Performance Assessment Task

Fruits and Vegetables
Grade 5

This task challenges a student to use understanding of measurement to convert accurately between units of weight. A student must be able to use multiple representations for the same weight and convert from larger to smaller units and the reverse. A student must be able to look at a range and find smallest and greatest values in a range and use those values to solve problems involving multiplication and division.

Common Core State Standards Math - Content Standards

Number and Operations in Base Ten

Perform operations with multi-digit whole numbers and with decimals to hundredths.

5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm.

5.NBT.6 Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

Measurement and Data

Convert like measurement units within a given measurement system.

5.MD.1 Convert among different-sized standard measurement units within a given measurement system (e.g. convert 5 cm to 0.05 m) and use these conversions in solving multi-step, real world problems.

Common Core State Standards Math – Standards of Mathematical Practice

MP.2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize* – to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents – and the ability to *contextualize,* to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

MP.6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Assessment Results

This task was developed by the Mathematics Assessment Resource Service and administered as part of a national, normed math assessment. For comparison purposes, teachers may be interested in the results of the national assessment, including the total points possible for the task, the number of core points, and the percent of students that scored at standard on the task. Related materials, including the scoring rubric, student work, and discussions of student understandings and misconceptions on the task, are included in the task packet.

Grade Level	Year	Total Points	Core Points	% At Standard
5	2004	8	3	63%

Fruit and Vegetables

This problem gives you the chance to:
- work with units of weight in the customary system

16 ounces = 1 pound

Jeff likes cooking with fruit and vegetables.

He needs to know how much they weigh.

This is what he found:

A tomato weighs between 1 ounce and 4 ounces.

An apple weighs between 4 ounces and 8 ounces.

A kiwi fruit weighs between 2 ounces and 4 ounces.

A banana weighs between 3 ounces and 6 ounces.

A carrot weighs between 2 ounces and 5 ounces.

A grape weighs between $\frac{1}{4}$ ounce and 1 ounce.

An orange weighs between 5 ounces and 10 ounces.

A plum weighs between 1 ounce and 3 ounces.

Use this list to answer the questions on the next page.

1. Jeff buys 4 apples.
   What is the least amount they can weigh? _____ ounces

   Explain your answer.

_____

_____

2. Jeff buys 6 plums.
   What is the greatest amount they can weigh? _____ pound _____ ounces

3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
   What is the least amount they can weigh in all? _____ pound _____ ounces

   Show how you figured it out.

4. Jeff buys half a pound of grapes.
   What is the greatest number of grapes he can get? _____

   Explain how you got your answer.

