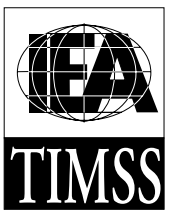
Released Mathematics and Science Literacy Items Population 3



A3. Experts say that 25% of all serious bicycle accidents involve head injuries and that, of all head injuries, 80% are fatal.

What percentage of all serious bicycle accidents involve fatal head injuries?

A. 16%

B. 20%

C. 55%

D. 105%

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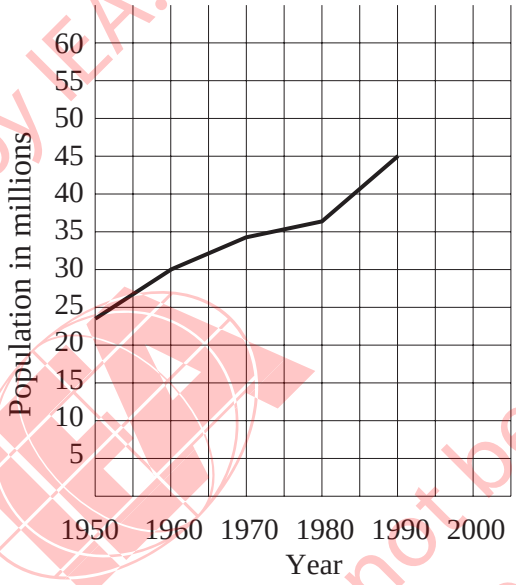
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	B	Mathematics Literacy	Complex Procedures	64%	488

A4. If the population increases by the same rate from the year 1990 to the year 2000 as in the years from 1980 to 1990, approximately what is the expected population by the year 2000?



A. 47 million

B. 50 million

C. 53 million

D. 58 million

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	C	Mathematics Literacy	Complex Procedures	72%	452

A5. A school club is planning a bus trip to the wildlife park. A bus which will hold up to 45 people will cost 600 centros (units of money) and admission tickets cost 30 centros each.

If the cost of the trip, including bus and admission ticket, is set at 50 centros per person, what is the minimum number of people who must participate to ensure that these costs are covered?

A. 12

B. 20

C. 30

D. 45

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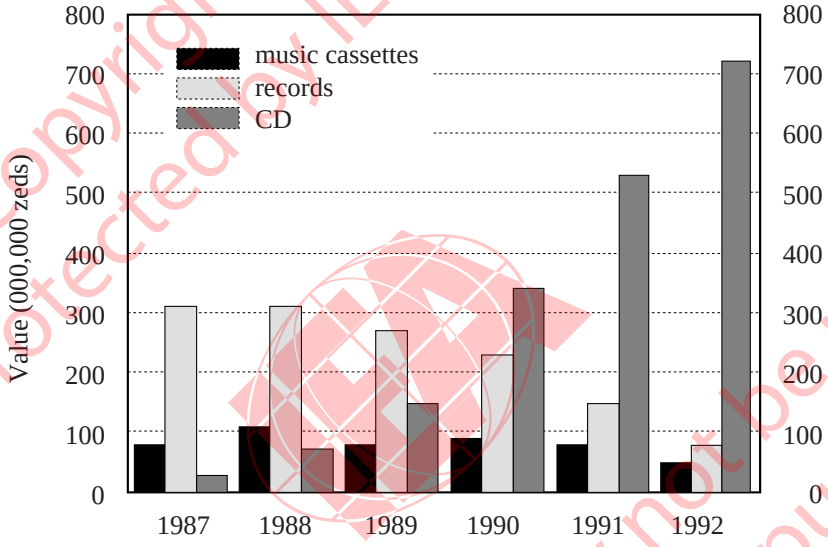
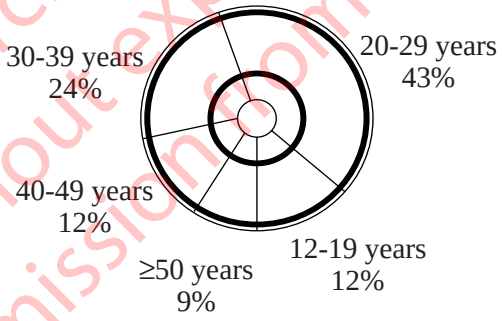
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	C	Mathematics Literacy	Solving Problems	50%	555

A8. The graphs give information about sales of CDs and other sound recording media in Zedland. Zeds are the monetary units used in Zedland.

