Sample Questions from the NAEP 1996 Assessment in Mathematics

The NAEP 1996 assessment in mathematics is a rich collection of questions developed to survey the mathematical knowledge and skills of students in grades 4, 8, and 12. Each student received both multiple-choice and constructed-response questions. As shown in the item maps (see Figures 1.4 through 1.6), multiple-choice and constructed-response questions are used to assess all levels of mathematical knowledge and skills. The sample questions presented below represent the types of questions used (i.e., multiple-choice, short constructed-response, and extended constructed-response) but do not illustrate the breadth of the content assessed.

Figures 1.7 through 1.8 present samples of questions. The tables accompanying the questions show two types of percentages: (1) the overall percentage of students within a grade who successfully answered the question and (2) the percentages of students within each of the achievement level intervals — *Basic*, *Proficient*, and *Advanced* as well as below *Basic* — who successfully answered the question.

The second question in Figure 1.7 is a short constructed-response question administered at grade 4. The question asked students to recognize the need for division and that the answer is the number of students remaining when 34 students are divided into groups of eight. One possible way of arriving at the correct answer would require students to divide 34 by 8 and note the remainder of 2. Another path to the solution would be to note that 34 is 2 more than 8 times 4. In either case, the number of remaining students, or substitutes, would be 2.

The third question in Figure 1.8 is an extended constructed-response question administered at grade 8. The question asked students to carefully note the context of the solution, daily ridership on Metro Rail, and then compare the relative value of two graphs. Students were asked to use both graphical representations of the data, one at a time, to argue for rapid increase in sales from March to October and to argue for little difference in the level of ticket sales between the same two months.

The third question in Figure 1.9 is a short constructed-response question administered at grade 12. The question asked students to compare the strength of two cherry-flavored drinks. As is the case with many of the questions included in the NAEP mathematics assessment, there are a number of ways for students to arrive at the correct answer. One approach might find students comparing 6/59 or 10.16 percent cherry flavor for Luis with 5/47 or 10.63 percent cherry flavor for Martin. The question measures students' ability to compare and order ratios and rates.

Figure 1.7 NAEP 1996 Mathematics Sample Questions for Grade 4

THE NATION'S REPORT CARD naep

N stands for the number of stamps John had. He gave 12 stamps to his sister. Which expression tells how many stamps John has now?

(A) $N + 12$

(B) $N - 12$

(C) $12 - N$

(D) $12 \times N$

The correct answer is B.

This multiple-choice question measures algebra and functions.

Grade 4	PERCENTAGE "CORRECT" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Correct	Below Basic 213 and below*	Basic 214 to 248*	Proficient 249 to 281*	Advanced 282 and above*
67	44	73	90	***

*NAEP mathematics composite scale range
***Sample size insufficient to permit reliable estimates

Ms. Hernandez formed teams of 8 students each from the 34 students in her class. She formed as many teams as possible, and the students left over were substitutes. How many students were substitutes?

Answer: _____

The correct answer is 2.

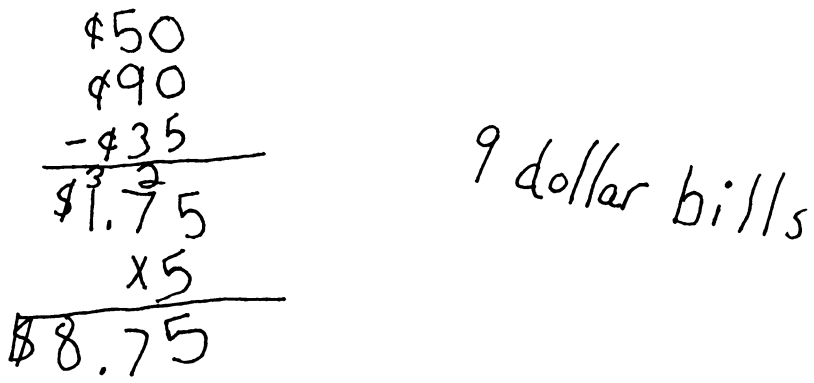
This short constructed-response question measures number sense, properties, and operations. Students' responses were scored correct or incorrect.

Grade 4	PERCENTAGE "CORRECT" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Correct	Below Basic 213 and below*	Basic 214 to 248*	Proficient 249 to 281*	Advanced 282 and above*
39	5	42	86	***

*NAEP mathematics composite scale range
***Sample size insufficient to permit reliable estimates

Sam can purchase his lunch at school. Each day he wants to have juice that costs 50¢, a sandwich that costs 90¢, and fruit that costs 35¢. His mother has only $1.00 bills. What is the least number of $1.00 bills that his mother should give him so he will have enough money to buy lunch for five days?

This short constructed-response question measures number sense, properties, and operations. Students' responses were scored using a three-point scoring guide that allowed for partial credit. The following is a sample of a student response that received the highest score, Satisfactory. A Satisfactory response to this question gives the correct answer of nine dollar bills.