_____

_____

_____

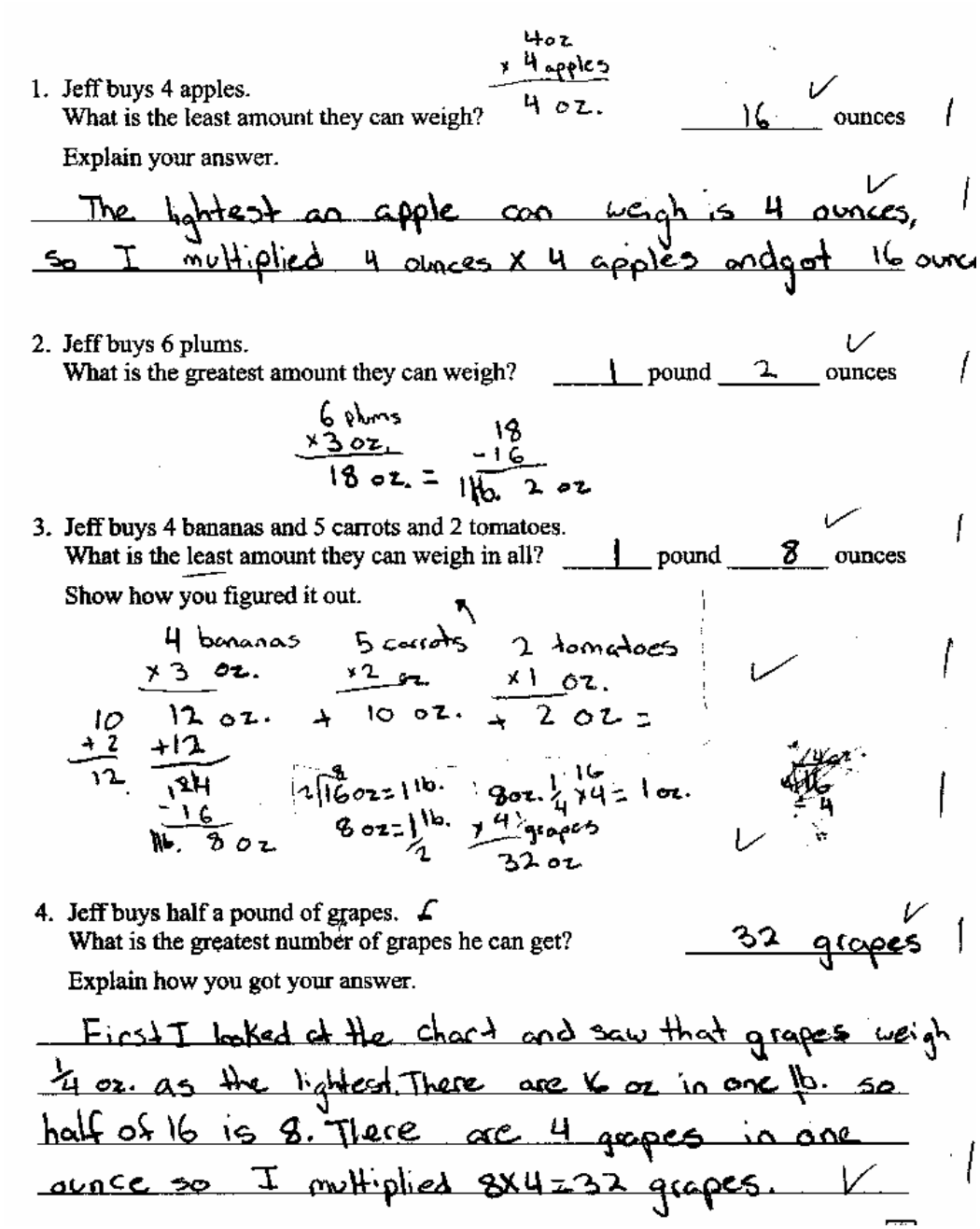
_____

8

Fruit and Vegetables	Test 5 Rubric	
The core elements of performance required by this task are: • be familiar with standard units of weight in the customary system Based on these, credit for specific aspects of performance should be assigned as follows	points	section points
1. Gives a correct answer: **16** ounces Gives a correct explanation such as: The lightest apple weighs 4 ounces and 4 x 4 ounces = 16 ounces.	1 1	2
2. Gives a correct answer: **1** lb **2** ounces *Special case* Accept $\mathbf{1\frac{1}{8}}$ pounds **18** ounces	1 1sc	1
3. Gives a correct answer: **1** lb **8** ounces *Special case* Accept $\mathbf{1\frac{1}{2}}$ pounds **24** ounces Shows correct work such as: 4 x 3 ounces + 5 x 2 ounces + 2 x 1 ounces = 12 ounces + 10 ounces + 2 ounces = 24 ounces	1 1sc 1 1	3
4. Gives a correct answer: **32** Gives a correct explanation such as: 1/2 a pound = 8 ounces. There are 32 quarters in 8 ounces.	1 1	2
Total Points		**8**

Looking at Student Work on Fruits and Vegetables:

Student A shows a good grasp of the situation and the mathematical operation of multiplication. The student uses clear labels to show multiple groups (like 6 plums) with different unit weights (like 3 oz.). Student A uses subtraction to convert ounces to ounces and pounds in part 2 and 3 of the prompt. Notice the student also uses a label of half pound. Student A also uses multiplication of fractions to verify the number of grapes per ounce.



1. Jeff buys 4 apples.
   What is the least amount they can weigh? 16 ounces
   Explain your answer.

4oz × 4 apples = 4 oz.