Value of various sound recording media sold in Zedland (millions of zeds)



CD sales according to age in 1992



With the aid of both graphs calculate how much money was spent by 12-19 year olds on CDs in 1992. Show your work.

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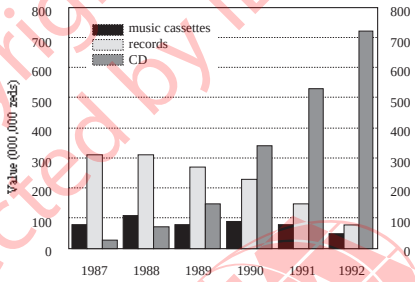
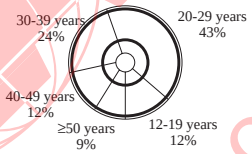
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Solving Problems	44%	573

A8. The graphs give information about sales of CDs and other sound recording media in Zedland. Zeds are the monetary units used in Zedland.

Value of various sound recording media sold in Zedland (millions of zeds)



CD sales according to age in 1992



With the aid of both graphs calculate how much money was spent by 12-19 year olds on CDs in 1992. Show your work.

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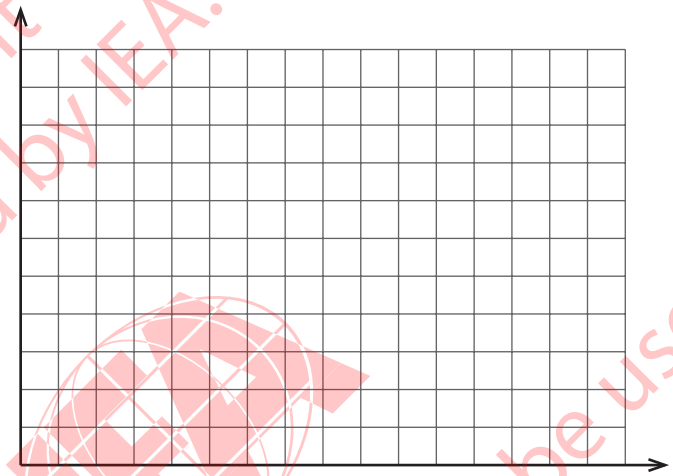
Note: Do not deduct for not including units of zeds in response.

Code	Response
	Correct Response
2 0	Answer: 86.4 million zeds (or equivalent). Explanation or method shown. *Example:* $(720 \times 1{,}000{,}000) \times (12 \div 100) = 86{,}400{,}000$
2 1	Answer in the range of 84 to 87.6 million zeds (or equivalent). Explanation or method shown.
	Partial Response
1 0	Answer in the range of 84 to 87.6 million zeds (or equivalent). No explanation or method shown.
1 1	Answer in the range of 84 to 87.6 zeds (or equivalent). Factor of 1 million is omitted. Explanation or method shown.
1 2	Answer outside range due to place value (decimal) error. Explanation or method shown. *Example:* $(710{,}000 \div 100) \times 12 = 85{,}200$
1 3	Includes some correct calculations, but final answer is missing or incorrect: *Examples: Calculation correct:* $((700$ to $730) \div 100) \times 12))$ *; no final answer. Calculation includes a computational error (other than Code 12)*
1 9	Other partial.

Continued Next Page

Incorrect Response	
70	Applies incorrect value of CDs. Calculates or attempts to calculate 12% of this value.
71	Applies correct value of CDs. Indicates incorrect calculation of 12%; eg. subtraction or division by 12.
79	Other incorrect.
Nonresponse	
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

A10. Using the set of axes below, sketch a graph which shows the relationship between the height of a person and his/her age from birth to 30 years. Be sure to label your graph, and include a realistic scale on each axis.



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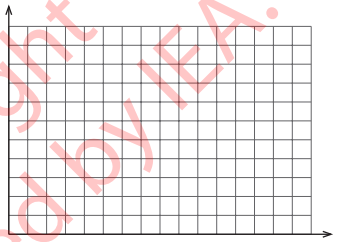
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Justifying and Proving	19%	685

A10. Using the set of axes below, sketch a graph which shows the relationship between the height of a person and his/her age from birth to 30 years. Be sure to label your graph, and include a realistic scale on each axis.



