

EXAMPLES OF HANDWRITTEN AND TYPED HOMEWORK SOLUTION RECOGNITIONS

The following example shows that the responses of GPT-4o include incorrect information when asked to extract the information from a handwritten homework solution¹ and print it literally. This implies that we cannot use images of student handwritten solutions as direct inputs to GPT-4o for homework assessments and feedback. [We also demonstrate the results recognized by the Mathpix snipping tool, which is better than that generated by GPT-4o.](#)

Note: For the responses of GPT-4o [and the output of the Mathpix snipping tool](#), we mark the incorrect parts with a red background and the dubious contents with a yellow background. In addition, we mark with the green background the response segments that we would like to highlight as correct.

 User

① Short Circuit V_2 :

$$V_1(\omega) = 12\angle 0^\circ \text{ V} \quad Z_R(\omega) = 300\Omega, \quad Z_L(\omega) = j250\Omega, \quad Z_C(\omega) = -j400\Omega$$

$$\text{Apply KVL: } -12\angle 0^\circ - (j250 + 300 - j400) I_1 = 0$$

$$I_1 = -\frac{12\angle 0^\circ}{300 - j150}$$

$$= \frac{12\angle 0^\circ}{335.41\angle -26.565^\circ} = -0.0358\angle 26.565^\circ \text{ A}$$

$$= 0.0358\angle 206.56^\circ \text{ A} = 0.0358\angle -153.44^\circ \text{ A}$$

$$\rightarrow i_1(t) = 0.0358 \cos(2500t - 153.44^\circ) \text{ A}$$

② Short Circuit V_1

$$V_2(\omega) = 12\angle 0^\circ \text{ V}, \quad Z_R(\omega) = 300\Omega, \quad Z_L(\omega) = j400\Omega, \quad Z_C(\omega) = -j250\Omega$$


$$\text{Apply KVL: } -12\angle 0^\circ + (j400 + 300 - j250) I_2 = 0$$

$$I_2 = \frac{12\angle 0^\circ}{j400 + 300 - j250} = \frac{12\angle 0^\circ}{300 + j150} = 0.0358\angle -26.56^\circ \text{ A}$$

$$\rightarrow i_2(t) = 0.0358 \cos(4000t - 26.56^\circ) \text{ A}$$

$$\text{Final Answer: } i(t) = i_1(t) + i_2(t) = [35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ)] \text{ mA}$$

Can you extract the information in the attached image and print it literally in the response? If you encounter equations, you may use LaTeX.

GPT-4o 

Sure, here is the extracted information from the image:

① Short Circuit V_2 :

$$V_1(j\omega) = 12\angle 0^\circ \text{ V}$$

¹This homework solution in this example was handwritten by one of the authors of the paper.

$$Z_R(j\omega) = 300\Omega, Z_L(j\omega) = j250\Omega, Z_C(j\omega) = -j400\Omega$$

Apply KVL:

$$-12\angle 0^\circ - j250I_1 + 300I_1 - j400I_1 = 0$$

$$I_1 = -\frac{12\angle 0^\circ}{300 - j150}$$

$$I_1 = \frac{12\angle 0^\circ}{335.41\angle -26.565^\circ} = -0.0358\angle 26.565^\circ$$

$$I_1 = 0.0358\angle 206.565^\circ \text{ A} = 0.0358\angle -153.44^\circ \text{ A}$$

$$\Rightarrow i_1(t) = 0.0358 \cos(2500t - 153.44^\circ) \text{ A}$$

② Short Circuit V_1 :

$$V_2(j\omega) = 12\angle 0^\circ \text{ V}$$

$$Z_R(j\omega) = 300\Omega, Z_L(j\omega) = j400\Omega, Z_C(j\omega) = -j250\Omega$$

Apply KVL:

$$12\angle 0^\circ + j400I_2 + 300I_2 - j250I_2 = 0$$

$$I_2 = \frac{12\angle 0^\circ}{j400 + 300 - j250} = \frac{12\angle 0^\circ}{300 + j150}$$

$$I_2 = 0.0358\angle -26.565^\circ \text{ A}$$

$$\Rightarrow i_2(t) = 0.0358 \cos(4000t - 26.565^\circ) \text{ A}$$

Final Answer:

$$i(t) = i_1(t) + i_2(t) = [35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ)] \text{ mA}$$

If you need any further assistance or additional details, feel free to ask!

To demonstrate the reliability of the Mathpix snipping tool in converting handwritten solutions, we present the tool's output for the same example here. Compared to the results generated by GPT-4o, the contents extracted by the Mathpix snipping tool contain no significant errors, unlike those in GPT-4o's output. However, the Mathpix snipping tool occasionally produces minor ambiguities. For instance, it sometimes fails to reliably distinguish between uppercase and lowercase letters for certain variables. In the highlighted example, the variables v_1 , z_R , z_L , and z_c should actually be V_1 , Z_R , Z_L , and Z_C , respectively.² However, for most cases in students' solutions, it is difficult to determine if a student intended, for example, z_c or Z_C . Therefore, we did not manually correct such minor "errors" in our dataset.

It is also important to note that the handwritten solution in this example is relatively neat. In contrast, some students' solutions exhibit more varied and freeform writing styles. For example, we observed the following recognition errors, which we corrected during the proofreading process.