The lightest an apple can weigh is 4 ounces, so I multiplied 4 ounces x 4 apples and got 16 ounces

2. Jeff buys 6 plums.
   What is the greatest amount they can weigh? 1 pound 2 ounces

6 plums × 3 oz. = 18 oz. = 18 − 16 = 1 lb. 2 oz

3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
   What is the least amount they can weigh in all? 1 pound 8 ounces
   Show how you figured it out.

4 bananas × 3 oz. = 12 oz.
5 carrots × 2 oz. = 10 oz.
2 tomatoes × 1 oz. = 2 oz.
10 + 2 + 12 = 24
24 − 16 = 1 lb. 8 oz
16 oz = 1 lb.
8 oz = 1/2 lb.
8 oz. 1/4 × 4 = 1 oz.
4 × 4 grapes = 32 oz

4. Jeff buys half a pound of grapes.
   What is the greatest number of grapes he can get? 32 grapes
   Explain how you got your answer.

First I looked at the chart and saw that grapes weigh 1/4 oz. as the lightest. There are 16 oz in one lb. so half of 16 is 8. There are 4 grapes in one ounce so I multiplied 8 x 4 = 32 grapes.

Student B also has a perfect score, but shows some confusion about use of decimal points when using measurement in part 2. Student B also finds the number of grapes in one pound first, then divides the total into two parts.

Student B

1. Jeff buys 4 apples.
   What is the least amount they can weigh? 16 ✓ ounces
   Explain your answer.

   You tak 4 ounces and x it by 4 apples ✓

2. Jeff buys 6 plums.
   What is the greatest amount they can weigh? 1 pound 2 ✓ ounces

3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
   What is the least amount they can weigh in all? 1 pound 8 ✓ ounces
   Show how you figured it out.

4. Jeff buys half a pound of grapes.
   What is the greatest number of grapes he can get? 32 ✓
   Explain how you got your answer.

   I did 4 x 64 and ÷ it by 2 and got 32 ✓

Student C has an interesting strategy for converting ounces into pounds and ounces. The student draws out the 24 ounces and crosses out the 16 ounces which make the pound.

Student C

1. Jeff buys 4 apples.
   What is the least amount they can weigh? 16 ounces
   Explain your answer.
   well 4 times 4 = 16 ounces or 1 pound

2. Jeff buys 6 plums.
   What is the greatest amount they can weigh? 1 pound 2 ounces

3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
   What is the least amount they can weigh in all? 1 pound 8 ounces
   Show how you figured it out.

   2 oz bad
   12 oz
   +10 oz
   24 oz

4. Jeff buys half a pound of grapes.
   What is the greatest number of grapes he can get? 32
   Explain how you got your answer.
   well first I added up how many ¼ I could get and I got 32 ¼. so he can have 32 grapes

Many students were unfamiliar with standard notation for writing weights. Student D gives the answer in pounds, using fractions for the partial quantity, and then gives the total weight in ounces. The student treats the blanks as two separate answers, rather than a combined measurement. Student D also confuses the inverse relationship that to get the most individual grapes for a given weight the smallest size of grape must be used not the largest.

Student D

1. Jeff buys 4 apples.
   What is the least amount they can weigh? 16 ✓ ounces 1
   Explain your answer.
   I picked the lowest ounce, 4, and x it by 4 and got 16 1