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Code	Response
	Correct Response
20	All the following features correct: 1. Correct scales and labels on both axes: Age: 0 - 30 years Height: 0 - 200 cm OR 0 - 80 inches (0 - 7 ft) 2. The graph starts at approximately 50 cm (20 inches). 3. Maximum height is reached at a realistic age (14 to 20 years). 4. The graph is horizontal after age of maximum height. 5. Maximum height is reasonable.
	Partial Response
10	Incorrect start of graph. Other features correct. *Examples: Graph starts at height of zero.* *Graph does not start at year zero.*
11	Unrealistic age for maximum height. Other features correct.
12	Incorrect graph after age of maximum height. Other features correct. *Examples: Graph continuously increases in the range of 20 - 30 years.* *Graph decreases after age of maximum height.*
13	Includes incorrect scales or labels. Other features correct.
19	Other partial.
	Incorrect Response
70	Includes incorrect start of graph AND incorrect scales. Other features correct.
71	Includes incorrect start of graph AND incorrect graph after age of maximum height. Other features correct.
79	Other incorrect.
	Nonresponse
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

A12. 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.

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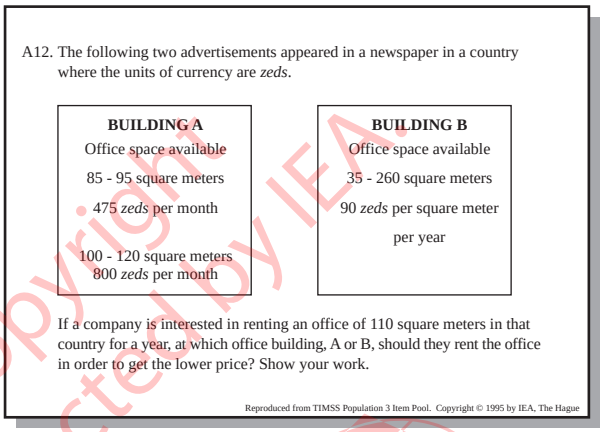
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Communicating	50%	554



A12. 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.

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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. 9600/800 AND 9900/825, or 825 to compare with the 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 partial.
	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

D6. A 45 000-litre water tank is to be filled at the rate of 220 liters per minute.

Estimate, to the nearest half an hour, how long it will take to fill the tank.

A. 4 hours

B. $3\frac{1}{2}$ hours

C. 3 hours

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

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D-6

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	B	Mathematics Literacy	Complex Procedures	65%	487

D7. If there are 300 calories in 100 grams of a certain food, how many calories are there in a 30 gram portion of that food?

A. 90

B. 100

C. 900

D. 1000

E. 9000

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D-7

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	A	Mathematics Literacy	Knowing	71%	451

D8. In a vineyard there are 210 rows of vines. Each row is 192 m long and plants are planted 4 m apart. On average, each plant produces 9 kg of grapes each season.

The total amount of grapes produced by the vineyard each season is closest to

A. 10 000 kg

B. 100 000 kg

C. 400 000 kg

D. 1 600 000 kg

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D-8

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	B	Mathematics Literacy	Complex Procedures	55%	531

D9. A store is having a '20% off' sale. The normal price of a <stereo system> is $1250.

What is the price of the <stereo system> after the 20% discount is applied?

A. $1000

B. $1050

C. $1230

D. $1500

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D-9

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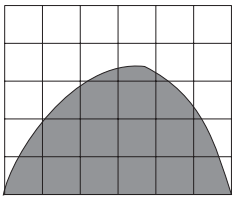
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	A	Mathematics Literacy	Routine Procedures	72%	450

D10.



Each of the small squares in the figure is 1 square unit. Which is the best estimate of the area of the shaded region?

