TIMSS

IEA's Third International Mathematics and Science Study

TIMSS Mathematics Items:

Released Set for Population 2 (Seventh and Eighth Grades)

Overview of TIMSS

TIMSS is a collaborative research project sponsored by the International Association for the Evaluation of Educational Achievement (IEA). In 1994-95, achievement tests in mathematics and science were administered to carefully selected samples of students in classrooms around the world. With more than 40 countries participating, five grades assessed in two school subjects, more than half a million students tested in more than 30 languages, and millions of open-ended responses generated, TIMSS is the largest and most ambitious study of comparative educational achievement ever undertaken.

TIMSS tested and collected contextual information about the schooling of students in the following grade levels:

- Students enrolled in the two adjacent grades that contained the largest proportion of 9-year-olds students – grades 3 and 4 in many countries
- Students enrolled in the two adjacent grades that contained the largest proportion of 13-year-old students – grades 7 and 8 in many countries
- Students in their final year of secondary education. As an additional option, countries could test two special subgroups of these students:
  - Students taking advanced courses in mathematics
  - Students taking advanced courses in physics

The three different groups of TIMSS students listed above are often referred to as Populations 1, 2, and 3, respectively. All countries participated in the testing at Population 2 (grades 7 and 8), which is the core of TIMSS. Table 1 lists the participants that satisfied all of the steps necessary to have their Population 2 mathematics results published in the international report.[1] Countries could choose whether or not to participate in the testing at the other two populations. About 30 countries participated in the testing at Population 1 and about 25 in the testing at Population 3.

TIMSS

[1] Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. (1996). *Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

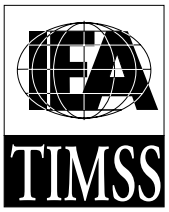
Table 1

TIMSS Participants

Included in the TIMSS International Analyses at Population 2

- Australia
- Austria
- Belgium (Flemish)
- Belgium (French)
- Bulgaria
- Canada
- Colombia
- Cyprus
- Czech Republic
- Denmark
- England
- France
- Germany
- Greece
- Hong Kong
- Hungary
- Iceland
- Iran, Islamic Republic
- Ireland
- Israel*
- Japan
- Korea, Republic of
- Kuwait*
- Latvia
- Lithuania
- Netherlands
- New Zealand
- Norway
- Portugal
- Romania
- Russian Federation
- Scotland
- Singapore
- Slovak Republic
- Slovenia
- South Africa
- Spain
- Sweden
- Switzerland
- Thailand
- United States

* Participated only at the upper grade.



The success of TIMSS depended on a collaborative effort between the research centers in each country responsible for implementing the project, and the network of centers responsible for managing across-country tasks such as training country representatives in standardized procedures, selecting comparable samples of schools and students, and conducting the various steps required for data processing and analysis. The TIMSS International Study Center, responsible for the international coordination of tasks, is housed in the Center for the Study of Testing, Evaluation, and Educational Policy (CSTEEP) at Boston College.

The TIMSS Mathematics Test

The TIMSS curriculum framework underlying the mathematics tests at all three populations was developed by groups of mathematics educators with input from the TIMSS National Research Coordinators (NRCs).[2] The **content** aspect of the framework represents the subject matter content of school mathematics. The **performance expectations** aspect of the framework describes, in a non-hierarchical way, the many kinds of performances or behaviors that might be expected of students in school mathematics. Working within the mathematics curriculum framework, mathematics test specifications were developed for Population 2 that included items representing a wide range of mathematics topics and eliciting a range of skills from the students.

The tests were developed through an international consensus involving input from experts in mathematics and measurement specialists.[3] The TIMSS Subject Matter Advisory Committee, which included distinguished scholars from 10 countries, ensured that the test reflected current thinking and priorities within the field of mathematics. The items underwent an iterative development and review process with one pilot testing effort involving 43 countries. Every effort was made to help ensure that the tests represented the curricula of the participating countries and that the items did not exhibit any bias towards or against particular countries, including modifying specifications in accordance with data from the curriculum analysis component, obtaining ratings of the items by subject matter specialists within the participating countries, and conducting thorough statistical item analysis of data collected in the pilot testing. The final forms of the test were endorsed by the NRCs of all the participating countries. The resulting test for the Population 2 students (seventh and eighth grades in many countries) contained 151 mathematics items representing a range of mathematics topics and skills.

Approximately one-fourth of the TIMSS items were in the free-response format, which required students to generate and write their own answers. Designed to represent approximately one-third of students' response time, some free-response questions asked for short answers, while others called for extended responses and required students to show their work. The remaining questions used a multiple-choice format. The distribution of items across content areas (as reported in the international reports) and performance expectations, as well as by item format, is presented in Table 2.

[2] The complete TIMSS curriculum frameworks can be found in Robitaille, D.F. et al. (1993). *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science*. Vancouver, B.C.: Pacific Educational Press.

[3] Please see Garden, R.A. (1996), "Development of the TIMSS Achievement Items" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design*. Vancouver, B.C. Pacific Education Press; and Garden, R.A. and Orpwood, G. (1996). "Development of the TIMSS Achievement Test" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I: Design and Development*. Chestnut Hill, MA: Boston College.

Table 2

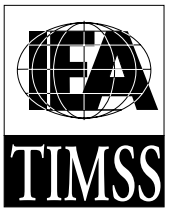
Distribution of Mathematics Items by Content Reporting Category and Performance Expectation[1] - Population 2

Content Category	Number of Items	Number of Multiple-Choice Items	Number of Short-Answer Items	Number of Extended-Response Items
Fractions and Number Sense	51 (37)	41 (27)	9 (9)	1 (1)
Algebra	27 (18)	22 (13)	3 (3)	2 (2)
Measurement	18 (12)	13 (7)	3 (3)	2 (2)
Geometry	23 (17)	22 (16)	1 (1)	0 (0)
Data Representation, Analysis and Probability[2]	21 (12)	19 (10)	1 (1)	1 (1)
Proportionality	11 (6)	8 (3)	2 (2)	1 (1)
Total	151 (102)	125 (76)	19 (19)	7 (7)

Performance Expectation	Number of Items	Number of Multiple-Choice Items	Number of Short-Answer Items	Number of Extended-Response Items
Knowing[2]	33 (16)	31 (13)	2 (2)	0 (0)
Performing Routine Procedures	38 (30)	32 (24)	6 (6)	0 (0)
Using Complex Procedures	32 (19)	28 (15)	4 (4)	0 (0)
Solving Problems[3]	48 (38)	34 (24)	7 (7)	7 (7)

[1]Figure in parentheses refers to the number of items in the released item set and provided in this volume.
[2]One item (M09) was deleted prior to analysis due to poor performing statistics. It is not included in this volume.
[3]Includes two extended-response items classified as "Justifying and Proving," two extended-response items classified as "Communicating," and one extended-response item classified as "Conjecturing."

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.



To ensure broad subject matter coverage without overburdening individual students, TIMSS used a rotated design that included both the mathematics and science items. In accordance with the design, the mathematics and science items were assembled in 26 different clusters — labeled A through Z. The clusters were assigned to eight different booklets in accordance with the rotated design so that representative samples of students responded to each cluster.[4] Each student completed one 90-minute test booklet containing both mathematics and science items.

Item Release Policy

In accordance with IEA policy, TIMSS has kept about one-third of the TIMSS items secure for possible future use in measuring international trends in mathematics and science achievement. For Population 2, the secure items are in clusters labeled A through H. All remaining items (in clusters I through Z) are available for general use. To facilitate this use, the released TIMSS items for Population 2 (seventh and eighth grades) have been replicated in their entirety in this mathematics volume and in the companion science volume. As shown in Table 2, this volume contains 102 mathematics items, including all of the free-response questions. To provide a unique identifier for each item, the TIMSS cluster and item number is shown in the black box on the right hand side of each page.

While the purpose of this volume is to encourage the use of TIMSS and TIMSS items, please note the IEA copyright; appropriate references to the IEA and TIMSS should be provided in your use of these items.

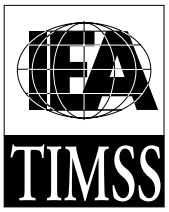
Item Documentation and Item Results

The TIMSS tests were prepared in English and translated into 30 additional languages. Each item is reproduced for this volume exactly as it was presented to each of the TIMSS countries. In translating the tests or making adaptations for cultural purposes, every effort was made to ensure that the meaning and difficulty of items did not change. This process required an enormous effort by the national centers, with many checks made along the way.[5]

Across the bottom of each item, there is documentation about the item, including the subject assessed and the classification of the item by content category and performance expectation. If the item is a two-part item, the documentation for Part A is shown on the first page and the documentation for Part B is shown on the following page.

[4] The TIMSS test design is fully documented in Adams, R. and Gonzalez, E. (1996). "Design of the TIMSS Achievement Instruments" in D.F. Robitaille and R.A. Garden (Eds.), *TIMSS Monograph No. 2: Research Questions and Study Design*. Vancouver, B.C.: Pacific Education Press; and Adams, R. and Gonzalez, E. (1996). "TIMSS Test Design" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I: Design and Development*. Chestnut Hill, MA: Boston College.

[5] More details about the translation verification procedures can be found in Mullis, I.V.S., Kelly, D.L., and Haley, K. (1996). "Translation Verification Procedures" in M.O. Martin and I.V.S. Mullis (Eds.), *Third International Mathematics and Science Study: Quality Assurance in Data Collection*. Chestnut Hill, MA: Boston College; and Maxwell, B. (1996). "Translation and Cultural Adaptation of the TIMSS Instruments" in M.O. Martin and D.L. Kelly (Eds.), *Third International Mathematics and Science Study Technical Report, Volume I*. Chestnut Hill, MA: Boston College.



Subject. All of the items in this volume are mathematics items. The science items are provided in a companion volume, *TIMSS Science Items: Released Set for Population 2 (Seventh and Eighth Grades).*

Key. For multiple-choice items, the key for the correct answer is provided. For free-response questions, the categories of responses and their codes are shown on the page following the item. In scoring the TIMSS free-response questions, TIMSS utilized two-digit codes with rubrics specific to each item. The first digit designates the correctness level of the response. The first digit is usually a "1" designating a correct response, a "7" indicating an incorrect response, or a "9" for non-response. Sometimes, however, fully correct responses are differentiated from partially correct responses. In these instances, the fully correct responses are designated by a "2" (or in one instance by a "3") and the partially correct responses by a "1." The second digit, combined with the first digit, represents a diagnostic code used to identify specific types of approaches, strategies, or common errors and misconceptions.

Content Category. The mathematics items were reported according to six content areas.

- Fractions and Number Sense
- Geometry
- Algebra
- Data Representation, Analysis, and Probability
- Measurement
- Proportionality

Table 3 indicates which items have been classified into each of the six content areas.

Performance Expectation. Items were classified into the following performance expectations.

- Knowing
- Performing Routine Procedures
- Using Complex Procedures
- Solving Problems

Percent of Students Responding Correctly. The percent of students responding correctly to the item reflects the international average across the countries participating in TIMSS at each grade tested. That is, first the percentage of students responding correctly to the item was calculated for each country. Next, an average was calculated across countries. For the upper grade (eighth grade in many countries), this average was calculated across 41 countries (see Table 1). For the lower grade (seventh grade in many countries), the average is based on 39 countries. For items using a partial credit scoring scheme, the percentages given are for students responding with fully correct answers.

International Difficulty Index. This statistic reflects the difficulty of the item as estimated from item response theory scaling (IRT). Since the TIMSS scale was developed based on the performance of students at both grades in all countries, the international scale values apply to both grades and to all countries. The higher the index, the more difficult the item.

Table 3

Item Listing by Mathematics Content Area

Fractions and Number Sense	
I02	People boarding bus.
I05	Discus throwing competition.
I06	Fraction larger than 2/7.
I07	Use of estimates.
J12	Dividing fractions.
J14	Divide 24.56 by 0.004.
J17	Distance on map.
K01	Shaded circles.
K02	Chemist mixes solution.
K06	Amount of students at Beaton High School.
K09	Adding fractions.
L08	Height of tree.
L09	Which is right number?
L17	Substracting fractions.
M04	Largest fraction.
M08	Decimal multiplication.
N11	Actual number of trees planted.
N14	List of equivalent fractions.
N16	Number of marbles in bag.
N17	Rate of fuel consumption.
N19	Shade units on grid.
O02	Percent increase in price.
O04	Number rounded to hundredth.
O09	Times Luis runs through course.
P12	Estimate number of cabbages.
P13	Heart beats per hour.
P14	Fraction of cake left.
P16	Decimal, as a fraction in lowest terms.
Q06	Amount of water used.
Q08	Number order.
Q09	Adding and multiplying fractions.
R06	2.201 - 0.753 = ?
R07	Thickness of sheet of paper.
R12	6000 - 2369 = ?
R13	Money left.
U01A	Total time for songs to play (a).
U01B	Total time for songs to play (b).
V01	Actual weight of dolphin.

