








TL;DR

Your goal is to create a reasonable dialogue that results in solving the problem on screen.

Please mark every option presented on the screen with , , or . If no option is

Great (), provide your own  option. Make your suggestion contain only one new step/idea that wasn't already in the conversation.

	Appropriate in conversation	Contains no inaccuracies	Contains no weirdness	Computations can be verified in <30 seconds	Advances the process of solving the problem
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Everything else is 

If you are unsure, you can mark with  - we'll inspect those and give guidance later.

"Advances the process of solving the problem" is subjective, but very important - trust your intuition. Statements like "ok, what's next?" are not advances, but suggestions to explore a particular approach to a solution can count as advances even if they don't ultimately pan out (e.g. for a problem "what is $2^{1000} \bmod 3$?" a statement like "calculating 2^{1000} is probably too hard" is an advance because it tries an approach and figures out it won't work). See more examples below.

[Video Tutorial](#)

(recommend watching after reading the instructions here)

NB: I make a mistake at [4:12] in this video when I mark this correction as  Okay:

Right. Now we need to find the sum of the values of z , which is $-b/a$ in the standard quadratic ax^2+bx+c

This statement is correct (follows from the quadratic formula or Vieta's formula) and advances us towards a solution, so it should probably be marked as 😊 Great!

Conversational Math AI Trainer Instructions

Welcome! We're so excited to have you work with us on this project. Together, we're going to be teaching an AI how to solve math problems! This document will introduce the task we'll be working on and give instructions for helping to collect the best data we can collect.

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Overview

We are training an AI that can solve hard math problems step-by-step in a way that's easy for humans to understand and follow along with. So far, we've trained an AI that's OK at math, but it's not so good at understanding when its single steps are good or bad. That's where you come in! We need AI Trainers to supervise the AI as it solves new math problems and rate the steps that it comes up with as good or bad.

We call this "Conversational Math" because we are teaching the AI to solve problems by talking to itself (kind of like you might do in your head as you try to solve a problem and ask yourself questions about what is working and what you should try next). **Throughout this document, we may refer to the problem solving process as a conversation in reference to this.**

As you work on this task, you should think about that goal: We want to teach our AI about how humans solve problems. We want to encourage it to take reasonable steps, to explain what it's doing in a way that we can follow along with, to discover when it gets stuck in a dead-end and try something new, and to discover correct final answers.

Let's solve this problem:
How many integers are solutions to the equation

$$(x - 2)^{(25 - x^3)} = 1?$$

Let's first think about the times when we get 1 as a result of raising something to a power.

Well, we know that 1 raised to any power is 1.

Right. Also, any number raised to the power of 0 is 1.

What else?

If we have -1 raised to an even power, we will also get 1.

So we have 3 cases.

Submit ratings

Give Up

An example of making progress on solving a problem

Instructions

Each time you start a task you'll be presented a screen like the one below, with a problem statement for some math problem (sometimes followed by several initial steps for solving it).

Let's solve this problem:
The radius of a cylinder is doubled and its height is tripled. If its original volume was 10 cubic feet, what is its volume now, in cubic feet?

We first need to find out the original volume of the cylinder. For that we can multiply the area of the base by the height.

The volume of a cylinder is the area of its base times its height.

Submit ratings (please rate all options)

Give Up

Your job is to read each of the options the AI suggests for starting to solve the problem. For each option, you should [rate](#) the options as **Great** (👍), **Okay** (👎), or **Bad** (👎). In some rare situations you might want to mark it **Unsure** (🤔). If none of the options were

Great, you'll be asked to write [your own next step](#), which you should try to keep brief and use to point the AI in the right direction (more instructions [below](#)).

Let's solve this problem:
The radius of a cylinder is doubled and its height is tripled. If its original volume was 10 cubic feet, what is its volume now, in cubic feet?

The volume of a cylinder is the area of its base times its height.

That's right. What is the formula to find the area of its base?

It's the constant pi times the square of the radius of the cylinder.

So if we double the radius, what will happen to the area of the base?

So if we double the radius, what will happen to the area of the base?

Submit completionsBack

After this, one of the options or your own will pop up to continue the conversation. New options will appear for the next step of the conversation, and you will repeat: rate each option, save your ratings, potentially write your own step, and then submit.

At some point, one of the options might have a **Final Answer**. If this option is selected, the problem is solved and the conversation will end. Then you can continue on to the next problem.