A. 10 square units

B. 12 square units

C. 14 square units

D. 16 square units

E. 18 square units

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D-10

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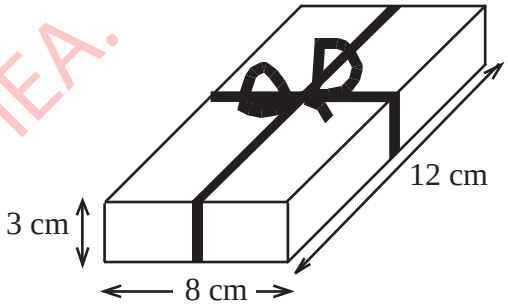
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	C	Mathematics Literacy	Knowing	61%	507

D11. Stu wants to wrap some ribbon around a box as shown and have 25 cm left to tie a bow.



How long a piece of ribbon does he need?

A. 46 cm

B. 52 cm

C. 65 cm

D. 71 cm

E. 77 cm

D-11

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	E	Mathematics Literacy	Complex Procedures	45%	575

D12. Brighto soap powder is packed in cube-shaped cartons. A carton measures 10 cm on each side.

The company decides to increase the length of each edge of the carton by 10 per cent.

How much does the volume increase?

A. 10 cm^3

B. 21 cm^3

C. 100 cm^3

D. 331 cm^3

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D-12

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	D	Mathematics Literacy	Solving Problems	31%	646

D13. In a school election with three candidates, Joe received 120 votes, Mary received 50 votes, and George received 30 votes.

What percentage of the total number of votes did Joe receive?

A. 60%

B. $66\frac{2}{3}\%$

C. 80%

D. 120%

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D-13

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	A	Mathematics Literacy	Routine Procedures	64%	488

D14. From a batch of 3000 light bulbs, 100 were selected at random and tested. If 5 of the light bulbs in the sample were found to be defective, how many defective light bulbs would be expected in the entire batch?

A. 15

B. 60

C. 150

D. 300

E. 600

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D-14

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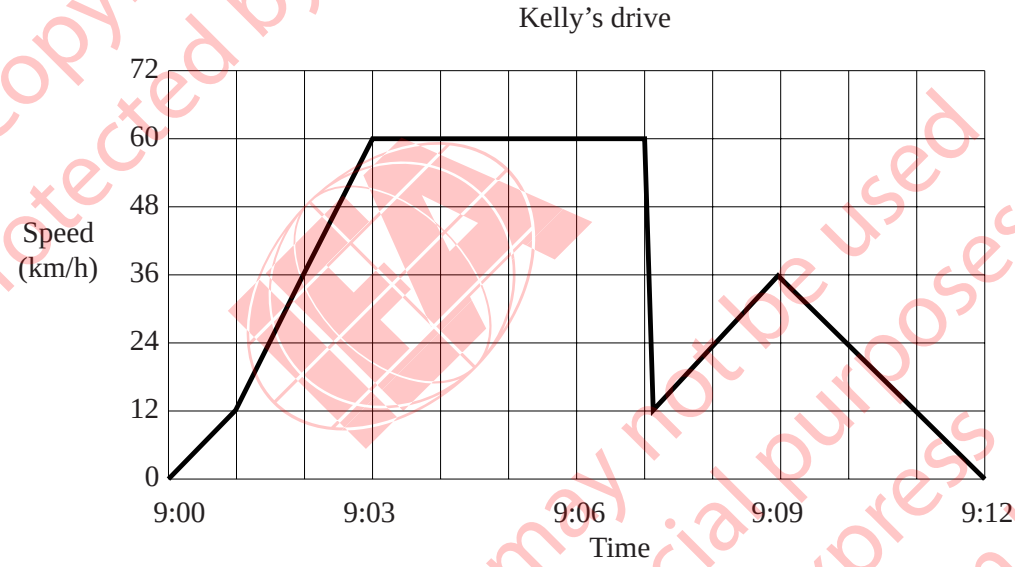
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	C	Mathematics Literacy	Solving Problems	66%	478

D15. Kelly went for a drive in her car. During the drive, a cat ran in front of the car. Kelly slammed on the brakes and missed the cat.

Slightly shaken, Kelly decided to return home by a shorter route. The graph below is a record of the car's speed during the drive.



D-15a

a) What was the maximum speed of the car during the drive?

_____

b) What time was it when Kelly slammed on the brakes to avoid the cat?