Algebra	
I01	What does N stand for?
I04	Number sequence.
J18	Number missing from table.
K04	x/2 < 7 is equivalent to…
L11	Total distance traveled by ball.
L13	Shapes in a pattern.
L16	Solve for x.
N13	Substitute for x.
O07	Solve for x.
P10	Equivalent algebraic expressions.
P15	Equivalent algebraic expression.
Q01	Expression representing number of hats.
Q02	Substraction of algebraic expressions.
Q07	Solve for W.
R09	False algebraic expression.
R11	Number of students with two pencils.
S01A	Sequence of triangles (a).
S01B	Sequence of triangle (b).
T01A	Weight of apples (a).
T01B	Weight of apples (b).

Measurement	
I03	Number of bottles filled.
J10	Area of paper uncovered.
K05	Area of a rectangle.
L12	Who had the longest pace?
M01	Weight shown on the scale.
N15	Angle closest to 30°.
O06	Time to take cake out of oven.
P11	Approximate length of pencil.
Q03	Longest time.
S02A	Area of square.
S02B	Length of side of square.
S02C	Perimeter of figure.
U02A	New rectangle (a).
U02B	New rectangle (b).
V04	Area of parallellogram.

Geometry	
I08	Point on a line.
J11	Properties of parallelograms.
J15	Which two triangles are similar?
J16	Likely coordinates of P.
K03	Rotated 3-dimensional figure.
K08	Congruent triangles.
L15	Measure of remaining angle.
M02	Lines of symmetry.
M05	Half-turn of shaded figure.
M07	Measure of angle BCD.
N12	Location of point on a line.
O03	Angles that add to 180°.
O08	Rotated triangle.
P08	Ratio of side length to perimeter.
P09	Similar triangles.
Q10	Measure of angle.
R10	Triangles in trapezoid.

Data Representation, Analysis and Probability	
I09	Color of card drawn from bag.
J13	Number of students per grade.
K07	Number of blue pens in drawer?
L10	Highest temperature on chart.
M03	Chance of picking red marble.
N18	Probability of even numbered chip.
O01	Speed of car from graph.
O05	Number of red faces.
P17	Temperature on table and thermometers.
Q04	Heights of four girls on graph.
R08	Distance car will travel.
V02	Price of renting office space.

Proportionality	
L14	Missing values in proportionality table.
M06	Number of girls in class.
Q05	More boys or girls in class.
R14	Amount Sue paid.
T02A	Larger pattern out of two smaller patterns (a).
T02B	Larger pattern out of two smaller patterns (b).
V03	Ratio of red paint to total amount of paint.

For More Information About TIMSS

For more details about the TIMSS results and procedures, please see the following reports:

Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study. Beaton, A.E., Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. Chestnut Hill, MA: Boston College, 1996.

Science Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study. Beaton, A.E., Martin, M.O., Mullis, I.V.S., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. Chestnut Hill, MA: Boston College, 1996.

Mathematics Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study. Mullis, I.V.S., Martin, M.O., Beaton, A.E., Gonzalez, E.J., Kelly, D.L., and Smith, T.A. Chestnut Hill, MA: Boston College, 1997.

Science Achievement in the Primary School Years: IEA's Third International Mathematics and Science Study. Martin, M.O., Mullis, I.V.S., Beaton, A.E., Gonzalez, E.J., Smith, T.A., and Kelly, D.L. Chestnut Hill, MA: Boston College, 1997.

Third International Mathematics and Science Study Technical Report, Volume I: Design and Development. Martin, M.O. and Kelly, D.L., Eds. Chestnut Hill, MA: Boston College, 1996.

Third International Mathematics and Science Study: Quality Assurance in Data Collection. Martin, M.O. and Mullis, I.V.S., Eds. Chestnut Hill, MA: Boston College, 1996.

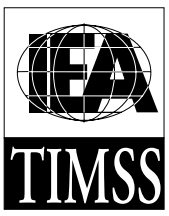
These reports can be ordered from the International Study Center at Boston College.

- To FAX Order: +1(617)552-8419
- To Phone Order: +1(617)552-4521
- To E-mail Order: timss@bc.edu

TIMSS reports and this released item set are also available on the World Wide Web:

- http://wwwcsteep.bc.edu/timss

Released Mathematics Items Population 2



I1. Brad wanted to find three consecutive whole numbers that add up to 81. He wrote the equation $(n - 1) + n + (n + 1) = 81$. What does the n stand for?

A. The least of the three whole numbers

B. The middle whole number

C. The greatest of the three whole numbers

D. The difference between the least and greatest of the three whole numbers

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Algebra	Performing Routine Procedures	37%	31%	628

I2. Two groups of tourists each have 60 people. If $\frac{3}{4}$ of the first group and $\frac{2}{3}$ of the second group board buses to travel to a museum, how many more people in the first group board buses than in the second group?

A. 2

B. 4

C. 5

D. 40

E. 45

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Solving Problems	58%	52%	530

I3. The number of 750 mL bottles that can be filled from 600 L of water is

A. 8

B. 80

C. 800

D. 8000

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Measurement	Knowing	42%	38%	603

I4. The numbers in the sequence 2, 7, 12, 17, 22, … increase by fives. The numbers in the sequence 3, 10, 17, 24, 31, … increase by sevens. The number 17 occurs in both sequences. If the two sequences are continued, what is the next number that will be seen in both sequences?

Answer:_____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Solving Problems	45%	37%	591

I-4 Coding Guide

I4. The numbers in the sequence 2, 7, 12, 17, 22, … increase by fives. The numbers in the sequence 3, 10, 17, 24, 31, … increase by sevens. The number 17 occurs in both sequences. If the two sequences are continued, what is the next number that will be seen in both sequences?

Answer:_____

Code	Response
Correct Response	
10	52
Incorrect Response	
70	27 AND 38
71	27 OR 38
72	17
73	31
74	42
75	"There is no other number that occurs in both sequences" or any similar explanation.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

I5. In a discus-throwing competition, the winning throw was 61.60 m. The second-place throw was 59.72 m. How much longer was the winning throw than the second-place throw?

A. 1.18 m

B. 1.88 m

C. 1.98 m

D. 2.18 m

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Solving Problems	72%	67%	448

I6. Write a fraction that is larger than $\frac{2}{7}$.

Answer: _____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Knowing	75%	74%	427

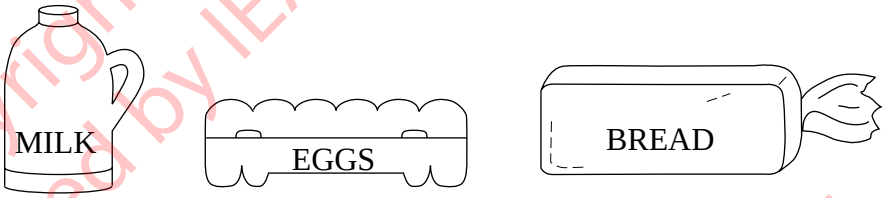
I-6 Coding Guide

I6. Write a fraction that is larger than $\frac{2}{7}$.

Answer: _____

Code	Response
Correct Response	
10	A fraction with numerator greater than 2 and denominator equal to 7
11	A fraction with numerator equal to 2 and denominator less than 7
12	3/8
13	1/2. (Other fractions with numeric value equal 1/2 should be coded 19.)
19	Other correct fraction.
Incorrect Response	
70	1/7
71	4/14
72	2/8
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

I7. Prabhu had $5 to buy milk, bread, and eggs. When he got to the shop he found that the prices were those shown below:



$1.50 $1.29 $1.44

At which of these times would it make sense to use estimates rather than exact numbers?

A. When Prabhu tried to decide whether $5 was enough money

B. When the clerk entered each amount into the cash register

C. When Prabhu was told how much he owed

D. When the clerk counted Prabhu's change

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Fractions and Number Sense	Knowing	64%	59%	495

I8. A straight line on a graph passes through the points (3,2) and (4,4). Which of these points also lies on the line?

A. (1,1)

B. (2,4)

C. (5,6)

D. (6,3)

E. (6,5)

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Geometry	Solving Problems	41%	38%	597

I9. In a bag of cards $\frac{1}{6}$ are green, $\frac{1}{12}$ are yellow, $\frac{1}{2}$ are white and $\frac{1}{4}$ are blue. If someone takes a card from the bag without looking, which color is it most likely to be?

A. White

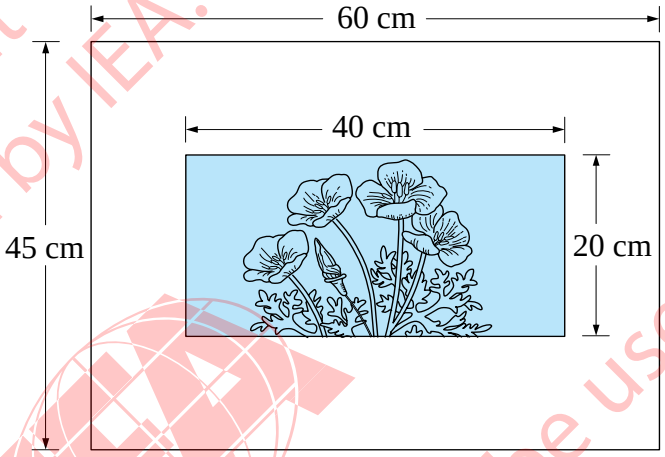
B. Blue

C. Green

D. Yellow

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Data Representation, Analysis & Probability	Using Complex Procedures	67%	60%	490

J10. A rectangular picture is pasted to a sheet of white paper as shown.



What is the area of the white paper not covered by the picture?

A. 165 cm^2

B. 500 cm^2

C. 1900 cm^2

D. 2700 cm^2

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Measurement	Solving Problems	45%	38%	596

J-11

J11. A quadrilateral MUST be a parallelogram if it has

A. one pair of adjacent sides equal

B. one pair of parallel sides

C. a diagonal as axis of symmetry

D. two adjacent angles equal

E. two pairs of parallel sides

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	E	Geometry	Knowing	49%	44%	573

J12. Divide: $\frac{8}{35} \div \frac{4}{15} =$

J-12

Answer: _____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Performing Routine Procedures	43%	36%	593

J12. Divide: $\frac{8}{35} \div \frac{4}{15} =$

Answer: _____

Code	Response
Correct Response	
10	33761
19	Other fractions or decimals equivalent to 6/7
Incorrect Response	
70	Any fraction with 2 as numerator.
71	A response (other than 90/105) indicates working out the common denominator, 105.
72	7/6 or equivalent
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

J13. The tab le shows the number of students in the 7th and 8th grades in a given school.

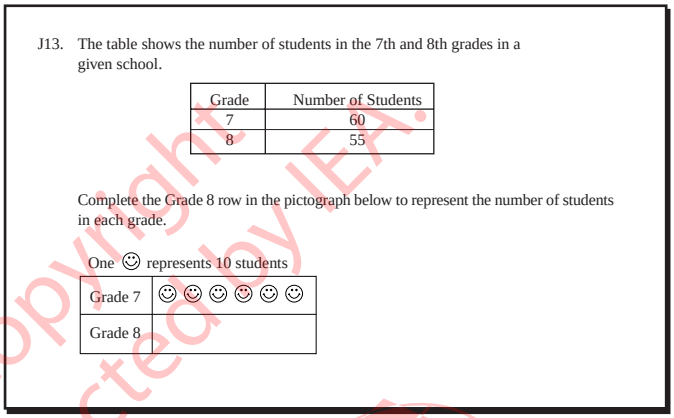
Grade	Number of Students
7	60
8	55

Complete the Grade 8 row in the pictograph below to represent the number of students in each grade.

One ☺ represents 10 students

Grade 7	☺ ☺ ☺ ☺ ☺ ☺
Grade 8	

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Data Representation, Analysis & Probability	Using Complex Procedures	81%	79%	394



J13. The table shows the number of students in the 7th and 8th grades in a given school.

Grade	Number of Students
7	60
8	55

Complete the Grade 8 row in the pictograph below to represent the number of students in each grade.

One ☺ represents 10 students

Grade 7	☺☺☺☺☺☺
Grade 8	

Note: Credit should be awarded for any drawing that includes 5 full faces and one partial face.

Code	Response
Correct Response	
10	5 and 1/2 faces. (See note above.)
11	5 full faces and some expression indicating one half face OR a new symbol for 5 is defined and used, e.g. expressions like "+5", fractions with faces as numerator or denominator or similar.
19	Other correct
Incorrect Response	
70	4 and 1/2 faces
71	5 faces
72	6 faces
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

J14. Divide: $0.004\overline{)24.56}$

A. 0.614

B. 6.14

C. 61.4

D. 614

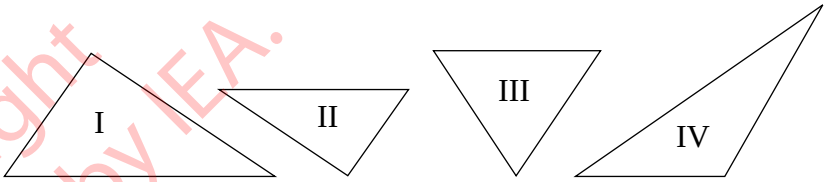
E. 6140

J-14

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	E	Fractions and Number Sense	Performing Routine Procedures	44%	37%	585

J15.

J-15



Which two triangles are similar?