Grade 4	PERCENTAGE "SATISFACTORY" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Satisfactory	Below Basic 213 and below*	Basic 214 to 248*	Proficient 249 to 281*	Advanced 282 and above*
17	1	14	44	***

*NAEP mathematics composite scale range
***Sample size insufficient to permit reliable estimates

Figure 1.8 NAEP 1996 Mathematics Sample Questions for Grade 8

THE NATION'S REPORT CARD naep

A car odometer registered 41,256.9 miles when a highway sign warned of a detour 1,200 feet ahead. What will the odometer read when the car reaches the detour?

(A) 42,456.9

(B) 41,279.9

(C) 41,261.3

(D) 41,259.2

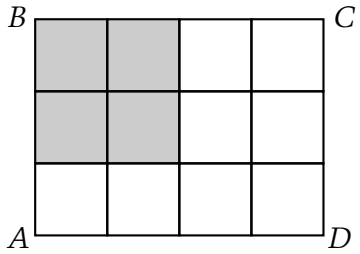
(E) 41,257.1

The correct answer is E.

This multiple-choice question measures the measurement strand.

Grade 8	PERCENTAGE "CORRECT" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Correct	Below Basic 261 and below*	Basic 262 to 298*	Proficient 299 to 332*	Advanced 333 and above*
26	11	25	50	70

* NAEP mathematics composite scale range



In the figure above, what fraction of rectangle *ABCD* is shaded?

(A) $\frac{1}{6}$

(B) $\frac{1}{5}$

(C) $\frac{1}{4}$

(D) $\frac{1}{3}$

(E) $\frac{1}{2}$

The correct answer is D.

This multiple-choice question measures number sense, properties, and operations.

Grade 8	PERCENTAGE "CORRECT" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Correct	Below Basic 261 and below*	Basic 262 to 298*	Proficient 299 to 332*	Advanced 333 and above*
65	32	78	96	99!

*NAEP mathematics composite scale range

! Statistical tests involving this value should be interpreted with caution. Standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions (see Apppendix A).

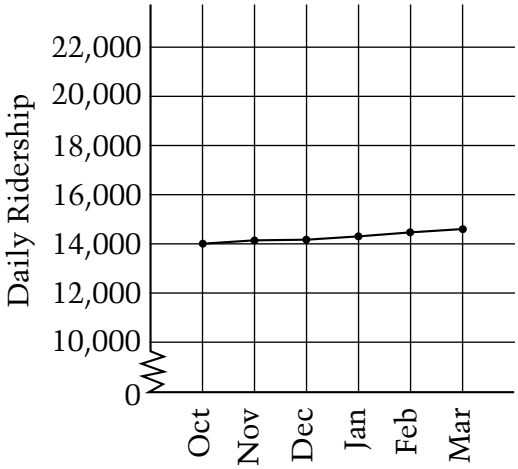
This question requires you to show your work and explain your reasoning. You may use drawings, words, and numbers in your explanation. Your answer should be clear enough so that another person could read it and understand your thinking. It is important that you show all of your work.

METRO RAIL COMPANY

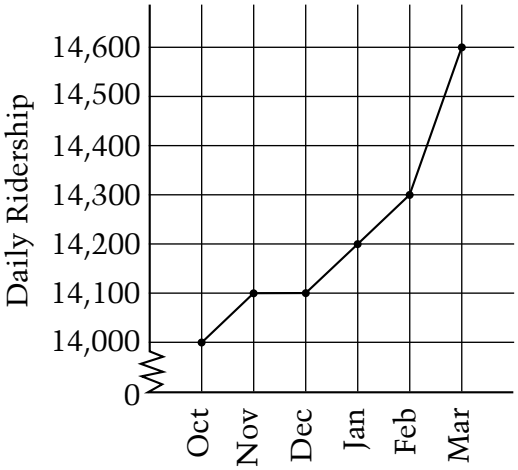
Month	Daily Ridership
October	14,000
November	14,100
December	14,100
January	14,200
February	14,300
March	14,600

The data in the table above has been correctly represented by both graphs shown below.

Graph A



Graph B



Which graph would be best to help convince others that the Metro Rail Company made a lot more money from ticket sales in March than in October?

Explain your reason for making this selection.

Why might people who thought that there was little difference between October and March ticket sales consider the graph you chose to be misleading?

This extended constructed-response question measures data analysis, statistics, and probability. Students' responses were scored using a four-point scoring guide that allowed for partial credit. Scores of 3 (Satisfactory) and 4 (Complete) are illustrated below.

Grade 8	PERCENTAGE "SATISFACTORY OR HIGHER" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Satisfactory or Higher	Below Basic 261 and below*	Basic 262 to 298*	Proficient 299 to 332*	Advanced 333 and above*
20	7	22	35	***

*NAEP mathematics composite scale range
***Sample size insufficient to permit reliable estimates

The following is a sample of a student response that received a Satisfactory score. A Satisfactory response to this question gives the correct response, Graph B, but provides an incomplete but partially correct explanation.