_____

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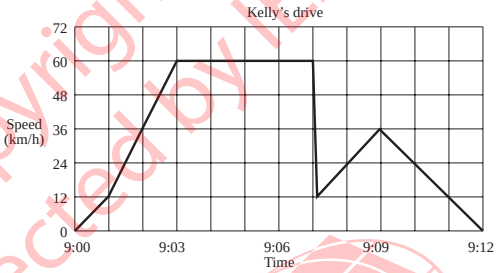
Part a

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Solving Problems	74%	435

D-15a Coding Guide

D15. Kelly went for a drive in her car. During the drive, a cat ran in front of the car. Kelly slammed on the brakes and missed the cat.

Slightly shaken, Kelly decided to return home by a shorter route. The graph below is a record of the car's speed during the drive.



a) What was the maximum speed of the car during the drive?

_____

b) What time was it when Kelly slammed on the brakes to avoid the cat?

_____

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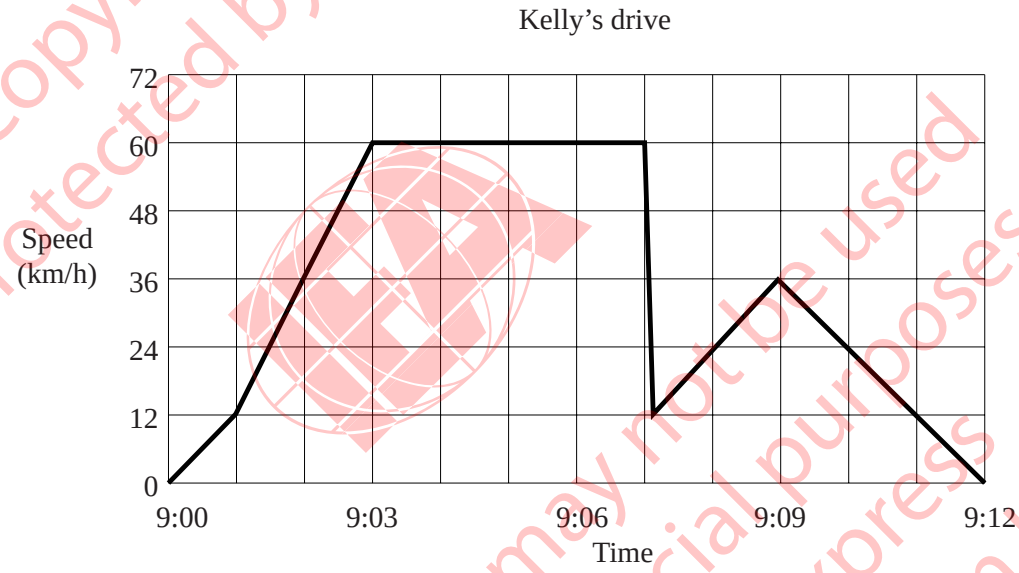
A: Codes Maximum Speed of Car

Note: Do not deduct for not including units.

Code	Response
	Correct Response
10	60 km/h.
	Incorrect Response
79	Any incorrect response.
	Nonresponse
90	Crossed-out/erased, illegible or impossible to interpret.
99	BLANK

D15. Kelly went for a drive in her car. During the drive, a cat ran in front of the car. Kelly slammed on the brakes and missed the cat.

Slightly shaken, Kelly decided to return home by a shorter route. The graph below is a record of the car's speed during the drive.



a) What was the maximum speed of the car during the drive?

_____

b) What time was it when Kelly slammed on the brakes to avoid the cat?