A. I and II

B. I and IV

C. II and III

D. II and IV

E. III and IV

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Geometry	Knowing	66%	59%	493

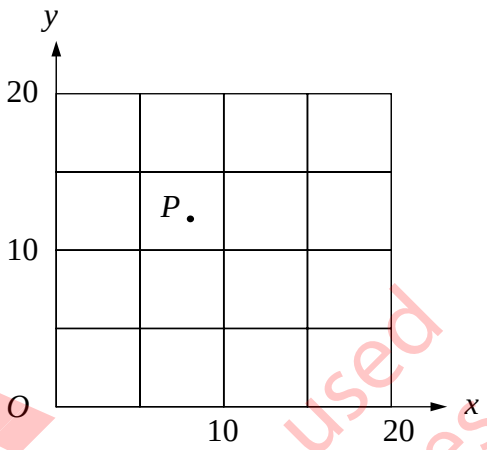
J16. Which of the following are most likely to be the coordinates of point *P* ?

A. (8, 12)

B. (8, 8)

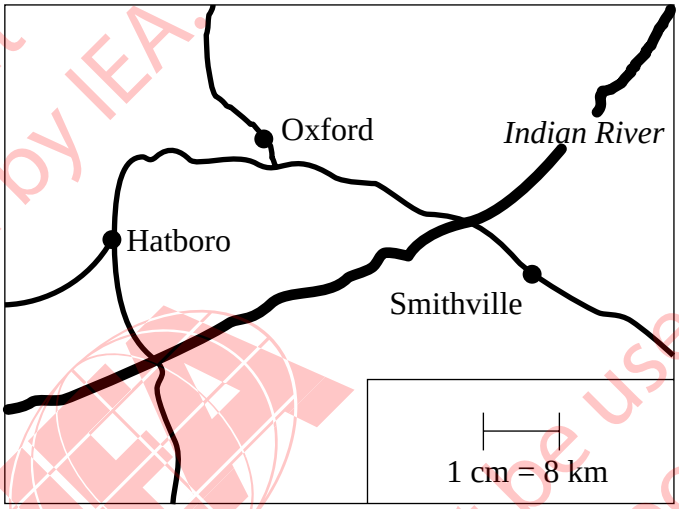
C. (12, 8)

D. (12, 12)



Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Geometry	Performing Routine Procedures	55%	47%	548

J17. One centimeter on the map represents 8 kilometers on the land.



About how far apart are Oxford and Smithville on the land?

A. 4 km

B. 16 km

C. 35 km

D. 50 km

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Using Complex Procedures	66%	62%	484

J18. The table represents a relation between x and y.

What is the missing number in the table?

A. 2

B. 3

C. 4

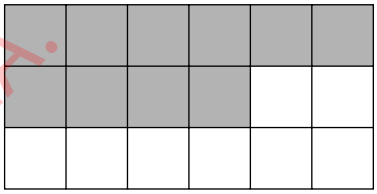
D. 5

E. 6

x	y
1	1
2	?
4	7
7	13

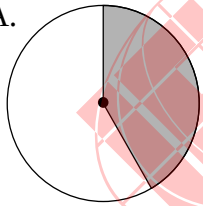
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Algebra	Performing Routine Procedures	42%	37%	594

K1.

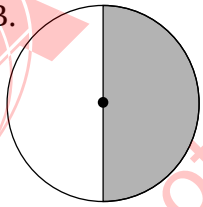


Which circle has approximately the same fraction shaded as that of the rectangle above?

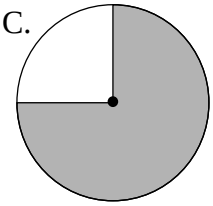
A.



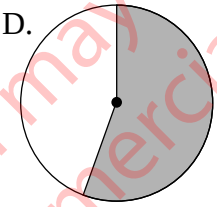
B.



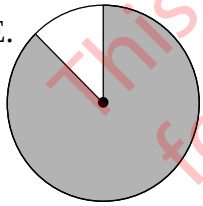
C.



D.



E.



Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Fractions and Number Sense	Using Complex Procedures	70%	65%	464

K-2

K2. A chemist mixes 3.75 milliliters of solution A with 5.625 milliliters of solution B to form a new solution. How many milliliters does this new solution contain?

Answer:_____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Solving Problems	66%	58%	487

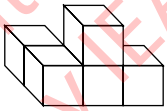
K2. A chemist mixes 3.75 milliliters of solution A with 5.625 milliliters of solution B to form a new solution. How many milliliters does this new solution contain?

Answer: _____

Note: There is no distinction made between responses with and without units.

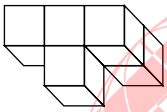
Code	Response
Correct Response	
10	9.375
19	Other responses equivalent to 9.375
Incorrect Response	
70	8.700 OR 8.7
71	Contains one miscalculated digit. *Example: 10.375, 9.395, 9.475 or similar*
72	One of the following: 6, 60, 600 OR 6000
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

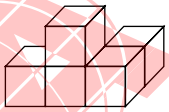
K3. This figure will be turned to a different position.

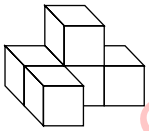


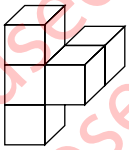
K-3

Which of these could be the figure after it is turned?

A. 

B. 

C. 

D. 

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Geometry	Using Complex Procedures	67%	63%	478

K-4

K4. $\frac{x}{2} < 7$ is equivalent to

A. $x < \frac{7}{2}$

B. $x < 5$

C. $x < 14$

D. $x > 5$

E. $x > 14$

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Algebra	Performing Routine Procedures	44%	36%	606

K-5

K5. The length of a rectangle is 6 cm, and its perimeter is 16 cm. What is the area of the rectangle in square centimeters?

Answer: _____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Solving Problems	40%	32%	613

K5. The length of a rectangle is 6 cm, and its perimeter is 16 cm. What is the area of the rectangle in square centimeters?

Answer: _____

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
10	12
Incorrect Response	
70	22
71	24
72	48
73	60
74	96 or indication of 6x16
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

K-6

K6. Last year there were 1172 students at Beaton High School. This year there are 15 percent more students than last year. Approximately how many students are at Beaton High School this year?

A. 1800

B. 1600

C. 1500

D. 1400

E. 1200

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Fractions and Number Sense	Using Complex Procedures	44%	36%	604

K7. A drawer contains 28 pens; some white, some blue, some red, and some gray. If the probability of selecting a blue pen is $\frac{2}{7}$, how many blue pens are in the drawer?

A. 4

B. 6

C. 8

D. 10

E. 20

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Data Representation, Analysis & Probability	Solving Problems	53%	48%	550

K8. These triangles are congruent. The measures of some of the sides and angles of the triangles are shown.

What is the value of x ?

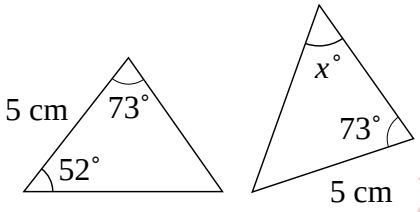
A. 52

B. 55

C. 65

D. 73

E. 75



Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Geometry	Performing Routine Procedures	35%	27%	639

K9. $\frac{3}{4}+\frac{8}{3}+\frac{11}{8}=$

A. $\frac{22}{15}$

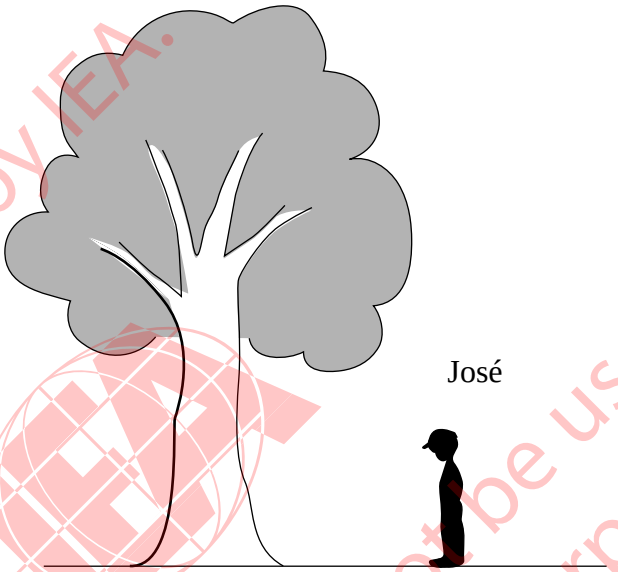
B. $\frac{43}{24}$

C. $\frac{91}{24}$

D. $\frac{115}{24}$

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Fractions and Number Sense	Performing Routine Procedures	49%	42%	563

L8.



José is 1.5 m tall. About how tall is the tree?

A. 4 m

B. 6 m

C. 8 m

D. 10 m

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Performing Routine Procedures	60%	55%	521

L9. Which number is five hundred four and seven-tenths?

A. 54.7

B. 504.7

C. 547

D. 5004.7

L-9

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Knowing	84%	82%	373

L10. This chart shows temperature readings made at different times on four days.

TEMPERATURES					
	6 a.m.	9 a.m.	Noon	3 p.m.	8 p.m.
Monday	15˚	17˚	20˚	21˚	19˚
Tuesday	15˚	15˚	15˚	10˚	9˚
Wednesday	8˚	10˚	14˚	13˚	15˚
Thursday	8˚	11˚	14˚	17˚	20˚

When was the highest temperature recorded?

A. Noon on Monday

B. 3 p.m. on Monday

C. Noon on Tuesday

D. 3 p.m. on Wednesday

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Data Representation, Analysis & Probability	Using Complex Procedures	87%	85%	354

L-11

L11. A rubber ball rebounds to half the height it drops. If the ball is dropped from a rooftop 18 m above the ground, what is the total distance traveled by the time it hits the ground the third time?

A. 31.5 m

B. 40.5 m

C. 45 m

D. 63 m

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Algebra	Solving Problems	34%	31%	640

L12. Four children measured the width of a room by counting how many paces it took them to cross it. The chart shows their measurements.

Name	Number of Paces
Stephen	10
Erlane	8
Ana	9
Carlos	7

Who had the longest pace?

A. Stephen

B. Erlane

C. Ana

D. Carlos

L-12

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Measurement	Solving Problems	74%	69%	448

L13. These shapes are arranged in a pattern.

○△○○△△○○○△△△

Which set of shapes is arranged in the same pattern?

L-13

A. ★□★□★★□□★★□□

B. □★□□★□□□★□□□□

C. ★□★★ □□★★★□□□

D. □□★★□★□□★★□★

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Algebra	Knowing	90%	87%	326

L14. The table shows the values of x and y, where x is proportional to y.

x	3	6	P
y	7	Q	35

What are the values of P and Q ?

A. $P = 14$ and $Q = 31$

B. $P = 10$ and $Q = 14$

C. $P = 10$ and $Q = 31$

D. $P = 14$ and $Q = 15$

E. $P = 15$ and $Q = 14$

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	E	Proportionality	Performing Routine Procedures	24%	20%	693

L15. In a quadrilateral, two of the angles each have a measure of 110˚, and the measure of a third angle is 90˚. What is the measure of the remaining angle?

A. 50˚

B. 90˚

C. 130˚

D. 140˚

E. None of the above

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Geometry	Solving Problems	40%	32%	623

L16. Find x if $10x - 15 = 5x + 20$

Answer: _____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Performing Routine Procedures	45%	28%	615

L-16 Coding Guide

L16. Find x if $10x - 15 = 5x + 20$

Answer: _____

Code	Response
Correct Response	
10	7
Incorrect Response	
70	1 OR 2.33.. OR 3
71	Other incorrect numeric answers.
72	Any expression or equation containing x.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

L17. What is the value of $\frac{2}{3} - \frac{1}{4} - \frac{1}{12}$?

A. $\frac{1}{6}$

B. $\frac{1}{3}$

C. $\frac{3}{8}$

D. $\frac{5}{12}$

E. $\frac{1}{2}$

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Performing Routine Procedures	50%	42%	571

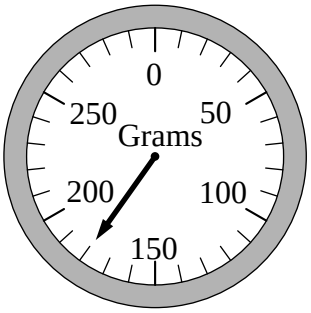
M1. What is the weight (mass) shown on the scale?

A. 153 g

B. 160 g

C. 165 g

D. 180 g

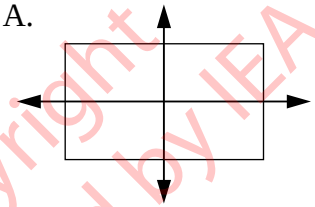


M-1

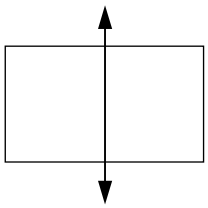
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Measurement	Knowing	87%	83%	366

M2. Which shows all of the lines of symmetry for a rectangle?

A.

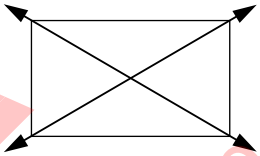


B.



C.

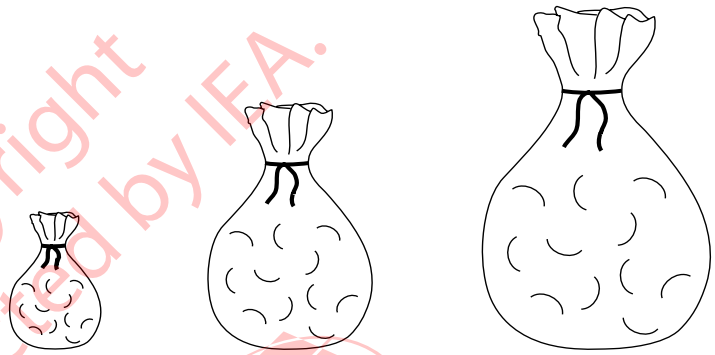
D.