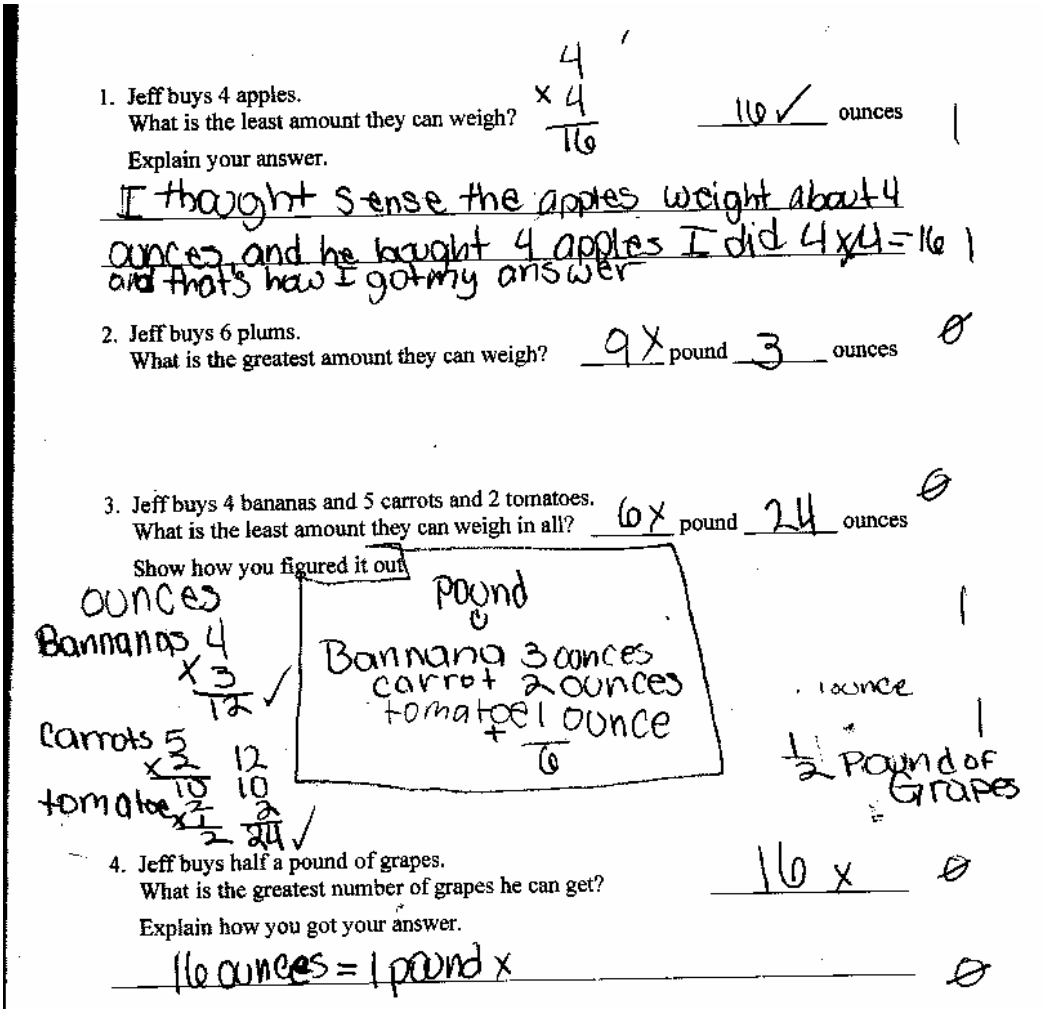
2. Jeff buys 6 plums.
   What is the greatest amount they can weigh? 2 ✓ 1 16 pound 18 ounces 1 sc

3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
   What is the least amount they can weigh in all? 6 1 16 pound ✓ 24 ounces 1 sc
   Show how you figured it out.
   b - 4 x 3 = 12
   c - 5 x 2 = 10 ✓ 1
   t - 2 x 1 = 2 1
   24 ✓
   8 ounces

4. Jeff buys half a pound of grapes.
   What is the greatest number of grapes he can get? 8 x grapes 0
   Explain how you got your answer.
   I knew that half a lb is 8 and and the most a grape weighs is 1 ounce, so I did 1 x 8 = 8 x 0
   How I got that - 16 on = 1lb 8 (6)
   16 - 2 = 8