Let's solve this problem:
Four fair coins are to be flipped. What is the probability that all four will be heads or all four will be tails? Express your answer as a common fraction.

Each coin has two possible outcomes, heads or tails.

And there are four coins. So, there are $2 * 2 * 2 * 2 = 2^4$ outcomes total.

Of those outcomes, there are only two where all the coins are heads or all the coins are tails.

😊

So, the probability of all heads or all tails is $2/2^4 = 2/16 = 1/8$.

🤔

😐

Final answer (only select if correct!):

😞

Submit ratingsGive Up

At any point, if you don't know how to advance the conversation with AI's or your own suggestions, you can press [Give Up](#) to end the conversation early and start a new problem. Please use this option sparingly - mostly when you can't solve the problem yourself and the AI is not offering any useful help.

Ratings

You should rate every option. A Great 😊 option is anything a good student of math would try. Most of the time it's a clear cut step forward towards solving the problem. But it could also be a sub-optimal choice, as long as it looks like something a reasonably smart human might say while trying to solve the problem. An Okay 😐 option is anything that's reasonable for a person to say, but it's not offering any insight, doesn't further the solution by exploring an option, performing a calculation, or offering an idea for the next step. A Bad 😞 option is one that confidently says something incorrect, is useless/off-topic/weird, leads the solution into a clear dead-end, or is correct but not explained clearly enough for a human to follow along with.

Sometimes you won't know how to rate an option. In that case, you can select Unsure 🤔.

Great 😊

A **Great** option is *all* of the following:






















- Correct
 - Nothing it states is wrong
- Verifiable
 - It should take you no more than about 30 seconds to verify that the statement is correct (more if you are rusty with the problem's general area, like trigonometry or number theory - use your judgment)
 - You might need to use a calculator to check some simple calculations, but if you feel like you need to take out paper and pencil to check that the suggestion is right, mark it **Bad** because it wasn't explained well enough
 - You might also need to look up a theorem (e.g. a trig identity) in order to verify correctness. If you can do this with a quick Google search you can mark it **Great**, if it's more obscure than that mark it **Bad**
- Appropriate

- It fits correctly into the context of the previous steps
- If the previous steps contain a mistake that wasn't noticed before, it's ok for a **Great** option to point out the mistake
- Insightful
 - They are reasonable things a smart human might try while solving the problem
 - Even if it's ultimately the wrong direction (but not immediately obviously a wrong direction), it can still be insightful to try. We want to teach the AI to learn how to recover from trying something that doesn't work out right away!
 - If the option is simply restating one of the previous steps, without adding any additional insight or setting direction for what to do next, mark it Okay
 - If the option is a statement of encouragement ('Good job!') but doesn't offer any additional insight or setting direction for what to do next, mark it Okay
 - Sometimes the suggestion might add the tiniest amount of further insight or guides the solution forward in a particular direction only slightly - it can be marked Great or Okay depending on context or even other suggestions that you see
- If the option has a final answer, it should not only be correct, but also clearly follow from the rest of the reasoning. Don't select options with incorrect final answers!

Examples

Let's solve this problem:

Four fair coins are to be flipped. What is the probability that all four will be heads or all four will be tails? Express your answer as a common fraction.

   <p>For the probability of getting all heads, the probability of the first coin being heads is $\frac{1}{2}$.</p>	   <p>For the probability that all four will be heads, the probability is $\left(\frac{1}{2}\right)^4$.</p>
   <p>Each coin has two possible outcomes, heads or tails.</p>	   <p>The probability of getting all heads is $\frac{1}{2} * \frac{1}{2} * \frac{1}{2} * \frac{1}{2} = \frac{1}{16}$.</p>
   <p>Each coin has 2 possible outcomes, so there are $2^4 = 16$ possible outcomes in total.</p>	   <p>So there are two cases. First case: all four are heads. What's the probability of that?</p>
   <p>So there are two possible outcomes, all heads or all tails.</p>	

Okay 😐

Okay options sound like something a person would say, they just don't contribute anything of essence to the conversation. They're reasonable, verifiably correct, and appropriate, but they're also redundant, stalling, or just don't add any value.

For example they might just repeat a fact or the problem itself, provide some encouragement without furthering the conversation ("Great job!"), complain that the problem is hard or say that it's easy, etc.