Graph B because it shows how the graph goes up so much.

because it shows a big jump because all they did was make each square worth more ridership

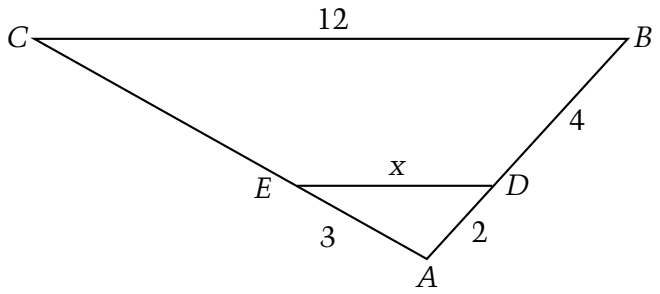
The following is a sample of a student response that received the highest score, Complete. A Complete response to this question gives the correct response, Graph B, and provides a complete explanation.

graph B

Because it has a smaller scale for daily riders it looks like a greater increase

Because it appears its increased a lot when its only increased $600

Figure 1.9 NAEP 1996 Mathematics Sample Questions for Grade 12



If triangles *ADE* and *ABC* shown in the figure above are similiar, what is the value of *x*?

(A) 4

(B) 5

(C) 6

(D) 8

(E) 10

The correct answer is A.

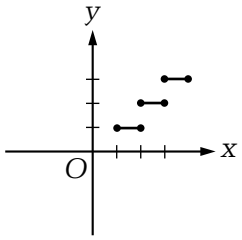
This multiple-choice question measures the geometry and spatial sense strand.

Grade 12	PERCENTAGE "CORRECT" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Correct	Below Basic 287 and below*	Basic 288 to 335*	Proficient 336 to 366*	Advanced 367 and above*
37	26	37	56	***

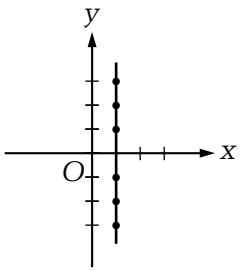
*NAEP mathematics composite scale range
***Sample size insufficient to permit reliable estimates

Which of the following could be the graph of a function?

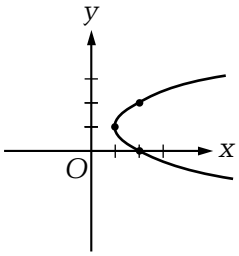
(A)



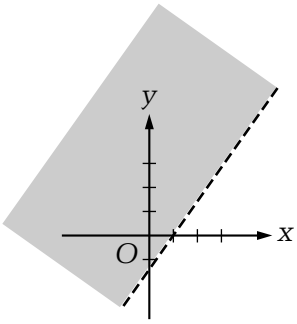
(B)



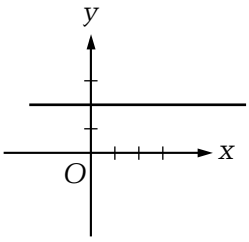
(C)



(D)



(E)



The correct answer is E.

This multiple-choice question measures algebra and functions.

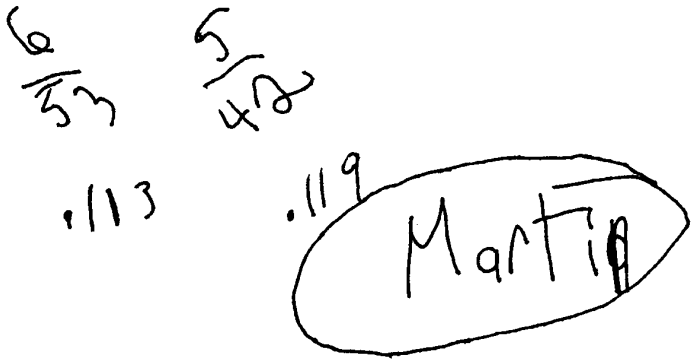
Grade 12	PERCENTAGE "CORRECT" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Correct	Below Basic 287and below*	Basic 288 to 335*	Proficient 336 to 366*	Advanced 367 and above*
20	8	17	56	***

* NAEP mathematics composite scale range
*** Sample size insufficient to permit reliable estimates

Luis mixed 6 ounces of cherry syrup with 53 ounces of water to make a cherry-flavored drink. Martin mixed 5 ounces of the same cherry syrup with 42 ounces of water. Who made the drink with the stronger cherry flavor?

Give mathematical evidence to justify your answer.

This short constructed-response question measures number sense, properties, and operations. Students' responses were scored using a three-point scoring guide that allowed for partial credit. The following is a sample of a student response that received the highest score, Satisfactory. A Satisfactory response to this question identifies Martin and shows correct mathematical justification.



Grade 12	PERCENTAGE "SATISFACTORY" WITHIN ACHIEVEMENT LEVEL INTERVALS			
Overall Percentage Satisfactory	Below Basic 287 and below*	Basic 288 to 335*	Proficient 336 to 366*	Advanced 367 and above*
23	3	22	60	***

*NAEP mathematics composite scale range
***Sample size insufficient to permit reliable estimates