M-2

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Geometry	Knowing	66%	63%	500

M3. There is only one red marble in each of these bags.



10 marbles 100 marbles 1000 marbles

Without looking in the bags, you are to pick a marble out of one of the bags. Which bag would give you the greatest chance of picking the red marble?

A. The bag with 10 marbles

B. The bag with 100 marbles

C. The bag with 1000 marbles

D. All bags would give the same chance.

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Data Representation, Analysis & Probability	Solving Problems	76%	73%	433

M4. Which number is largest?

A. $\frac{4}{5}$

B. $\frac{3}{4}$

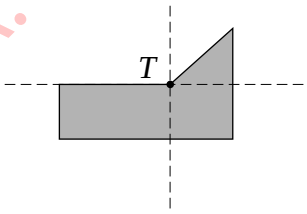
C. $\frac{5}{8}$

D. $\frac{7}{10}$

M-4

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Fractions and Number Sense	Using Complex Procedures	39%	34%	615

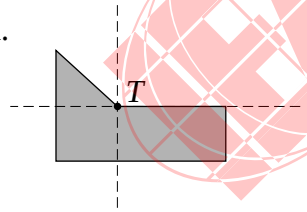
M5. A half-turn about point *T* in the plane is applied to the shaded figure.



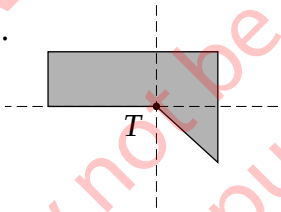
M-5

Which of these shows the result of the half-turn?

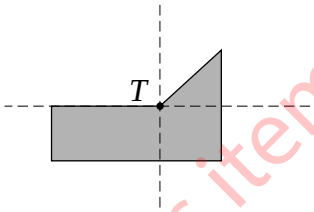
A.



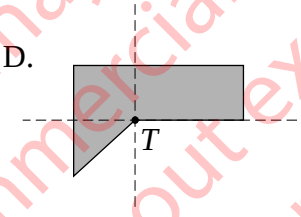
B.



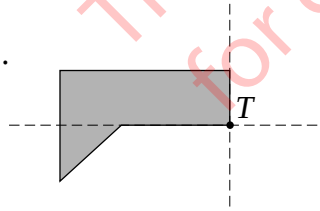
C.



D.



E.



Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Geometry	Performing Routine Procedures	52%	43%	565

M6. A class has 28 students. The ratio of girls to boys is 4 : 3. How many girls are in the class?

Answer: _____

M-6

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Proportionality	Solving Problems	37%	30%	634

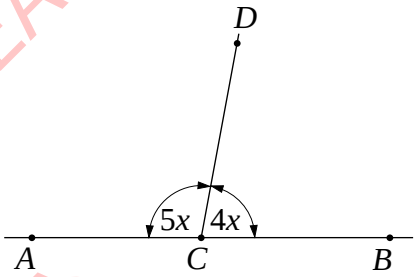
M-6 Coding Guide

M6. A class has 28 students. The ratio of girls to boys is 4 : 3. How many girls are in the class?

Answer:_____

Code	Response
Correct Response	
10	16
Incorrect Response	
70	7
71	12
72	13
73	15
74	21
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

M7. In this figure *AB* is a straight line.



What is the measure, in degrees, of angle *BCD* ?

A. 20

B. 40

C. 50

D. 80

E. 100

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Geometry	Solving Problems	72%	67%	457

M8. Multiply: $0.203 \times 0.56 =$

Answer: _____

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Performing Routine Procedures	49%	44%	575

M-8 Coding Guide

M8. Multiply: $0.203 \times 0.56 =$

Answer: _____

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Code	Response
Correct Response	
10	0.11368
Incorrect Response	
70	1.1368
71	11.368
72	11368
73	Other response in which the error is a misplaced decimal point.
74	Other response with one miscalculated digit such as 0.11369, 0.11358, etc.
75	Decimal number larger than 0 and less than 1, not covered by the codes above.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

N11. A newspaper reported that about 18 200 trees had been planted in the park. The number was rounded to the nearest hundred. Which of these could have been the actual number of trees planted?

A. 18 043

B. 18 189

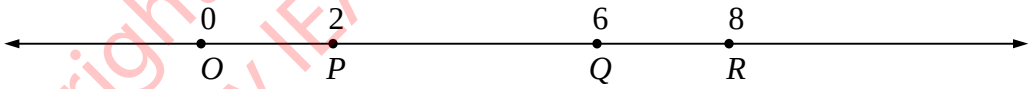
C. 18 289

D. 18 328

N-11

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Solving Problems	82%	79%	392

N12. Point *X* (not shown) on the number line is 5 units from point *R* and 3 units from point *Q*.



Where is point *X* located?

A. Between *O* and *P*

B. Between *P* and *Q*

C. Between *Q* and *R*

D. To the right of *R*

N-12

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Geometry	Performing Routine Procedures	66%	61%	489

N13. If $x = 2$, what is the value of $\frac{7x+4}{5x-4}$?

Answer:_____

N-13

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Performing Routine Procedures	53%	37%	576

N-13 Coding Guide

N13. If $x = 2$, what is the value of $\frac{7x+4}{5x-4}$?

Answer: _____

Code	Response
Correct Response	
10	3
11	An alternative form such as 18/6 OR 9/3 OR 6/2
Incorrect Response	
70	Indicates the correct substitution of x=2 in numerator and/or denominator but student did not correctly complete the solution.
71	Indicates a wrong substitution such as 7x=72 OR 7x=7+2 in the denominator; for example, any fractions with 76 or 13 as numerators and 48 or 3 as denominators.
72	A response containing the variable x.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

N14. In which list of fractions are all of the fractions equivalent?

A. $\frac{3}{4}, \frac{6}{8}, \frac{12}{14}$

B. $\frac{3}{5}, \frac{5}{7}, \frac{9}{15}$

C. $\frac{3}{8}, \frac{6}{16}, \frac{12}{32}$

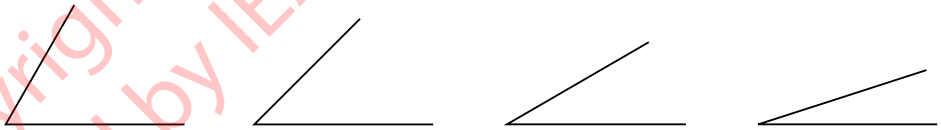
D. $\frac{5}{10}, \frac{10}{15}, \frac{1}{2}$

N-14

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Knowing	67%	62%	483

N15. Which of these angles has a measure closest to 30° ?

A. B. C. D.



N-15

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Measurement	Knowing	64%	62%	492

N16. Jan had a bag of marbles. She gave half of them to James and then a third of the marbles still in the bag to Pat. She then had 6 marbles left. How many marbles were in the bag to start with?

A. 18

B. 24

C. 30

D. 36

N-16

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Fractions and Number Sense	Solving Problems	47%	43%	580

N17. A car has a fuel tank that holds 35 L of fuel. The car consumes 7.5 L of fuel for each 100 km driven. A trip of 250 km was started with a full tank of fuel. How much fuel remained in the tank at the end of the trip?

A. 16.25 L

B. 17.65 L

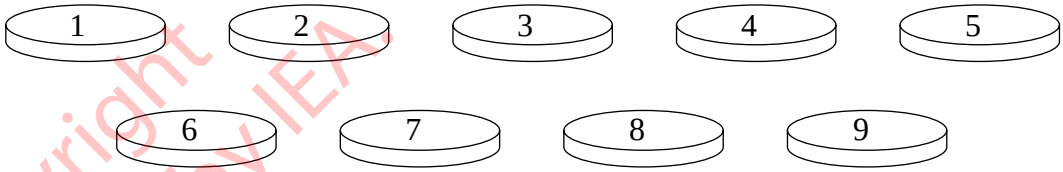
C. 18.75 L

D. 23.75 L

N-17

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Fractions and Number Sense	Solving Problems	39%	35%	611

N18. The nine chips shown are placed in a jar and mixed.



Madeleine draws one chip from the jar. What is the probability that Madeleine draws a chip with an even number?

A. $\frac{1}{9}$

B. $\frac{2}{9}$

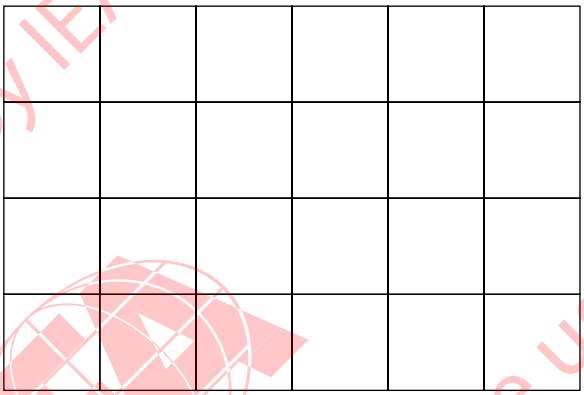
C. $\frac{4}{9}$

D. $\frac{1}{2}$

N-18

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Data Representation, Analysis & Probability	Solving Problems	56%	48%	541

N19. Shade in $\frac{5}{8}$ of the unit squares in the grid.



N-19

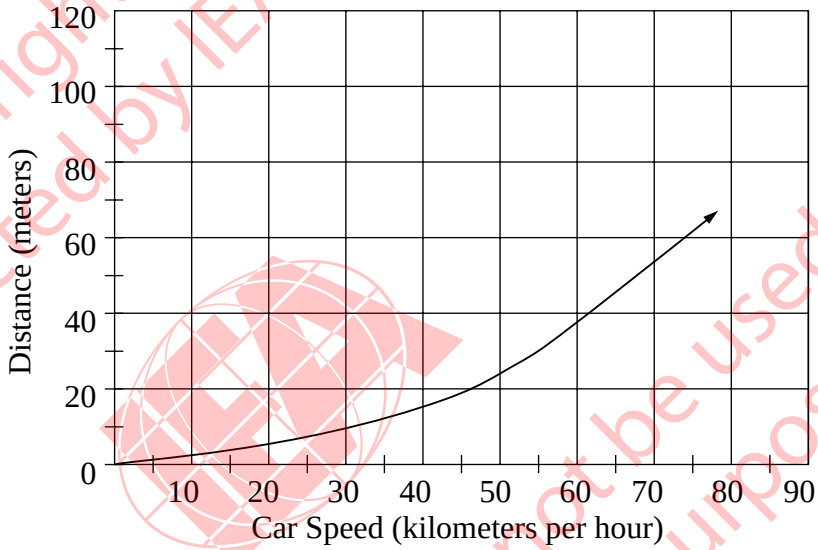
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Knowing	52%	46%	559

N-19 Coding Guide

N19. Shade in $\frac{5}{8}$ of the unit squares in the grid.

Code	Response
Correct Response	
10	15 squares are shaded (regardless of which squares).
Incorrect Response	
70	5 squares shaded
71	8 squares shaded
72	14 or 16 squares shaded.
73	Five (5) squares shaded AND 3 more squares (a total of 8) marked on the grid.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

O1. The graph shows the distance traveled before coming to a stop after the brakes are applied for a typical car traveling at different speeds.



A car traveling on a highway stopped 30 m after the brakes were applied. About how fast was the car traveling?

A. 48 km per hour

B. 55 km per hour

C. 70 km per hour

D. 160 km per hour

O-1

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Data Representation, Analysis & Probability	Solving Problems	58%	51%	535

O2. If the price of a can of beans is raised from 60 cents to 75 cents, what is the percent increase in the price?

A. 15%

B. 20%

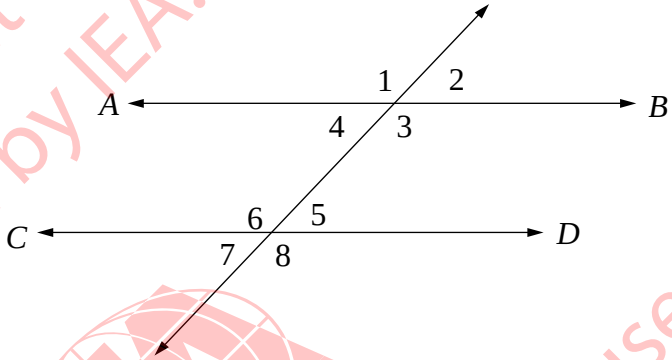
C. 25%

D. 30%

O-2

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Performing Routine Procedures	28%	23%	680

O3. In this figure, lines *AB* and *CD* are parallel.



Two angles whose measures must add up to 180° are

A. ∠1 and ∠3

B. ∠4 and ∠6

C. ∠2 and ∠5

D. ∠2 and ∠7

E. ∠1 and ∠8

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Geometry	Knowing	47%	42%	581

O4. Which of these is 89.0638 rounded to the nearest hundredth?