Another kind of correct statement that should be marked Okay is one that makes progress along a direction, but it's stalling on making a more decisive amount of progress. For example if the problem is to find the last digit of 2^{10000} , the first couple of steps that look like

$2^1 = 2$, ends in 2

$2^2 = 4$, ends in 4

$2^3 = 8$, ends in 8,

$2^4 = 16$, ends in 6,

$2^5 = 32$, ends in 2,

$2^6 = 64$, ends in 4,

$2^7 = 128$, ends in 8,

$2^8 = 256$, ends in 6,

$2^9 = 512$, ends in 2,

can all be marked **Great** because they are contributing to our understanding of the problem, but if this continues for too long, eventually it's just stalling on making the critical observation that there is a pattern in the last digits. So at some point (which might reasonably be anywhere between 2^6 and 2^{10}) please stop marking the suggestions as **Great** and instead mark it as **Okay**.

Examples

Let's solve this problem:
 Joe and JoAnn each bought 12 ounces of coffee in a 16-ounce cup. Joe drank 2 ounces of his coffee and then added 2 ounces of cream. JoAnn added 2 ounces of cream, stirred the coffee well, and then drank 2 ounces. What is the resulting ratio of the amount of cream in Joe's coffee to that in JoAnn's coffee? Express your answer as a fraction.

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>So Joe bought 12 ounces of coffee in a 16 ounce cup.</p> </div> <div style="text-align: right;">?</div> </div>	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>So, at the end, Joe has drunk 2 ounces of his coffee so he has 12 ounces left.</p> </div> <div style="text-align: right;">?</div> </div>
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>Let's start with Joe. He bought 12 ounces of coffee in a 16-ounce cup.</p> </div> <div style="text-align: right;">?</div> </div>	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>So, Joe originally had 12 ounces of coffee and JoAnn originally had 12 ounces of coffee.</p> </div> <div style="text-align: right;">?</div> </div>
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>So Joe and JoAnn each buy 12 ounces of coffee.</p> </div> <div style="text-align: right;">?</div> </div>	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>So Joe bought 12 ounces of coffee in a 16-ounce cup.</p> </div> <div style="text-align: right;">?</div> </div>
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="display: flex; flex-direction: column; align-items: center;"> </div> <div style="flex-grow: 1;"> <p>So, Joe starts with 12 ounces of coffee and adds 2 ounces of cream.</p> </div> <div style="text-align: right;">?</div> </div>	

Submit ratings

Give Up

A lot of these answers are **Okay** because they don't say anything wrong but they also just stall, repeating information from the question. The last answer is **Bad** because it actively says something wrong (Joe added 2 oz after drinking some of the original 12!). So is the second one (he has 10oz left after drinking 2). The third answer could be **Okay** or **Great** because it's repeating the problem, but also makes the suggestion to start with Joe. The first and the 6th answers are similar, but are even closer to just repeating the problem, so they are just **Okay**. The fourth answer is definitely only **Okay** because it only repeats the problem. None of these answers are clearly **Great** - a clearly **Great** answer would say something more insightful like

"The amount of cream in Joe's coffee in the end is 2oz" or "After JoAnn added 2 oz of cream and stirred, she had 2 oz of cream in $12+2=14$ oz of liquid".

*Sometimes **Okays** are similar to weak **Greats** - the line isn't always obvious.*

Bad 😞

Any of these characteristics will make an option **Bad**:

- Hard to verify
 - It's not explained well and you'd need to use paper and pencil to check that it's correct
- Wrong
 - Even if most of the suggestion is correct, but it also states something that is wrong, mark it **Bad**
- Contains gibberish
- Contains off-topic text or non-sequiturs
- Suggests attempting something that is unreasonable for this problem
- Derails the conversation
- Leads the solution into an immediately obvious dead end or makes it go in circles

Examples

Let's solve this problem:
If $f(x) = 3x + 1$, what is $f(3)$?

<div><div>😊 😐 😞</div><div>So the function f takes a number x and does three things to it: It first multiplies it by 3, then adds 1.</div><div>?</div></div>	<div><div>😊 😐 😞</div><div>To find $f(3)$, we just plug in 3 for x.</div><div>?</div></div>
<div><div>😊 😐 😞</div><div>Let's plug 3 in for x in the function. So we get $f(3) = 3(3) + 1$.</div><div>?</div></div>	<div><div>😊 😐 😞</div><div>What's $f(3)$?</div><div>?</div></div>

*The first answer is **Bad** because it is incorrect (it says f does 3 things to x but only lists 2). The second and third answers are **Great** because they both move the problem forward, even though the third might be better. The fourth answer is **Okay** because it is correct but does not move us forward.*

Unsure ?