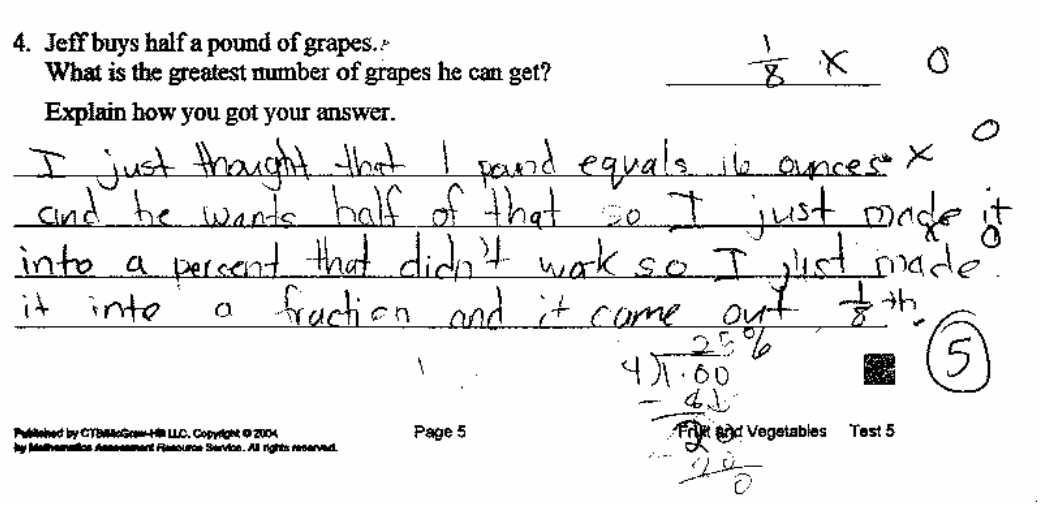
Student E is also unfamiliar with weight notation. In part 3 the student adds the lowest weight for each type of produce to get an answer of 6. Then the student finds the total weight in ounces for each individual type of produce to get the correct weight of 24 ounces. The student struggles with why 2 blanks were provided. In part 4 the student makes no attempt to relate weight of grapes to the question.

Student E



Part 4 was quite challenging for students to think about. Student F does not see how to combine information. At first the student works with the idea of 1/4 of an ounce, but misses the per-grape concept. The student doesn't think either about the meaning of the answer. Does it make sense that 1/8 of a grape would equal half a pound?

Student F


4. Jeff buys half a pound of grapes.
What is the greatest number of grapes he can get?
$\frac{1}{8}$ X 0
Explain how you got your answer.
I just thought that 1 pound equals 16 ounces X 0
and he wants half of that so I just made it
into a percent that didn't wark so I just made
it into a fraction and it come out $\frac{1}{8}$th. (5)
25%
4)1.00
-8
20
-20
0
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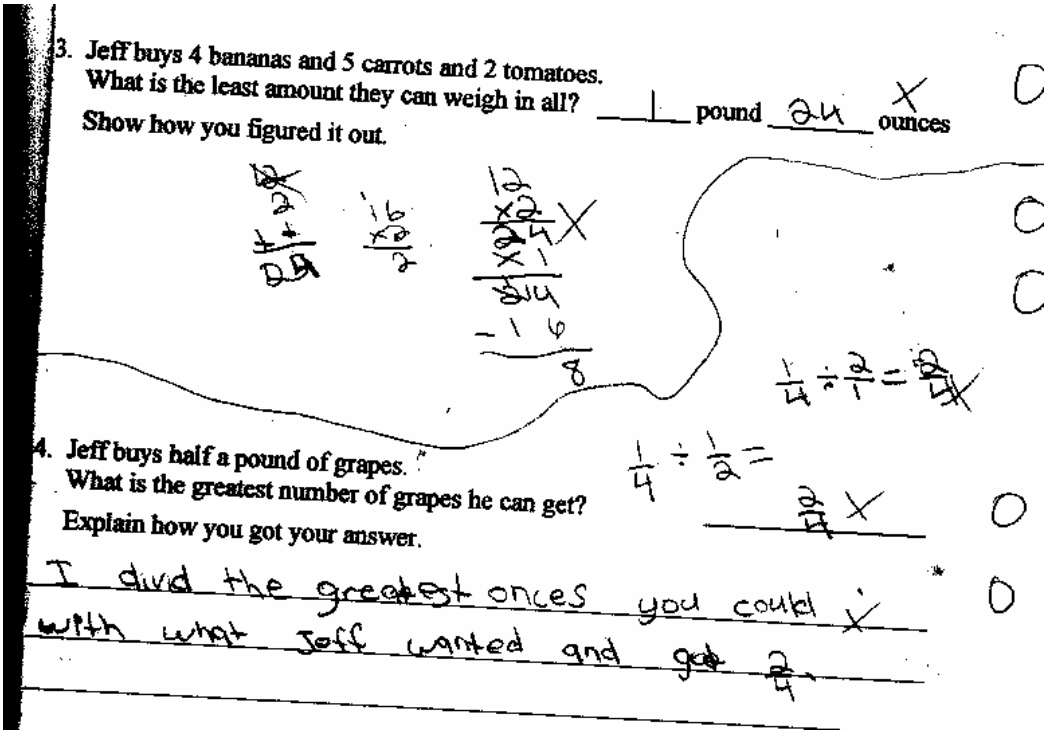
Fruit and Vegetables Test 5