A. 100

B. 90

C. 89.1

D. 89.06

E. 89.064

O-4

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Fractions and Number Sense	Performing Routine Procedures	46%	43%	587

O5. Each of the six faces of a certain cube is painted either red or blue. When the cube is tossed, the probability of the cube landing with a red face up is $\frac{2}{3}$. How many faces are red?

A. One

B. Two

C. Three

D. Four

E. Five

O-5

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Data Representation, Analysis & Probability	Solving Problems	47%	41%	587

O6. A cake is put in the oven at 7:20. If the cake takes three quarters of an hour to bake, at what time should it be taken out of the oven?

Answer: _____

O-6

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Performing Routine Procedures	70%	65%	465

O-6 Coding Guide

O6. A cake is put in the oven at 7:20. If the cake takes three quarters of an hour to bake, at what time should it be taken out of the oven?

Answer: _____

Code	Response
Correct Response	
10	8:05
19	Responses equivalent to 8:05
Incorrect Response	
70	7:50
71	8:00
72	8:10
73	8:15
74	8:35
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

O7. If $3(x + 5) = 30$, then $x =$

A. 2

B. 5

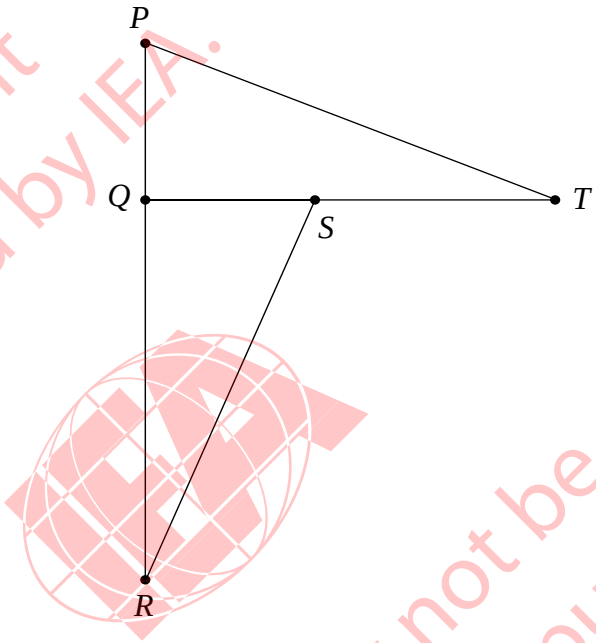
C. 10

D. 95

O-7

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Algebra	Performing Routine Procedures	72%	62%	474

O8. Triangle *PQT* can be rotated (turned) onto triangle *SQR*.



What point is the center of rotation?

A. *P*

B. *Q*

C. *R*

D. *S*

E. *T*

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Geometry	Performing Routine Procedures	70%	61%	483

O9. Luis exercises by running 5 km each day. The course he runs is $\frac{1}{4}$ km long. How many times through the course does he run each day?

Answer: _____

O-9

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Solving Problems	50%	42%	571

O-9 Coding Guide

O9. Luis exercises by running 5 km each day. The course he runs is $\frac{1}{4}$ km long. How many times through the course does he run each day?

Answer: _____

Code	Response
Correct Response	
10	20
Incorrect Response	
70	20 km
71	5/4
72	2
73	3
74	4
75	5
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

P8. What is the ratio of the length of a side of a square to its perimeter?

A. $\frac{1}{1}$

B. $\frac{1}{2}$

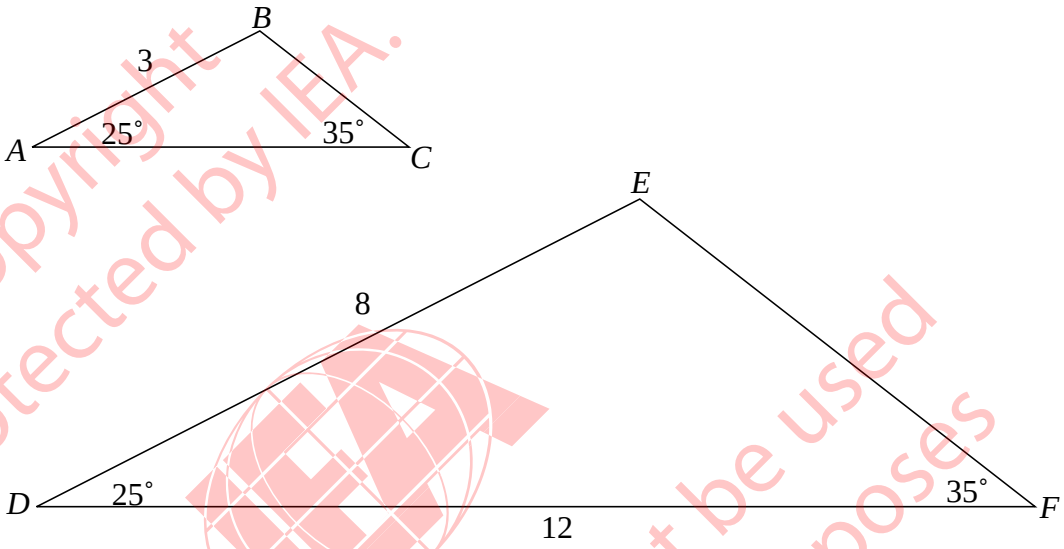
C. $\frac{1}{3}$

D. $\frac{1}{4}$

P-8

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Geometry	Solving Problems	56%	50%	536

P9. Triangles *ABC* and *DEF* are similar triangles.



What is the length of side *AC* ?

A. 2

B. 4

C. 4.5

D. 5.5

E. 32

P-9

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Geometry	Performing Routine Procedures	38%	36%	617

P10. If m represents a positive number, which of these is equivalent to $m + m + m + m$?

A. $m + 4$

B. $4m$

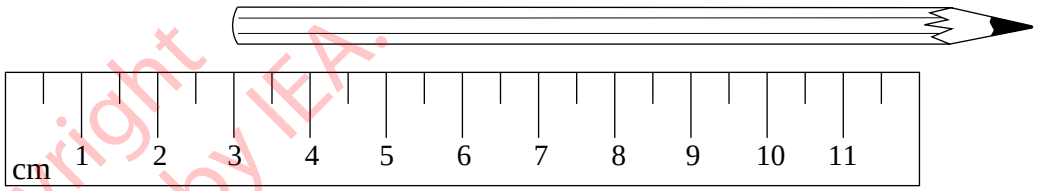
C. m^4

D. $4(m + 1)$

P-10

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Algebra	Knowing	58%	47%	540

P11.



Which of these is closest to the length of the pencil in the figure?

A. 9 cm

B. 10.5 cm

C. 12 cm

D. 13.5 cm

P-11

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Measurement	Using Complex Procedures	52%	49%	541

P12. Mark's garden has 84 rows of cabbages. There are 57 cabbages in each row. Which of these gives the BEST way to estimate how many cabbages there are altogether?

A. $100 \times 50 = 5000$

B. $90 \times 60 = 5400$

C. $80 \times 60 = 4800$

D. $80 \times 50 = 4000$

P-12

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Using Complex Procedures	70%	66%	463

P13. A person's heart is beating 72 times a minute. At this rate, about how many times does it beat in one hour?

A. 420 000

B. 42 000

C. 4 200

D. 420

P-13

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Solving Problems	66%	61%	479

P14. Janis, Maija, and their mother were eating a cake. Janis ate $\frac{1}{2}$ of the cake. Maija ate $\frac{1}{4}$ of the cake. Their mother ate $\frac{1}{4}$ of the cake. How much of the cake is left?

A. $\frac{3}{4}$

B. $\frac{1}{2}$

C. $\frac{1}{4}$

D. None

P-14

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Fractions and Number Sense	Solving Problems	76%	72%	422

P15. Which of these expressions is equivalent to y^3 ?

A. $y + y + y$

B. $y \times y \times y$

C. $3y$

D. $y^2 + y$

P-15

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Algebra	Knowing	66%	55%	500

P16. Write 0.28 as a fraction reduced to its lowest terms.

Answer:_____

P-16

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Performing Routine Procedures	33%	30%	637

P16. Write 0.28 as a fraction reduced to its lowest terms.

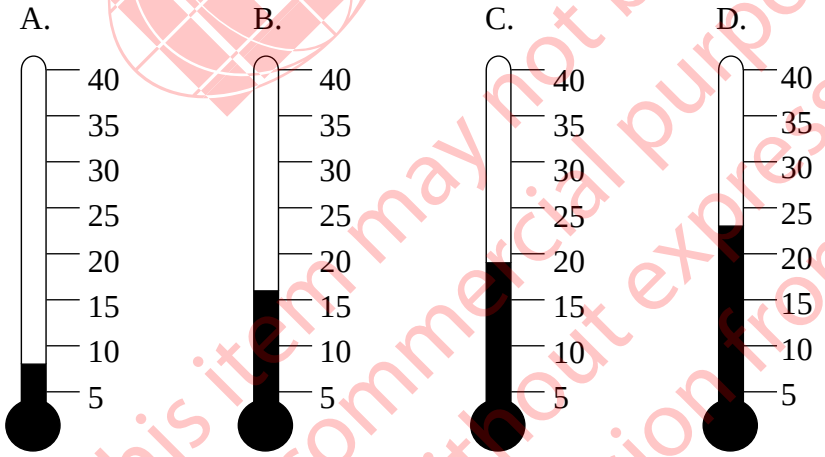
Answer:_____

Code	Response
Correct Response	
10	7/25
Incorrect Response	
70	28/100 OR 14/50
71	Any fractions other than 28/100 with 28 as numerator.
72	Any fractions with 28 as denominator.
73	2/8 OR 1/4
74	Any expression which mixes decimal notation into the fraction *Example: 0,28/10 or 0.28/10*
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

P17. This table shows temperatures at various times during the week.

TEMPERATURES					
	6 a.m.	9 a.m.	Noon	3 p.m.	8 p.m.
Monday	15˚	17˚	20˚	21˚	19˚
Tuesday	15˚	15˚	15˚	10˚	9˚
Wednesday	8˚	10˚	14˚	13˚	15˚
Thursday	8˚	11˚	14˚	17˚	20˚

Which thermometer shows the temperature at 8 p.m. on Monday?



P-17

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Data Representation, Analysis & Probability	Using Complex Procedures	82%	79%	374

Q1. Juan has 5 fewer hats than Maria, and Clarissa has 3 times as many hats as Juan. If Maria has n hats, which of these represents the number of hats that Clarissa has?

A. $5 - 3n$

B. $3n$

C. $n - 5$

D. $3n - 5$

E. $3(n - 5)$

Q-1

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	E	Algebra	Using Complex Procedures	47%	37%	595

Q2. Subtract: $\frac{2x}{9} - \frac{x}{9} =$

A. $\frac{1}{9}$

B. 2

C. x

D. $\frac{x}{9}$

E. $\frac{x}{81}$

Q-2

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Algebra	Performing Routine Procedures	51%	40%	568

Q3. Which of these is the longest time?

A. 15 000 seconds

B. 1 500 minutes

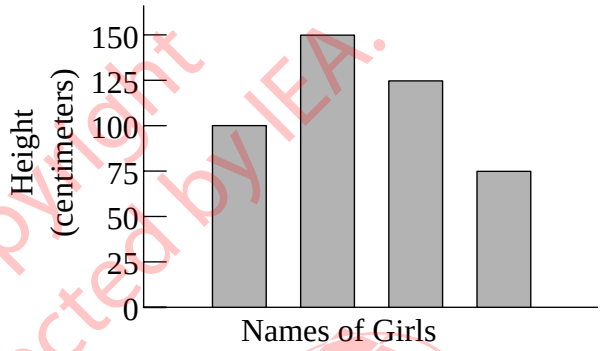
C. 10 hours

D. 1 day

Q-3

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Measurement	Using Complex Procedures	35%	31%	636

Q4. The graph shows the heights of four girls.



The names are missing from the graph. Debbie is the tallest. Amy is the shortest. Dawn is taller than Sarah. How tall is Sarah?

A. 75 cm

B. 100 cm

C. 125 cm

D. 150 cm

Q-4

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Data Representation, Analysis & Probability	Using Complex Procedures	83%	81%	376

Q5. Three-fifths of the students in a class are girls. If 5 girls and 5 boys are added to the class, which statement is true of the class?

A. There are more girls than boys.

B. There are the same number of girls as there are boys.

C. There are more boys than girls.

D. You cannot tell whether there are more girls or boys from the information given.

Q-5

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Proportionality	Solving Problems	65%	62%	487

Q6. The Smith family uses about 6000 L of water per week. Approximately how many liters of water do they use per year?

A. 30 000

B. 240 000

C. 300 000

D. 2 400 000

E. 3 000 000

Q-6

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Performing Routine Procedures	40%	35%	610

Q7. $P = LW$. If $P = 12$ and $L = 3$, then W is equal to

A. $\frac{3}{4}$

B. 3

C. 4

D. 12

E. 36

Q-7

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Algebra	Performing Routine Procedures	63%	49%	519

Q8. Which list shows the numbers from smallest to largest?

