**Discussion Task Notes—<u>Language Difficulties</u>** (some possible responses)

1.  Verbs – "takes" as in "takes…six hours." The verb "takes" when combined with a time, like "six hours," is used to describe the "duration" of an event or activity. "Take" is one of the most widely used words in English. The most common meaning of the word is "to pick up" and perhaps carry an object: to take a card; to take a piece of cake. Of the more than 100 definitions of take listed by Dictionary.com, only definitions #48 and #49 relate to the use of "take" in this word problem.
    Take: to occupy; fill (time, space). His hobby takes most of his time.
    Take: to use up; to consume. His car takes a great deal of gas.

2.  Adjectives—"certain." "a certain construction job" implies that we do not need to know exactly what the job is to solve the problem. The sentence makes sense without the word "certain," a word that is commonly found in many word problems. So why is "certain" there? It implies that there are many possible construction jobs, and that this is one of them. It also implies that in order to solve the problem, we don't need to know what the job is. This may be confusing to English learners.

3.  Adverb—"usually"— meaning typically or on average. The use of "usually" implies that there could be extenuating factors (like rain, if the job is outside) that could change the duration of the job. However, we can assume that there is an average rate at which the job is performed. We can also assume that all workers work at this average rate. In real life some workers work faster than others. Some work quickly and take no breaks, and some work slowly and take long breaks.

4.  Prepositions—"in"—Prepositions are particularly difficult for English learners, especially those with weak proficiency in English. They often occur in fixed expressions or collocations (groups of words that go together) and their use and meaning is not obvious to learners. Prepositions such as "by," "in," and "out of" are frequently used in math and can have multiple and different meanings depending on the context. It is often best to simply teach students their usage in particular contexts and have students practice saying them in unison, in partners and individually, rather than trying to teach the rules for using each preposition in isolation.

5.  Conjunctions—"so". This word is used in many different ways in conversational English. It is often used as a pause filler. In math, "so" has a particular and important meaning. It means "it follows that," and indicates that there is a causal relationship between one of set facts and the facts that follow.

6.  Declarative phrases—"There are." There are is frequently used in everyday contexts in spoken English and in math. However, the phrase confuses English learners. There has several different meanings in English. There also sounds the same as several words in English that are spelled differently and mean different things than there.

7.  Ellipses—Ellipses in language contexts just means the deletion of words. The language of mathematics is very terse and economical. Ellipses (leaving out words is more prevalent in math language than in any other language).
    There are several instances of ellipses in the problem. Four workers (to complete the job) (in) six hours. This phrasing is particularly difficult as it brings together two different facts and two different numbers in one phrase.

8.  Fixed Expressions and Idiomatic expressions—"Called in sick" is an idiomatic expression that means that a worker became sick and did not come to work.

9.  Modal auxiliary—should (meaning probability). The modal auxiliary should is not necessary here. How long did it take or how long will it take is easier for some English learners to understand.

10. Words not commonly used in conversational English. The word construction may not be frequently heard by English learners and might need to be explained to some with pictures and examples.

**Discussion Task Notes—<u>Math Difficulties</u>** (some possible responses)
There is an assumption in problems like this one that all workers work at the same average rate. This essential assumption helps to simplify the problem. Learners might not understand this assumption.

There is also an assumption that workers are interchangeable and can all do whatever is needed to complete the job. For example, if only one worker is an electrician, and the job includes wiring, then the problem cannot be solved and makes not sense.

There are two critical mathematical ideas that results from this. First, the total number of "person-hours" to do the job is a constant, in this case 24. Second, the more workers = less time; fewer workers = more time.

The easiest way to solve the problem is to make use of a concept called person-hours. Since it takes four workers six hours to do the job, the job requires a total of 24 (4 x6) person-hours. In order for three workers to complete the job, they would each have to work 8 hours, so that the total work done is 8 X 3 = 24 person-hours. (Divide the total person-hours, 24, by the number of workers, 3, to get the number of hours, 8.)

A second approach is to figure out how long it would take one person to do the job. If 4 workers take 6 hours, it would take 1 worker 24 hours. Then it is easy to figure out tat two workers can complete the job in 12 hours, etc. As one variable increases, the other decreases.

A much harder way to solve the problem involves finding the individual rates of each worker in fractions of a job. The four workers can each do ¼ of the total job in six hours. Therefore, in one hour each does 1/24 (1/4 divided by 6) of the total job. So when only three workers come to work, they can do 3/24 of the job for every hour the work. The problem then becomes: how many times do we need to add 3/24 to get a complete job, 24/24. Since 8 X 3 is 24, the job will take 8 hours to complete.

## <u>Other Possible Difficulties</u>
Some students may find it difficult to understand the problem in terms of an abstract "job." They may find it easier to understand concrete examples of jobs, e.g., washing dishes at a restaurant, packing boxes, preparing meals, doing a homework project, planting seeds in a garden.

The notion that workers are interchangeable with others can be alien to some students. In many students' experiences, that would not make sense. Many Western cultures assume the standardization of work and work situations with workers following standard procedures and taking a set amount of time to complete a task. Others do not.

The important concept of standardization or common rate or unit rate may be difficult for some students to grasp. Students may not realize how central the concept of standardization is in the United States and in the way many US-Americans think; They may not realize that the concept is important in mathematics.
The idea that three workers are supposed to do the job of four could be a puzzling concept to some students. The idea that it is possible to "call in sick" may not be permissible in some of the jobs some students know about and could puzzle them.