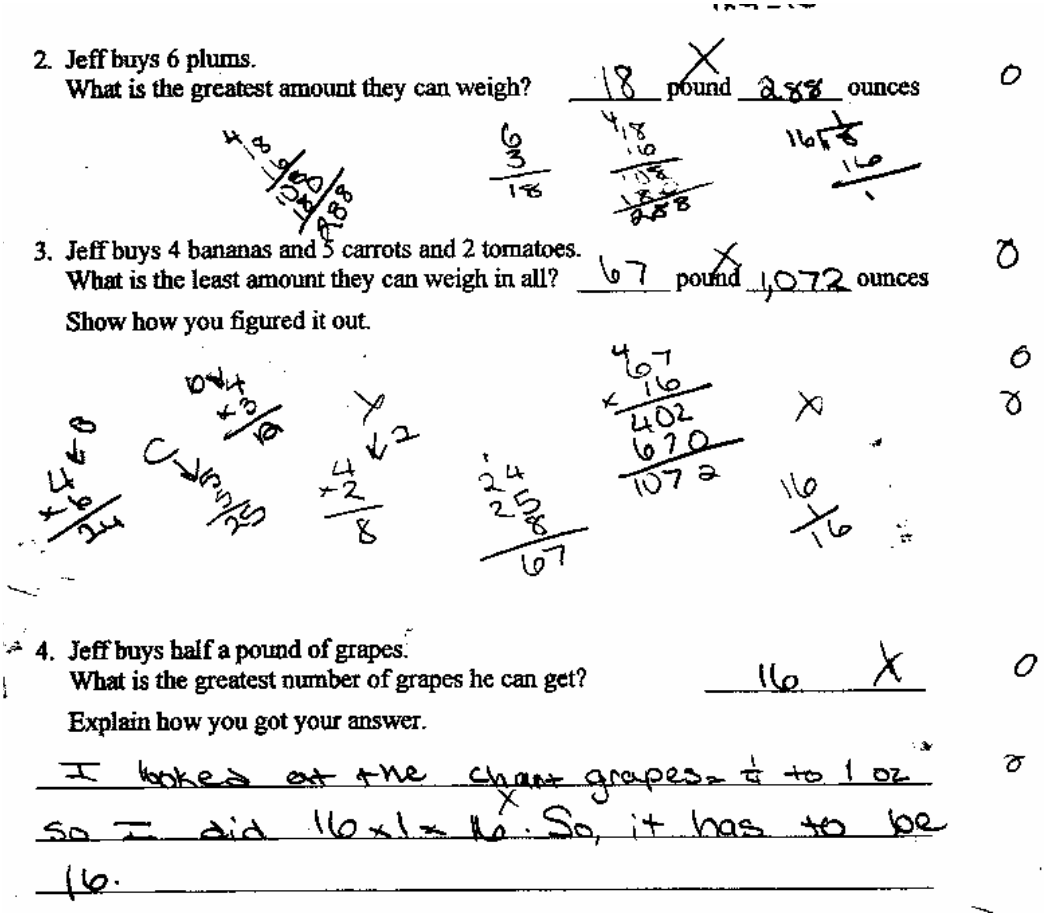
Student G tries to take half of the one-fourth ounce, rather than half of a pound. Does it make sense that 2/4 of a grape would equal half a pound?