A. $0.345,\ 0.19,\ 0.8,\ \frac{1}{5}$

B. $0.19,\ \frac{1}{5},\ 0.345,\ 0.8$

C. $0.8,\ 0.19,\ \frac{1}{5},\ 0.345$

D. $\frac{1}{5},\ 0.8,\ 0.345,\ 0.19$

Q-8

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Using Complex Procedures	44%	38%	587

Q9. $\frac{3}{4}+\left(\frac{2}{3}\times\frac{1}{4}\right)=$

A. $\frac{1}{8}$

B. $\frac{5}{16}$

C. $\frac{17}{48}$

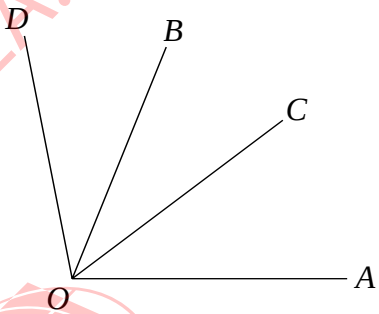
D. $\frac{5}{6}$

E. $\frac{11}{12}$

Q-9

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	E	Fractions and Number Sense	Performing Routine Procedures	51%	46%	558

Q10. In the figure, the measure of $\angle AOB$ is 70º, the measure of $\angle COD$ is 60º, and the measure of $\angle AOD$ is 100º.



What is the measure of $\angle COB$?

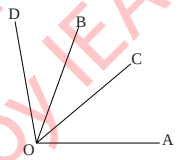
Answer:_____

Q-10

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Geometry	Using Complex Procedures	45%	40%	587

Q-10 Coding Guide

Q10. In the figure, the measure of $\angle AOB$ is 70°, the measure of $\angle COD$ is 60°, and the measure of $\angle AOD$ is 100°.



What is the measure of $\angle COB$?

Answer:_____

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
10	30
Incorrect Response	
70	20
71	35
72	40
73	45
74	50
75	60 OR 70
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

R6. Subtract: 2.201 – 0.753 =

A. 1.448

B. 1.458

C. 1.548

D. 1.558

R-6

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Fractions and Number Sense	Performing Routine Procedures	74%	74%	437

R7. A stack of 200 identical sheets of paper is 2.5 cm thick. What is the thickness of one sheet of paper?

A. 0.008 cm

B. 0.0125 cm

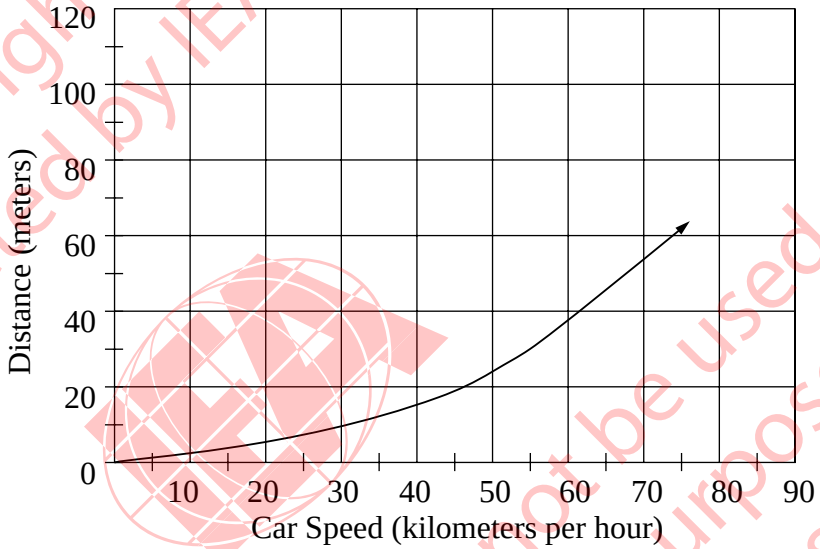
C. 0.05 cm

D. 0.08 cm

R-7

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Fractions and Number Sense	Solving Problems	47%	43%	583

R8. The graph shows the distance traveled before coming to a stop after the brakes are applied for a typical car traveling at different speeds.



A car is traveling 80 km per hour. About how far will the car travel after the brakes are applied?

A. 60 m

B. 70 m

C. 85 m

D. 100 m

R-8

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	B	Data Representation, Analysis & Probability	Solving Problems	49%	44%	565

R9. Which one of the following is FALSE when *a*, *b*, and *c* are different real numbers?

A. $(a + b) + c = a + (b + c)$

B. $ab = ba$

C. $a + b = b + a$

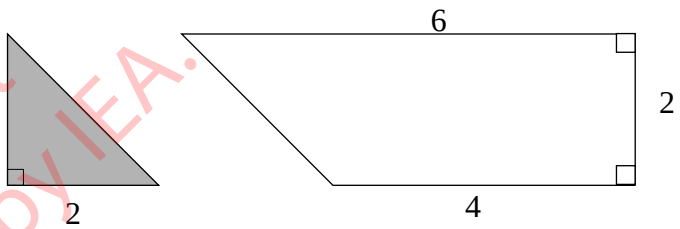
D. $(ab)c = a(bc)$

E. $a - b = b - a$

R-9

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	E	Algebra	Knowing	40%	35%	603

R10.



How many triangles of the shape and size of the shaded triangle can the trapezoid above be divided into?

A. Three

B. Four

C. Five

D. Six

R-10

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Geometry	Using Complex Procedures	52%	47%	551

R11. A group of students has a total of 29 pencils and everyone has at least one pencil. Six students have 1 pencil each, 5 students have 3, and the rest have 2. How many students have only 2 pencils?

A. 4

B. 6

C. 8

D. 9

R-11

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	A	Algebra	Solving Problems	47%	43%	584

R12. Subtract:

$$\begin{array}{r} 6000 \\ \underline{-2369} \end{array}$$

A. 4369

B. 3742

C. 3631

D. 3531

R-12

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	C	Fractions and Number Sense	Performing Routine Procedures	86%	86%	360

R13. Mr. Lewis had $360. He spent $\frac{7}{9}$ of it. How much money did he have left?

Answer:_____

R-13

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Solving Problems	32%	27%	642

R-13 Coding Guide

R13. Mr. Lewis had $360. He spent $\frac{7}{9}$ of it. How much money did he have left?

Answer: _____

Code	Response
Correct Response	
10	80
Incorrect Response	
70	2/9
71	40
72	120
73	180
75	300
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

R14. Peter bought 70 items and Sue bought 90 items. Each item cost the same and the items cost $800 altogether. How much did Sue pay?

Answer: Sue paid _____

R-14

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Proportionality	Solving Problems	38%	32%	617

R-14 Coding Guide

R14. Peter bought 70 items and Sue bought 90 items. Each item cost the same and the items cost $800 altogether. How much did Sue pay?

Answer: Sue paid _____

Code	Response
Correct Response	
10	450
Incorrect Response	
70	5
71	400
72	420
73	500
74	600
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

S1. Here is a sequence of three similar triangles. All of the small triangles are congruent.

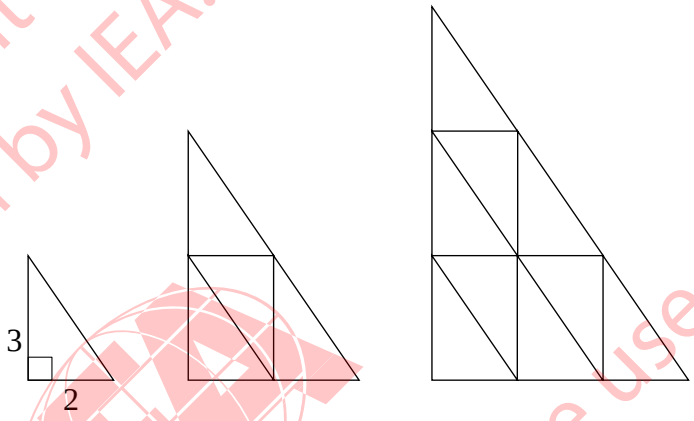


Figure 1 Figure 2 Figure 3

a. Complete the chart by finding how many small triangles make up each figure.

Figure	Number of small triangles
1	1
2	
3	

b. The sequence of similar triangles is extended to the 8th Figure. How many small triangles would be needed for Figure 8?

S-1a

Part A

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Solving Problems	75%	72%	422

S1. Here is a sequence of three similar triangles. All of the small triangles are congruent.

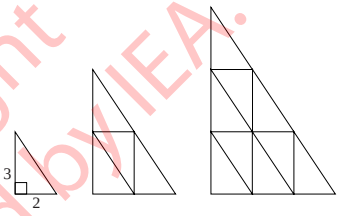


Figure 1 Figure 2 Figure 3

a. Complete the chart by finding how many small triangles make up each figure.

Figure	Number of small triangles
1	1
2	
3	

b. The sequence of similar triangles is extended to the 8th Figure. How many small triangles would be needed for Figure 8?

A: Codes for number of small triangles, each figure.

Code	Response
Correct Response	
10	4 AND 9
Incorrect Response	
70	5 AND 10
71	5 AND any integer other than 10
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

S1. Here is a sequence of three similar triangles. All of the small triangles are congruent.

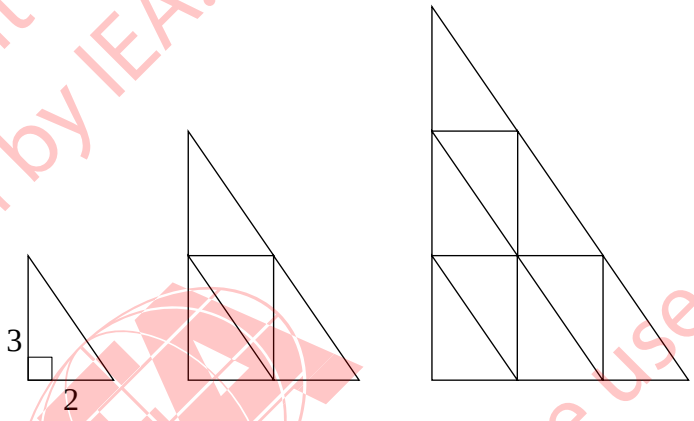


Figure 1 Figure 2 Figure 3

a. Complete the chart by finding how many small triangles make up each figure.

Figure	Number of small triangles
1	1
2	
3	

b. The sequence of similar triangles is extended to the 8th Figure. How many small triangles would be needed for Figure 8?

S-1b

Part B

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Solving Problems	26%	18%	692

S1. Here is a sequence of three similar triangles. All of the small triangles are congruent.

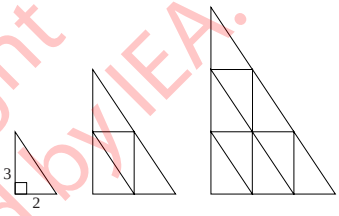


Figure 1 Figure 2 Figure 3

a. Complete the chart by finding how many small triangles make up each figure.

Figure	Number of small triangles
1	1
2	
3	

b. The sequence of similar triangles is extended to the 8th Figure. How many small triangles would be needed for Figure 8?

B: Codes for number of triangles in Figure 8

Code	Response
Correct Response	
10	64
Incorrect Response	
70	16
71	35
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

S2. The figure consists of 5 squares of equal size. The area of the whole figure is 405 cm^2.

Find the area of one square.

Answer _____ square centimeters

Find the length of the side of one square.

Answer _____ centimeters

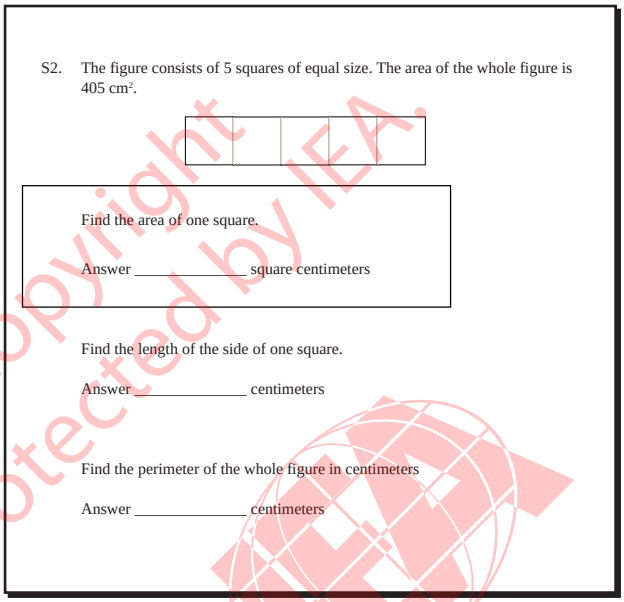
Find the perimeter of the whole figure in centimeters

Answer _____ centimeters

S-2a

Part A

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Solving Problems	60%	53%	499



S2. The figure consists of 5 squares of equal size. The area of the whole figure is 405 cm².

Find the area of one square.

Answer _____ square centimeters

Find the length of the side of one square.

Answer _____ centimeters

Find the perimeter of the whole figure in centimeters

Answer _____ centimeters

A: Codes for area

Code	Response
Correct Response	
10	81
Incorrect Response	
70	1
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

S2. The figure consists of 5 squares of equal size. The area of the whole figure is 405 cm^2.

Find the area of one square.

Answer _____ square centimeters

Find the length of the side of one square.

Answer _____ centimeters

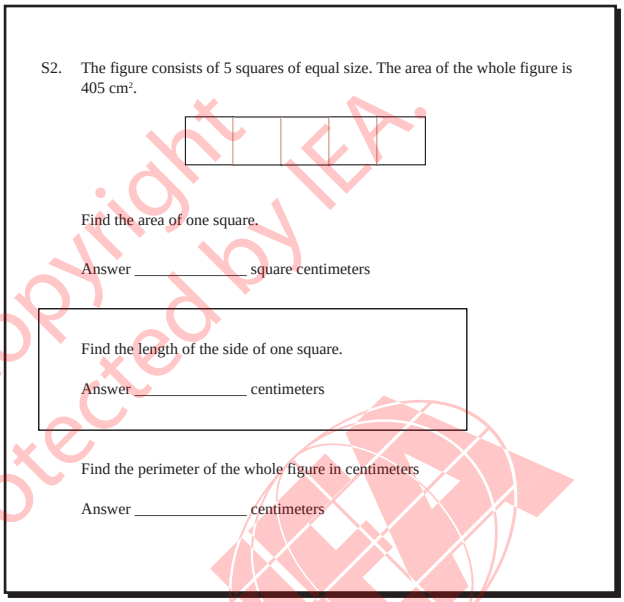
Find the perimeter of the whole figure in centimeters

Answer _____ centimeters

S-2b

Part B

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Solving Problems	29%	19%	665



S2. The figure consists of 5 squares of equal size. The area of the whole figure is 405 cm².

Find the area of one square.

Answer _____ square centimeters

Find the length of the side of one square.

Answer _____ centimeters

Find the perimeter of the whole figure in centimeters

Answer _____ centimeters

B: Codes for length

Code	Response
Correct Response	
10	9
Incorrect Response	
70	1
71	20.25
72	Other indication of division by 4
73	40.5 OR any other indication of division by 2
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

S2. The figure consists of 5 squares of equal size. The area of the whole figure is 405 cm^2.

Find the area of one square.

Answer _____ square centimeters

Find the length of the side of one square.

Answer _____ centimeters

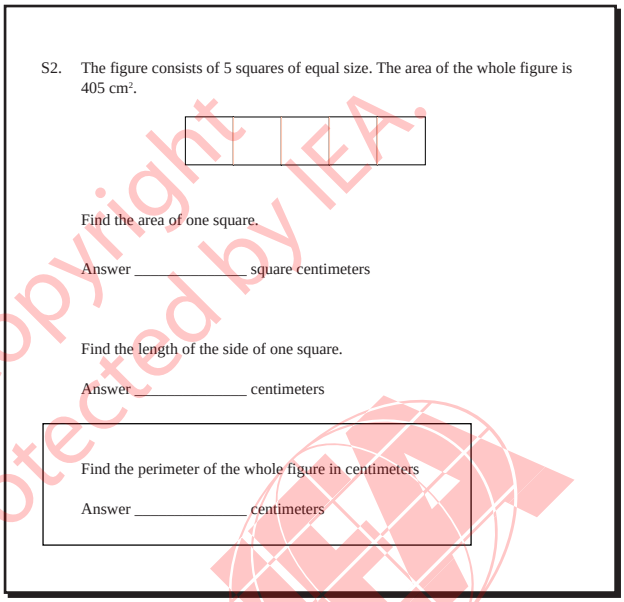
Find the perimeter of the whole figure in centimeters

Answer _____ centimeters

S-2c

Part C

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Solving Problems	23%	17%	680



S2. The figure consists of 5 squares of equal size. The area of the whole figure is 405 cm².

Find the area of one square.

Answer _____ square centimeters

Find the length of the side of one square.

Answer _____ centimeters

Find the perimeter of the whole figure in centimeters

Answer _____ centimeters

C: Codes for perimeter

Code	Response
Correct Response	
10	108
12	Other responses consistent with answer on part (b), using multiplication by 12
19	Other correct responses consistent with part (b).
Incorrect Response	
70	81(4x20.25) OR any other indication of multiplication by 4
71	405
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

T1. There are 54 kilograms of apples in two boxes. The second box of apples weighs 12 kilograms more than the first. How many kilograms of apples are in each box? Show your work.

T-1a

Correctness

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Solving Problems	31%	23%	627

T-1a Coding Guide

T1. There are 54 kilograms of apples in two boxes. The second box of apples weighs 12 kilograms more than the first. How many kilograms of apples are in each box? Show your work.

A: Codes for Correctness

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
20	33 kg AND 21 kg.
Partial Response	
10	Follows the right steps but makes a small arithmetic error resulting in an incorrect answer.
11	Either 33 kg OR 21 kg, with or without another incorrect weight.
Incorrect Response	
70	15 kg AND 39 kg.
71	One of the answers is 42 kg.
72	15 kg AND 27 kg.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

T1. There are 54 kilograms of apples in two boxes. The second box of apples weighs 12 kilograms more than the first. How many kilograms of apples are in each box? Show your work.

T-1b

Method

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Algebra	Solving Problems	33%	25%	631

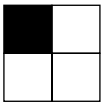
T1. There are 54 kilograms of apples in two boxes. The second box of apples weighs 12 kilograms more than the first. How many kilograms of apples are in each box? Show your work.

B: Codes for Method

Note: If the first digit to part A is a "7", the first digit to part B also must be a "7". Similarly, if part A is "90", so is part B; and if part A is "99", so is part B

Correct Response	
10	An equation with an unknown variable explicitly shown.
11	Method: divide 54 by 2, then add 6 to 27 to get 33 and subtract 6 from 27 to get 21. [Addition and subtraction of 6 need not be shown if student has arrived at the correct solution].
12	Method: subtract 12 from 54 to obtain 42, then divide by 2 to obtain 21kg and then add 12 to get 33 kg. [Addition of 12 to obtain 33 need not be shown if student arrived at the correct solution].
19	Other fully satisfactory solution including "guess and check" with justification that 21 + 33 = 54
Incorrect Response	
70	No method is shown.
71	Method shown is inadequate, but begins in appropriate manner.
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

T2. Two boxes of square-shaped cardboard pieces are available to make a larger pattern. There are 4 small squares in each piece.

All pieces in Box 1 look like 

All pieces in Box 2 look like 

In the required pattern, for every piece from Box 2 there are 2 pieces from Box 1.

a) If 60 pieces from Box 2 are used in the required pattern, how many pieces will be needed altogether?

Answer: _____

b) What fraction of the small squares in the required pattern will be black?

Answer: _____

T-2a

Part A

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Proportionality	Solving Problems	22%	16%	699

T2. Two boxes of square-shaped cardboard pieces are available to make a larger pattern. There are 4 small squares in each piece.

All pieces in Box 1 look like 

All pieces in Box 2 look like 

In the required pattern, for every piece from Box 2 there are 2 pieces from Box 1.

a) If 60 pieces from Box 2 are used in the required pattern, how many pieces will be needed altogether?

Answer: _____

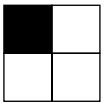
b) What fraction of the small squares in the required pattern will be black?

Answer: _____

A: Codes for number of pieces

Code	Response
Correct Response	
10	180
Incorrect Response	
70	30
71	90
72	120
73	240
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

T2. Two boxes of square-shaped cardboard pieces are available to make a larger pattern. There are 4 small squares in each piece.

All pieces in Box 1 look like 

All pieces in Box 2 look like 

In the required pattern, for every piece from Box 2 there are 2 pieces from Box 1.

a) If 60 pieces from Box 2 are used in the required pattern, how many pieces will be needed altogether?

Answer: _____

b) What fraction of the small squares in the required pattern will be black?

Answer: _____

T-2b

Part B

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Proportionality	Solving Problems	8%	6%	815

T2. Two boxes of square-shaped cardboard pieces are available to make a larger pattern. There are 4 small squares in each piece.

All pieces in Box 1 look like 

All pieces in Box 2 look like 

In the required pattern, for every piece from Box 2 there are 2 pieces from Box 1.

a) If 60 pieces from Box 2 are used in the required pattern, how many pieces will be needed altogether?

Answer: _____

b) What fraction of the small squares in the required pattern will be black?

Answer: _____

B: Codes for fractions of the squares black

Note: The term "equivalent" in the codes below includes percentages and decimals.

Code	Response
Correct Response	
10	1/3
19	A fraction or percent equivalent to 1/3. *Examples: 60/180 or 33%*
Incorrect Response	
70	1/4 OR both 1/4 and 1/2
71	3/8 or equivalent
72	1/2 or equivalent
73	3/4 or equivalent
74	Any INTEGER
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

U1. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Amount of Time
1	2 minutes 41 seconds
2	3 minutes 10 seconds
3	2 minutes 51 seconds
4	3 minutes
5	3 minutes 32 seconds

ESTIMATE to the nearest minute the total time taken for all five songs to play and explain how this estimate was made.

Estimate: _____

Explain:

U-1a

Part A

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Solving Problems	35%	31%	631

U-1a Coding Guide

U1. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Amount of Time
1	2 minutes 41 seconds
2	3 minutes 10 seconds
3	2 minutes 51 seconds
4	3 minutes
5	3 minutes 32 seconds

ESTIMATE to the nearest minute the total time taken for all five songs to play and explain how this estimate was made.

Estimate: _____

Explain:

A: Codes for total estimate

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
10	15 minutes
11	16 minutes
Incorrect Response	
70	13 minutes
71	14 minutes
72	15 min. 14 sec
73	17 minutes
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

U1. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Amount of Time
1	2 minutes 41 seconds
2	3 minutes 10 seconds
3	2 minutes 51 seconds
4	3 minutes
5	3 minutes 32 seconds

ESTIMATE to the nearest minute the total time taken for all five songs to play and explain how this estimate was made.

Estimate: _____

Explain:

U-1b

Part B

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Solving Problems	31%	28%	639

U1. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Amount of Time
1	2 minutes 41 seconds
2	3 minutes 10 seconds
3	2 minutes 51 seconds
4	3 minutes
5	3 minutes 32 seconds

ESTIMATE to the nearest minute the total time taken for all five songs to play and explain how this estimate was made.

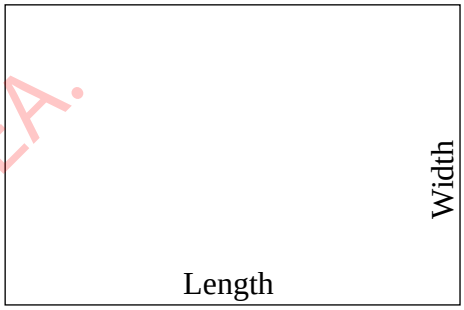
Estimate: _____

Explain:

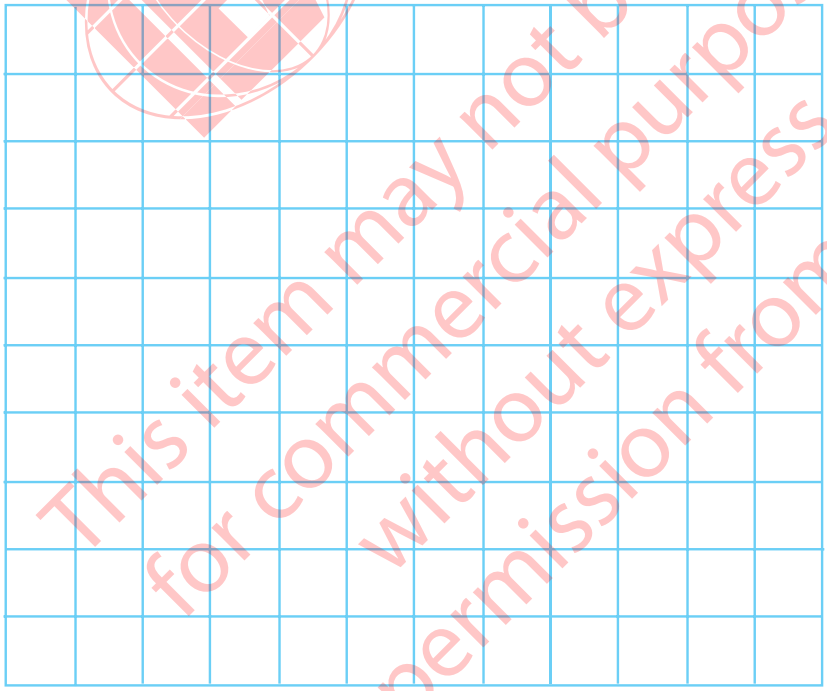
B: Codes for explanation

Code	Response
Correct Response	
10	Each amount of time is correctly rounded to whole minutes *Example: 3+3+3+3+4 OR 3+3+3+3+3*
11	Each amount of time is correctly rounded to nearest 5,10,15 or 30 seconds.
12	No calculation shown. Statements may include "rounded off to nearest minute", "rounded the numbers up and down" or similar expressions.
13	Adds correctly and then rounds off from 15 min. 14 sec.
19	Other correct
Incorrect Response	
70	Each amount of time is rounded off, but one or more rounding is incorrect.
71	Rounds off from 14 min. 34 sec.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

U2.



a. In the space below, draw a new rectangle whose length is one and one half times the length of the rectangle above, and whose width is half the width of the rectangle above. Show the length and width of the new rectangle in centimeters on the figure.