- " $\sqrt{(\omega)}$ " was corrected to " $V(\omega)$ ".
- " $2 \cos(-45^\circ) + j^2 \sin(-45^\circ)$ " was corrected to " $2 \cos(-45^\circ) + j2 \sin(-45^\circ)$ ".
- " \dot{i} " was corrected to " i ".

Mathpix Snipping tool

(1) Short Circuit V_2 :

$$v_1(\omega) = 12\angle 0^\circ V \quad z_R(\omega) = 300\Omega, \quad z_L(\omega) = j250\Omega, \quad z_c(\omega) = -j400\Omega$$

Apply KVL: $-12\angle 0^\circ - (j250 + 300 - j400)I_1 = 0$

$$\begin{aligned} I_1 &= -\frac{12\angle 0^\circ}{300 - j150} \\ &= \frac{12\angle 0^\circ}{335.41\angle -26.565^\circ} = -0.0358\angle 26.565^\circ \text{ A} \\ &= 0.0358\angle 206.56^\circ \text{ A} = 0.0358\angle -153.44^\circ \text{ A} \\ &\rightarrow i_1(t) = 0.0358 \cos(2500t - 153.44^\circ) \text{ A} \end{aligned}$$

(2) Short Circuit V_1

$$V_2(\omega) = 12\angle 0^\circ V, \quad z_R(\omega) = 300\Omega, \quad z_L(\omega) = j400\Omega, \quad z_c(\omega) = -j250\Omega$$

Apply KVL: $-12\angle 0^\circ + (j400 + 300 - j250)I_2 = 0$

$$\begin{aligned} I_2 &= \frac{12\angle 0^\circ}{j400 + 300 - j250} = \frac{12\angle 0^\circ}{300 + j150} = 0.0358\angle -26.56^\circ \text{ A} \\ &\rightarrow i_2(t) = 0.0358 \cos(4000t - 26.56^\circ) \text{ A} \end{aligned}$$

Final Answer: $i(t) = i_1(t) + i_2(t) = [35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ)] \text{ mA}$

²Since the handwritten solution was prepared by one of the authors, we know that their intended notation is V_1 , Z_R , Z_L , and Z_C .

The following example shows that GPT-4o may provide incorrect information when prompted to extract and print the information from a typed homework solution.

 User

(1) Short Circuit V_2 :

$$V_1(\omega) = 12\angle 0^\circ V, Z_R(\omega) = 300\Omega, Z_L(\omega) = j250\Omega, Z_C(\omega) = -j400\Omega$$

$$\text{Apply KVL: } -12\angle 0^\circ - (j250 + 300 - j400)I_1 = 0$$

$$I_1 = -\frac{12\angle 0^\circ}{300 - j150}$$

$$= -\frac{12\angle 0^\circ}{335.41\angle -26.565^\circ} = -0.0358\angle 26.565^\circ A = 0.0358\angle 206.56^\circ A = 0.0358\angle -153.44^\circ A$$

$$\rightarrow i_1(T) = 0.0358 \cos(2500T - 153.44^\circ) A$$

(2) Short circuit V_1 :

$$V_2(\omega) = 12\angle 0^\circ V, Z_R(\omega) = 300\Omega, Z_L(\omega) = j400\Omega, Z_C(\omega) = -j250\Omega$$

$$\text{Apply KVL: } -12\angle 0^\circ + (j400 + 300 - j250)I_2 = 0$$


$$I_2 = \frac{12\angle 0^\circ}{j400 + 300 - j250}$$

$$= \frac{12\angle 0^\circ}{300 + j150} = 0.0358\angle -26.56^\circ A$$

$$\rightarrow i_2(T) = 0.0358 \cos(4000T - 26.56^\circ) A$$

$$\text{Final Answer: } i(t) = i_1(t) + i_2(t) = [35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ)] \text{ mA}$$

Can you extract the information in the attached image and print it literally in the response? If you encounter equations, you may use LaTeX.

GPT-4o 

Sure, here is the extracted information from the image:

(1) Short Circuit V_2 :

$$V_1(\omega) = 12\angle 0^\circ V, Z_R(\omega) = 300\Omega, Z_L(\omega) = j250\Omega, Z_C(\omega) = -j400\Omega$$

Apply KVL:

$$-12\angle 0^\circ - (j250 + 300 - j400)I_1 = 0$$

$$I_1 = \frac{12\angle 0^\circ}{300 - j150} = \frac{12\angle 0^\circ}{335.41\angle -26.565^\circ}$$

$$= -0.0358\angle 26.565^\circ A = 0.0358\angle 206.56^\circ A = 0.0358\angle -153.44^\circ A$$

$$\rightarrow i_1(T) = 0.0358 \cos(2500T - 153.44^\circ)A$$

(2) Short circuit V_1 :

$$V_2(\omega) = 12\angle 0^\circ V, Z_R(\omega) = 300\Omega, Z_L(\omega) = j400\Omega, Z_C(\omega) = -j250\Omega$$

Apply KVL:

$$-12\angle 0^\circ + (j400 + 300 - j250)I_2 = 0$$

$$I_2 = \frac{12\angle 0^\circ}{j400 + 300 - j250} = \frac{12\angle 0^\circ}{300 + j150} = 0.0358\angle -26.56^\circ A$$

$$\rightarrow i_2(T) = 0.0358 \cos(4000T - 26.56^\circ)A$$

Final Answer:

$$i(t) = i_1(t) + i_2(t) = [35.8 \cos(2500t - 153.44^\circ) + 35.8 \cos(4000t - 26.56^\circ)]mA$$