Student G


3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
What is the least amount they can weigh in all? 1 pound 24 ounces X C
Show how you figured it out.
12 x2 24 X
x1
24
-16
8
C
C
$\frac{1}{4} \div \frac{2}{1} = \frac{2}{4}$ X
4. Jeff buys half a pound of grapes.
What is the greatest number of grapes he can get?
$\frac{1}{4} \div \frac{1}{2} =$
$\frac{2}{4}$ X 0
Explain how you got your answer.
I divd the greatest onces you could X 0
with what Jeff wanted and got $\frac{2}{4}$

Student H struggles again with unfamiliarity with notation. In part 2 the student finds the correct number of ounces, but mislabels them as pounds. Then the student tries to convert the pounds to ounces. In part 3 the student does the same procedure, but also overlooks that the problem switches from greatest weight to least weight.

Student H



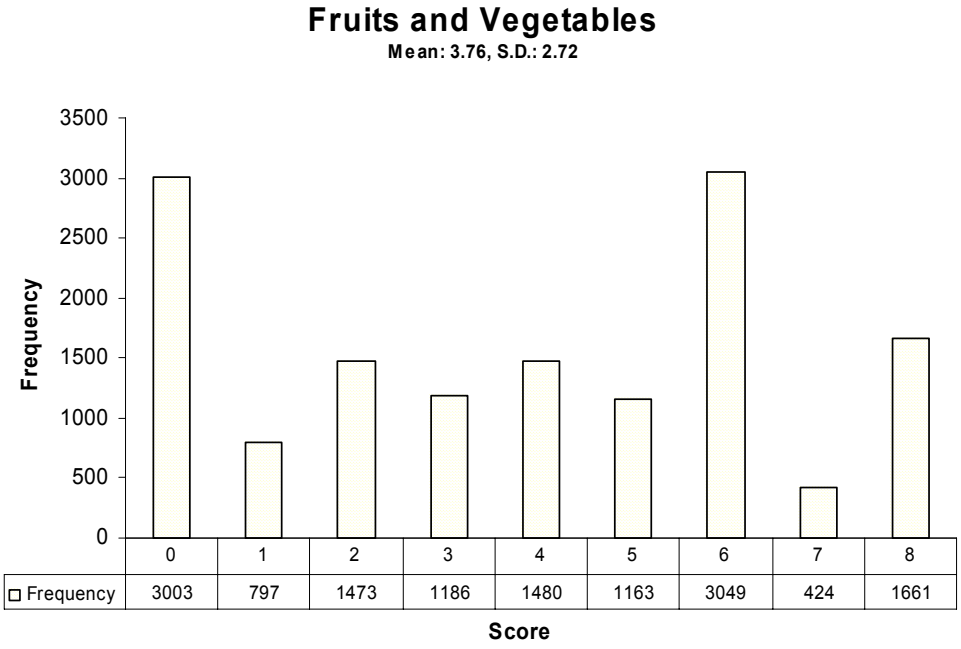
2. Jeff buys 6 plums.
What is the greatest amount they can weigh? 18 pound 288 ounces

3. Jeff buys 4 bananas and 5 carrots and 2 tomatoes.
What is the least amount they can weigh in all? 67 pound 1,072 ounces
Show how you figured it out.

4. Jeff buys half a pound of grapes.
What is the greatest number of grapes he can get? 16
Explain how you got your answer.
I looked at the class grapes = ½ to 1 oz
so I did 16 x 1 = 16. So, it has to be 16.

Teacher Notes:

Frequency Distribution for each Task – Grade 5
Grade 5 – Fruits and Vegetables



Score:	0	1	2	3	4	5	6	7	8
% < =	21.1%	26.7%	37.0%	45.4%	55.8%	63.9%	85.4%	88.3%	100.0%
% > =	100.0%	78.9%	73.3%	63.0%	54.6%	44.2%	36.1%	14.6%	14.6%

The maximum score available for this task is 8 points.
The cut score for a level 3 response, meeting standards, is 3 points.