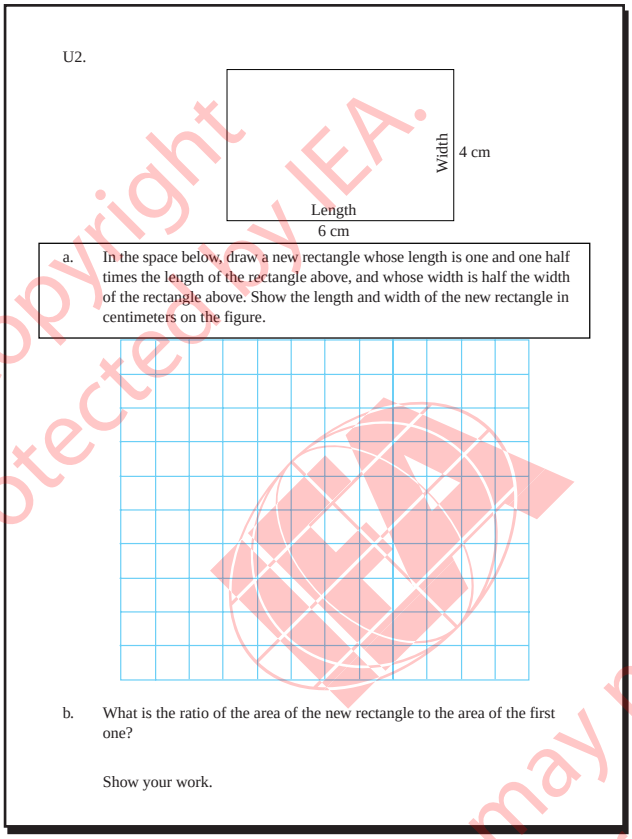
b. What is the ratio of the area of the new rectangle to the area of the first one?

Show your work.

U-2a

Part A

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Solving Problems	31%	24%	621

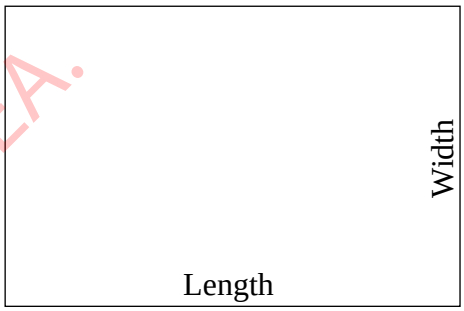


A: Codes for drawing

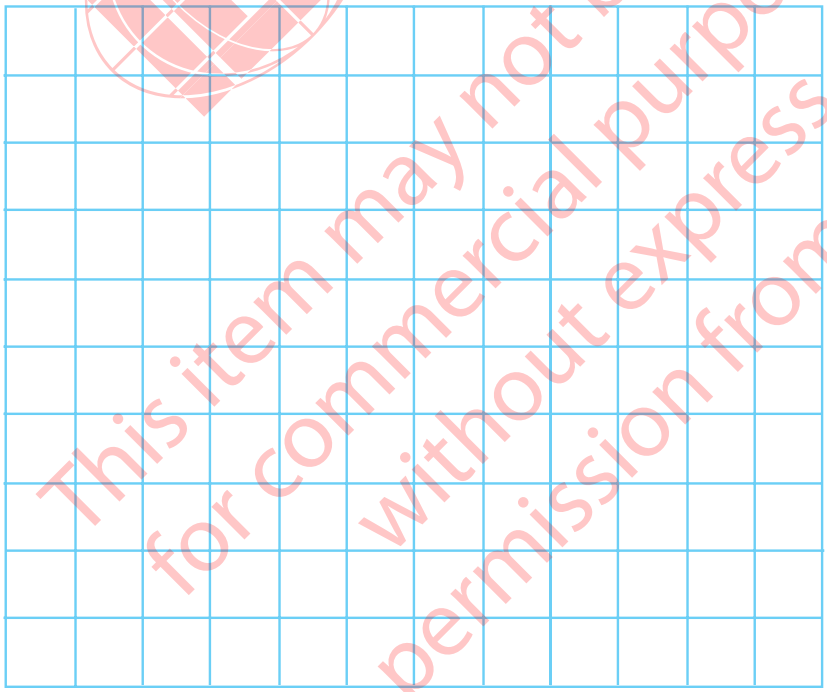
Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
20	9 cm and 2 cm. Correct drawing shown.
Partial Response	
10	9 cm and 2 cm. Drawing is incorrect or missing.
11	The length and/or width is not given or is incorrect. Correct drawing is shown.
Incorrect Response	
70	15 cm and 2 cm. Explicitly written or implicit from the drawing.
71	7.5 cm and 2 cm. Explicitly written or implicit from the drawing.
72	3 cm and 2 cm. Explicitly written or implicit from the drawing.
73	2 cm width and a length equal to any other numbers except those given above. Explicitly written or implicit from the drawing.
74	9 cm length and a width equal to any other numbers than those given above. Explicitly written or implicit from the drawing.
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

U2.



a. In the space below, draw a new rectangle whose length is one and one half times the length of the rectangle above, and whose width is half the width of the rectangle above. Show the length and width of the new rectangle in centimeters on the figure.



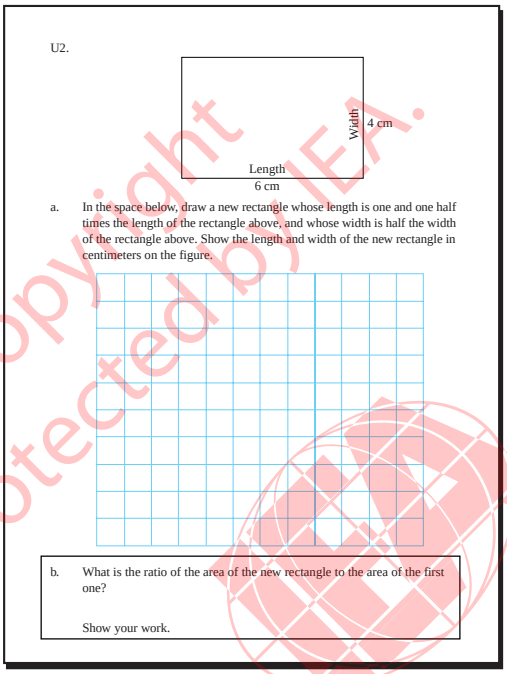
b. What is the ratio of the area of the new rectangle to the area of the first one?

Show your work.

U-2b

Part B

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Solving Problems	10%	6%	737



B: Codes for ratio and areas

Code	Response
Correct Response	
20	3:4, 3/4 or equivalent. The areas are 18 cm ^{2} and 24 cm ^{2}. (No work needs to be shown. Also, areas do not need to be mentioned if the ratio is consistent with the areas of the given rectangle and the rectangle the student has drawn in U-2a)
21	The ratio is NOT 3:4 but areas and ratio of part (b) are consistent with response in part (a).
Partial Response	
10	4:3 or equivalent. (Ratio is reversed.) The areas are 18 cm ^{2} and 24 cm ^{2}.
11	An incorrect ratio or no ratio is given. The areas are 18 cm ^{2} and 24 cm ^{2}.
12	The difference between the areas, 6, is given instead of the ratio. The areas are 18 cm ^{2} and 24 cm ^{2}.
13	Areas are NOT 18 cm ^{2} and 24 cm ^{2} but are consistent with response in part a) and an incorrect ratio or no ratio is given.
14	Areas are NOT 24 cm ^{2} and 18 cm ^{2} but are consistent with response in part a) and a difference consistent with those areas is given instead of the ratio.
Incorrect Response	
70	Focuses exclusively on the ratios of lengths and widths between the given rectangle and the new rectangle. No areas are shown.
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

V1. Rounded to the nearest 10 kg the weight of a dolphin was reported as 170 kg. Write down a weight that might have been the actual weight of the dolphin.

Answer: _____

V-1

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Fractions and Number Sense	Using Complex Procedures	53%	47%	547

V1. Rounded to the nearest 10 kg the weight of a dolphin was reported as 170 kg. Write down a weight that might have been the actual weight of the dolphin.

Answer: _____

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
10	Number within the interval 165≤X<170
11	170
12	Number within the interval 170<X≤175
13	Two or more numbers within the interval 165≤X≤175 *Examples: 165 to 169* *168 or 171*
Incorrect Response	
70	Number within the interval 175<X<180
71	150 OR 200
72	160 OR 180
73	Result of converting 170 kg to other units
79	Other incorrect
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

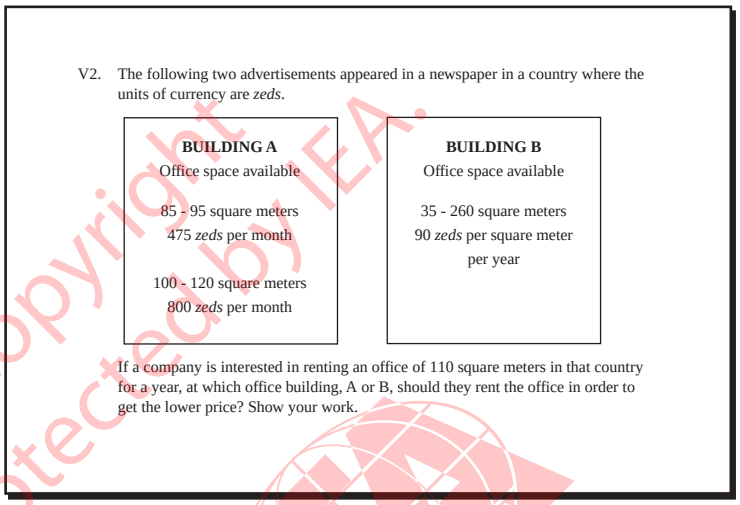
V2. The following two advertisements appeared in a newspaper in a country where the units of currency are *zeds*.

BUILDING A	**BUILDING B**
Office space available 85 - 95 square meters 475 *zeds* per month 100 - 120 square meters 800 *zeds* per month	Office space available 35 - 260 square meters 90 *zeds* per square meter per year

If a company is interested in renting an office of 110 square meters in that country for a year, at which office building, A or B, should they rent the office in order to get the lower price? Show your work.

V-2

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Data Representation, Analysis & Probability	Solving Problems	19%	14%	675



V2. The following two advertisements appeared in a newspaper in a country where the units of currency are *zeds*.

BUILDING A
Office space available

85 - 95 square meters
475 *zeds* per month

100 - 120 square meters
800 *zeds* per month

BUILDING B
Office space available

35 - 260 square meters
90 *zeds* per square meter
per year

If a company is interested in renting an office of 110 square meters in that country for a year, at which office building, A or B, should they rent the office in order to get the lower price? Show your work.

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
30	Building A. Correct calculation of rents for both buildings. 9600 yearly/800 monthly and 9900 yearly/825 monthly, OR 825 to compare with 800 given.
39	Other correct.
Partial Response	
20	Building A. Correct calculation of rent for Building A OR B but not both.
21	Building B OR building is not named. Correct calculation of rents for both buildings.
Minimal Response	
10	Building A. Calculations or explanation are incorrect or inadequate.
11	Building A. No work shown.
12	Building B, OR building is not named. Correct calculation of rent for Building A OR B but not both.
16	Building A. Explanation is given only in the form of extracts from the advertisements.
19	Other minimal.
Incorrect Response	
70	Building B. Incorrect or inadequate calculations.
71	Building B. No work shown.
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

V3. To mix a certain color of paint, Alana combines 5 liters of red paint, 2 liters of blue paint, and 2 liters of yellow paint. What is the ratio of red paint to the total amount of paint?

A. $\frac{5}{2}$

B. $\frac{9}{4}$

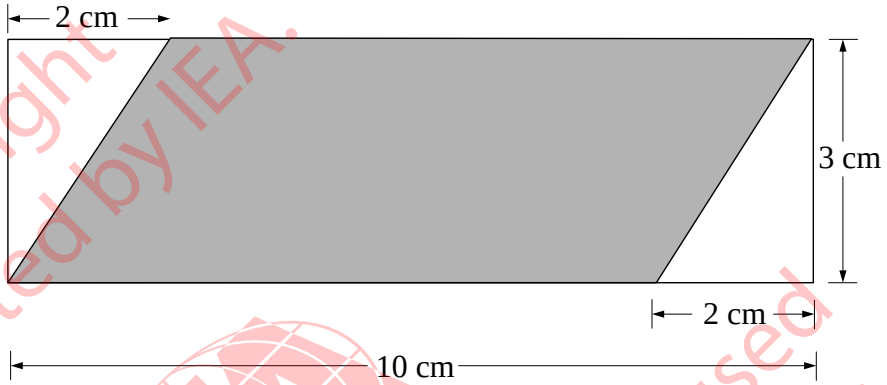
C. $\frac{5}{4}$

D. $\frac{5}{9}$

V-3

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	D	Proportionality	Performing Routine Procedures	42%	37%	603

V4. The figure shows a shaded parallelogram inside a rectangle.



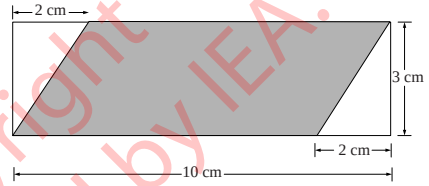
What is the area of the parallelogram?

Answer:_____

V-4

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Mathematics	next page	Measurement	Using Complex Procedures	40%	34%	610

V4. The figure shows a shaded parallelogram inside a rectangle.



What is the area of the parallelogram?

Answer:_____

Note: There is no distinction made between responses with and without units.

Code	Response
Correct Response	
10	24
Incorrect Response	
70	10
71	18
72	26
73	30
74	60
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

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