Anything that the instructions didn't cover you can mark as "Unsure" and then move on. Please use this sparingly.

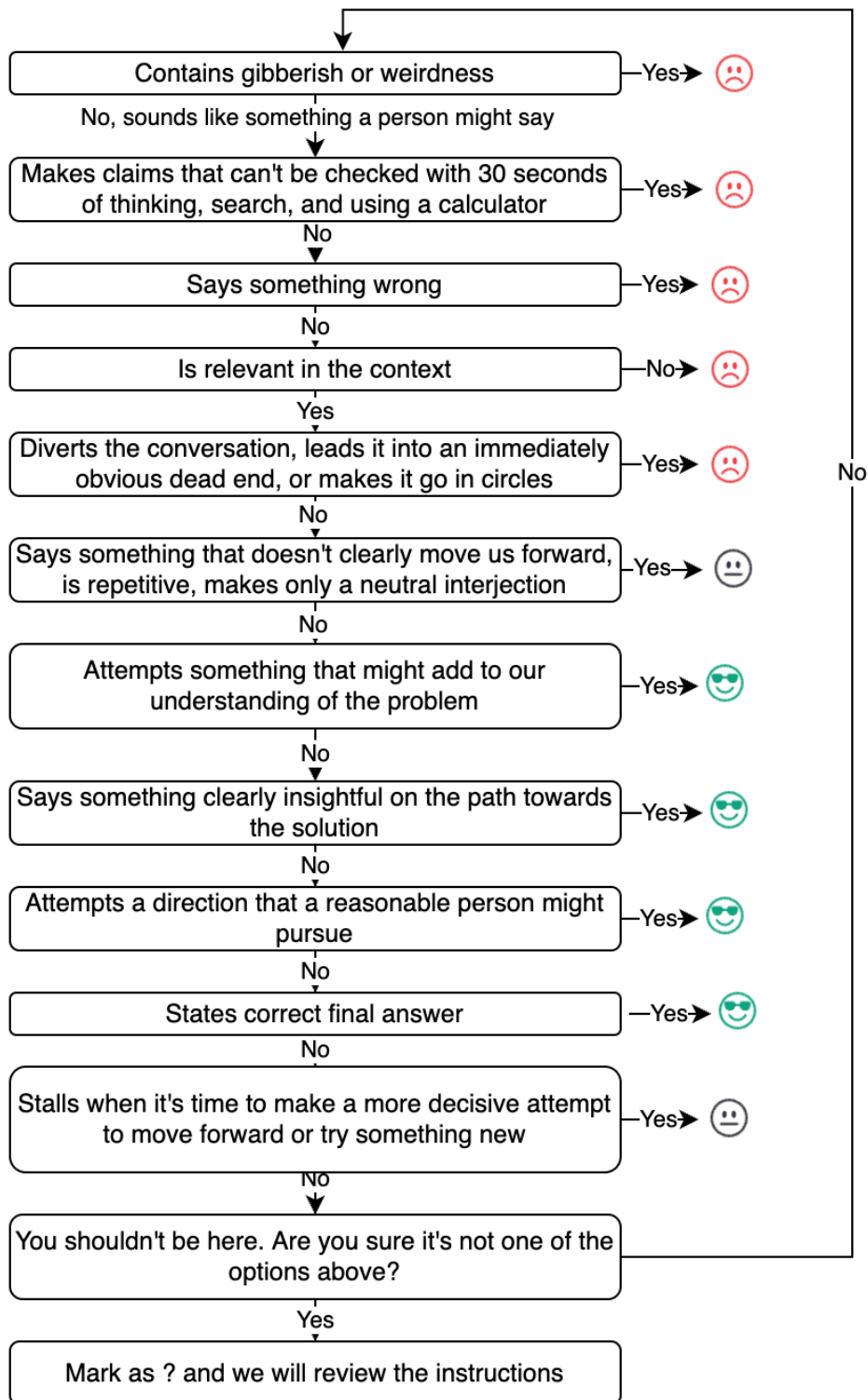
Sometimes you might be uncertain if something qualifies as **Great** or merely **Okay**. Feel free to exercise your own judgment. For example if the problem is about $n!$, a statement " $n! = 1 * 2 * \dots * n$ " might be argued to be **Great** because the first step towards a solution is remembering what $n!$ is, or **Okay** because everyone knows what $n!$ is, so it's just restating the obvious.