Many students (about 71%) could find the smallest weight for 4 apples and show how they figured it out. More than half the students (about 63%) could also find the greatest weight for 6 plums. About 38% of the students could find smallest or greatest weights for individual produce items or combinations of produce including converting ounces to pounds and ounces. About 15% of the students met all the demands of the task, including dealing with the inverse relationship of using the smallest weight to get the largest number of grapes. 21% of the students scored no points on this task. 94% of students with this score attempted the task.

Fruit and Vegetables

Points	Understandings	Misunderstandings
0	94% of the students attempted the task.	Students may have had difficulty interpreting the table. Some students picked numbers in between the two values on the table or used highest value when they needed lowest value.
2	Students could pick the correct value from the table to find the lowest weight for 4 apples and show their calculations.	The most common error was to use the lowest weight for tomatoes instead of for apples (about 40%)
3	Students could find the lowest weight for 4 apples and the greatest weight for 6 plums, including converting ounces to ounces and pounds.	In trying to find the greatest weight for plums, 13% multiplied by 1 oz. or 2 oz. instead of the maximum of 3 oz. While the correct answer was 18 oz. which needed to be converted to 1 lb. 2 oz., 32% of the students had answers between 2 lb and 18 lb.
4	Students could find the lowest weight for apples and show calculations. Students could find the total weight of the fruits and vegetables for part 3, but could not correctly convert the answer to pounds and ounces.	A common error was to think that there were enough ounces to make 1 lb., but then put the total 24 ounces in the second blank. Many students realized it was more than a pound and put answers like 1 1/2 lbs. some number of ounces.
6	Students could find lowest and greatest weights for fruits and vegetables using a table and converting to pounds and ounces where appropriate.	Students had difficulty with the inverse relationship between greatest amount of fruit and lowest weight for fruit. 43% of the students who missed this question used the highest weight for grapes instead of the lowest, giving them an answer of 8 grapes. Almost 17% thought there would be a fractional number of grapes. 6% of the students who missed this part of the task didn't attempt it.
8	Students could use a table to find lowest and greatest weights for fruits and vegetables, convert ounces to pounds and ounces using standard notation, and reason inversely to find the most fruit by using the lowest weight.	

Based on teacher observations, this is what fifth graders know and are able to do:

- Recognize when to use multiplication
- Read and interpret a table given a range of values
- Multiply a group of objects by the appropriate weight from the table to find least or greatest weight

Areas of difficulty for fifth graders, fifth graders struggled with:

- Converting ounces to pounds and ounces
- Thinking about the inverse relationship between weight and total number of a fruit
- Dealing with fractional amounts of 1/2 pound

Questions for Reflection on Fruits and Vegetables:

- Have your students worked with measurement this year? Do you think they are familiar with notation for writing pounds and ounces?
- Do you see evidence that students understood how to use the table to find lowest and highest weights for different types of fruits and vegetables?
- What other types of questions might you ask using this table?
- Did students understand that this was a multiplication situation (multiple groups) or did they use repeated addition?
- Did your students use labels to help keep track of the types of information found by multiplication? How do the labels show sense-making?
- What strategies did students use to change from ounces to ounces and pounds? Did they subtract? Use division? Round to an approximate number of pounds? Use the blanks for different facts about the problem not related to the particular labels?
- What type of logic do students need to develop to help them trade units? How does understanding the base-10 system help them understand the trading in measurement? How comfortable do you think students are with units that are not in ones or tens? Are there any other major pieces of logic that could help students with this type of problem? How can you help students build generalizations about time or distance that they can apply to new measurement situations?

Implications for Instruction:

Students at this grade level need to have experience using a variety of tables and graphs to solve problems. Students should have experiences with different types of measurement situations and be able to generalize about making conversions among units. Students need to also be familiar with the notational formats of measurement, going from larger to progressively smaller units (understanding the logic of trading smaller units for larger units.)

Teacher Notes: