 3 70B does not recognize the equivalence between $\frac{10}{50+200\omega j}$ and $\frac{0.2}{1+j4\omega}$ in this example. In addition, it is acceptable that the units of ω are not specified during the calculation process.

- ♠ q_130202_cs_3 [Unit]: The units of all variables are identified clearly and correctly throughout the calculation process. The student correctly uses $k\Omega$ for resistances and μF for capacitance.

Note: This is a hallucination of Llama 3 70B, as the student never mentioned the units $k\Omega$ and μF in their solution.

- ♣ q_130202_cs_9 [Method]: The student uses a different method than the official solution, but it is still a correct approach. Instead of directly finding the transfer function $H(\omega)$, the student uses the impedance and nodal analysis to find the ratio of V_o to V_i , which is equivalent to $H(\omega)$.

Note: Llama 3 70B correctly identifies an alternative approach as correct.

- ♠ q_130203_cs_5:

Final Answer: The student's final answer is not entirely correct. While they have derived the correct expression for $\mathbf{H}(\omega)$, they haven't simplified it to the final form. The correct final answer is $\mathbf{H}(\omega) = \frac{0.6}{1+j(0.8)\omega}$, whereas the student's answer is $\mathbf{H}(\omega) = (3/5) * 1/(1 + j\omega 4/5)$, which is close but not identical.

Unit: The student has not explicitly identified the units of the variables throughout the calculation process. While it's not a major error, it's essential to clearly identify the units of variables to avoid confusion.

Note: In terms of the final answer, Llama 3 70B does not find the equivalence between $\mathbf{H}(\omega) = \frac{0.6}{1+j(0.8)\omega}$ and $\mathbf{H}(\omega) = \frac{3}{5} \cdot \frac{1}{1+j\omega\frac{4}{5}}$. Regarding units, their inclusion is sometimes unnecessary during the calculation process of a network function.

♠♣ q_130208_cs_11 [Unit]: The student does not explicitly identify the units of the variables throughout the calculation process. However, based on the context of the problem, it can be inferred that R_1 and R_2 are in $k\Omega$, C is in μF , and ω is in rad/s . It would be better if the student explicitly stated the units of each variable.

Note: Llama 3 70B seems to have some ability to infer the units of circuit variables. However, it is acceptable that the student did not explicitly state the units of the variables when calculating a network function with variable notations.

♠ q_130209_ws_24 [Final Answer]: The student's final answers are not entirely correct.

- The transfer function $H(\omega)$ is close, but the student has a typo in the numerator, writing $j0.04\omega$ instead of $j\omega/25$. Similarly, in the denominator, it should be $j\omega/10$ instead of $j0.1\omega$.
- The gain $|H(\omega)|$ is close, but the student has a typo in the numerator, writing $16 \times 10^{-4}\omega$ instead of $\omega^2/625$. Similarly, in the denominator, it should be $\omega^2/100$ instead of $1 \times 10^{-2}\omega$.
- The phase shift $\angle H(\omega)$ is close, but the student has a typo in the second term, writing $+\tan^{-1}(0.1\omega)$ instead of $-\tan^{-1}(\omega/10)$.

Note: Llama 3 70B does not recognize the equivalence between different representations of an expression.