Similarly the distinction between Okay and Bad might sometimes be fuzzy. For example "Hey, listen, this was great!" could be "okay" if you think the tone is appropriate, or "bad" if you think it's weird to use this tone while discussing math problems.

In both cases, just pick one of the **Great**, **Okay**, or **Bad** options if you find them appropriate and justifiable. You don't have to be 100% systematic about these gray areas.













Pick **unsure** ? if you encounter a statement that doesn't really satisfy any of the criteria covered above for Great, Okay, or Bad. We will review such statements and update the instructions accordingly.

Visual summary of the meaning of **Great**, **Okay**, and **Bad**



Trainer-Written Steps

Let's start with Joe. He bought 12 ounces of coffee in a 16-ounce cup.

<div><div></div><div>That means there was 4 ounces of room in the cup before he added cream.</div><div>?</div></div>	<div><div></div><div>So there was 4 ounces of space left in his cup.</div><div>?</div></div>
<div><div></div><div>So there was 4 ounces of room in his cup.</div><div>?</div></div>	<div><div></div><div>That means there was 4 ounces of space in his cup before he added the cream.</div><div>?</div></div>

*None of these options are **Great**, so we need to write our own. The bad options here forget that Joe drank 2oz of coffee before adding cream, while the okay ones are making correct observations that don't advance the solution.*

If none of the options are **Great**, you'll be asked to write your own step of the problem solving conversation. Make sure your step would qualify as **Great**.

Don't move the conversation too far forward - we want the AI to do as much of the talking as possible. Please either suggest what the next step should be ("next, let's figure out the prime factors of 24", "let's use the double angle formula") or provide one single verifiable step of the solution ("the only prime factors of 24 are 2 and 3", " $\sin(2x) = 2 \sin x \cos x$ "). Make sure you are not merely repeating what was already said in the conversation above. But also make sure you are not lumping together more than one step: " $\sin(2x) = 2 \sin x \cos x$, and $\cos x = \sqrt{1 - \sin^2 x}$, so $\sin(2x) = 2 \sin x \sqrt{1 - \sin^2 x}$ " lumps too many steps together, something like "Let's use $\sin(2x) = 2 \sin x \cos x$ next." or even "let's use the sine of double angle formula" is more appropriate.

Let's solve this problem:

Joe and JoAnn each bought 12 ounces of coffee in a 16-ounce cup. Joe drank 2 ounces of his coffee and then added 2 ounces of cream. JoAnn added 2 ounces of cream, stirred the coffee well, and then drank 2 ounces. What is the resulting ratio of the amount of cream in Joe's coffee to that in JoAnn's coffee? Express your answer as a fraction.

Let's start with Joe. He bought 12 ounces of coffee in a 16-ounce cup.

Joe added 2 ounces of cream after drinking his coffee, so he still has 2 full ounces in his.

Joe added 2 ounces of cream after drinking his coffee, so he still has 2 full ounces in his.

Submit completion

Back

We help the model with a single clear step, not giving too much away about the full solution.

Some good ways to do this might be to:

- Ask a question about a previous step(s)
 - "I'm not sure this equation is right, can you take a closer look?"
 - "We know that X and Y, can we use that to say anything about Z?"
- Suggest a new strategy
 - "Can we try factoring the polynomial?"
- Offer one simple step forward
 - "This simplifies to $(n+1)! = 720$. How can we use that?"

When to Give Up on a Conversation

If a conversation is not going anywhere, and you don't know how to guide it towards an eventual solution, you can click the **Give Up** button to move on to a new problem. Feel free to use your best judgment here. You'll definitely encounter problems that are too hard for the AI right now and some of them might be too hard for you as well. Don't spend too much time trying to solve one problem. If you don't know what a reasonable next step in the solution might be after looking at AI's suggestions and also thinking independently for 2-3 minutes, it's ok to give up.

When you press **Give Up**, you'll be asked to provide a brief reason for giving up: let us know if there are some areas of math you are not familiar with, if a problem was not formulated well enough, if it seems too difficult, if there are technical issues with the website, etc.