_____

D-15b

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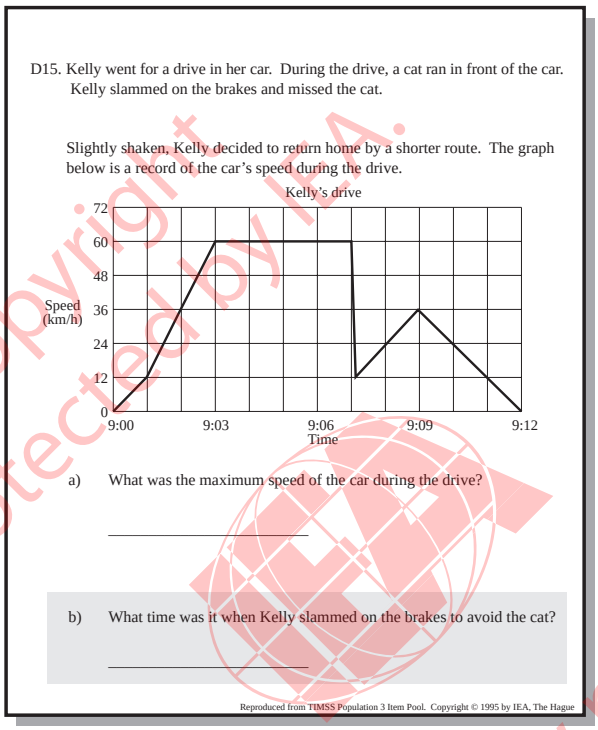
Part b

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Solving Problems	59%	512



D15. Kelly went for a drive in her car. During the drive, a cat ran in front of the car. Kelly slammed on the brakes and missed the cat.

Slightly shaken, Kelly decided to return home by a shorter route. The graph below is a record of the car's speed during the drive.

a) What was the maximum speed of the car during the drive?

_____

b) What time was it when Kelly slammed on the brakes to avoid the cat?

_____

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B: Codes Times Slammed on Brakes

Code	Response
	Correct Response
10	9:07.
	Incorrect Response
70	9:06.
71	Answers between 9:06 and 9:07, exclusive.
72	Answers shortly after 9:07. *Examples: It was approximately 9:07 and 10 seconds, when Kelly slammed on the brakes to avoid the cat.* *Approximately 9:07 and 2 seconds.*
79	Other incorrect.
	Nonresponse
90	Crossed-out/erased, illegible or impossible to interpret.
99	BLANK

D16. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Length 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:

D-16a

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Estimate

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Solving Problems	39%	600

D16. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Length 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:

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A: Codes for Total Estimate

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

D16. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Length 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:

D-16b

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Explain

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Solving Problems	32%	635

D16. Teresa wants to record 5 songs on tape. The length of time each song plays for is shown in the table.

Song	Length 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:

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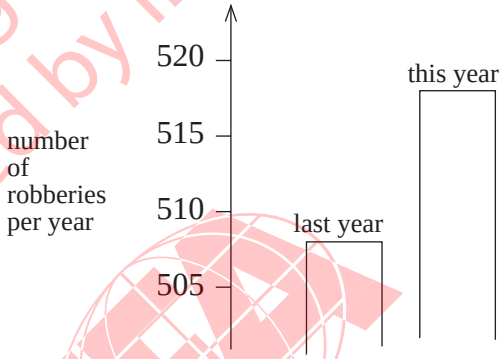
B: Codes for Explanation

Code	Response
	Correct Response
10	Each amount of time is correctly rounded to whole minutes before adding. *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

D17. A TV reporter showed this graph and said:

"There's been a huge increase in the number of robberies this year."



Do you consider the reporter's statement to be a reasonable interpretation of the graph? Briefly explain.

D-17

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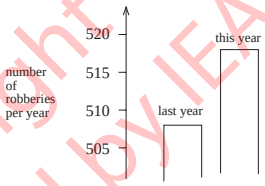
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Mathematics Literacy	next page	Mathematics Literacy	Knowing	19%	681

D17. A TV reporter showed this graph and said:

"There's been a huge increase in the number of robberies this year."



Do you consider the reporter's statement to be a reasonable interpretation of the graph? Briefly explain.

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Note: The use of NO in these codes includes all statements indicating that the interpretation of the graph is NOT reasonable. YES includes all statements indicating that the interpretation is reasonable.

Code	Response
	Correct Response
20	NO. Focuses on the fact that only a small part of the graph is shown. *Examples: Not reasonable. The entire graph should be displayed.* *I don't think it is a reasonable interpretation of the graph because if they were to show the whole graph you would see that there is only a slight increase in robberies.*
21	NO. Contains correct arguments in terms of ratio or percentage increase. *Examples: Not reasonable. 10 is not a huge increase compared to a total of 500.* *No. According to the percentage, the increase is only about 2%.*
29	Other correct.

Continued Next Page

Partial Response	
10	NO. No explanation given.
11	NO. Focuses ONLY on an increase given by the exact number of robberies. *Examples: Not reasonable. It increased by 10 robberies.* *The word "huge" does not explain the reality of the increased number of robberies. The increase was only about 10 and I wouldn't call that "huge."*
12	NO. Focuses on the size of increase WITHOUT THE USE OF NUMBERS. *Example: Not reasonable. There has been an increase, but not a huge increase.*
13	NO. Indicates that the graph is misleading, but fails to point out the crucial features. *Examples: Not reasonable. The scale on the y-axis is misleading.* *No, it only looks like a huge amount because of huge bars and far apart distances.* *No, because it only appears that there was an increase of about 10 robberies. The T.V. guy misinterpreted the graph; he never read the axis.*
14	NO. Explanation consists of irrelevant arguments. *Example: No, because the previous year may have been just as high or higher but on the other hand it could be because the crime rate is becoming outrageous.*
19	Other partial.
Incorrect Response	
70	YES. No explanation given.
71	YES. Focuses on the increase in the exact number of robberies. *Examples: Reasonable interpretation. The increase is about 10.* *Yes, because as you can see from the graph, last year there were about 508 robberies and this year there were about 518. There were about 10 more robberies this year than last.*
72	YES. Focuses on the appearance of the graph.
73	Includes arguments, but no conclusions are drawn.
79	Other incorrect.
Nonresponse	
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

A1. Nuclear energy can be generated by fission or fusion. Fusion is not currently being used in reactors as an energy source. Why is this?

A. The scientific principles on which fusion is based are not yet known.

B. The technological processes for using fusion safely are not developed.

C. The necessary raw materials are not readily available.

D. Waste products from the fusion process are too dangerous.

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	B	Science Literacy	Understanding	40%	619

A2. CFCs (chlorofluorocarbons) revolutionized personal and industrial life for 30 years. They were the coolant in refrigerators and the propellants in aerosols, pressure packs and fire extinguishers. There are now very strong international moves to stop the use of these substances because

A. they are chemically inert.

B. they contribute to the greenhouse effect.

C. they are poisonous to humans.

D. they destroy the ozone layer.

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	D	Science Literacy	Understanding	77%	417

A6. When an animal or plant species is introduced to an area where it has never previously existed, it frequently creates a problem by multiplying out of control and displacing established species. One way of fighting introduced species is to poison them. This may be impractical, be very costly or carry heavy risks. Another method, called *biological control*, involves the use of living organisms, other than human beings, to control the pest species.

a) Give an actual example of biological control.

b) Describe one serious problem that can occur as a result of implementing biological control.

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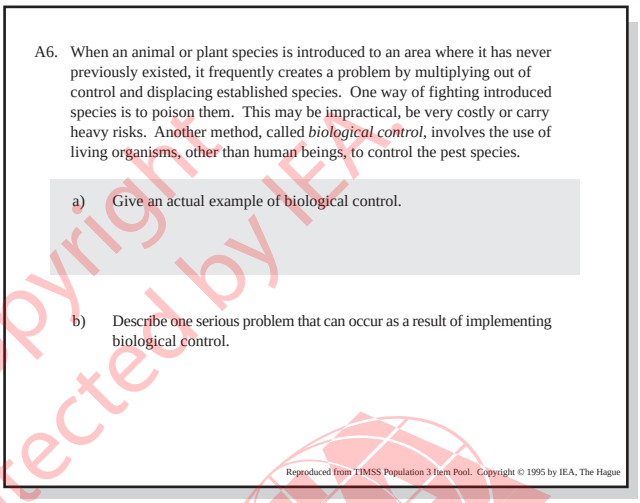
Part a

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Understanding	37%	631



A6. When an animal or plant species is introduced to an area where it has never previously existed, it frequently creates a problem by multiplying out of control and displacing established species. One way of fighting introduced species is to poison them. This may be impractical, be very costly or carry heavy risks. Another method, called *biological control*, involves the use of living organisms, other than human beings, to control the pest species.

a) Give an actual example of biological control.

b) Describe one serious problem that can occur as a result of implementing biological control.

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A: Codes for Example

Note: Correct responses do not have to include specific examples of species.

Code	Response
	Correct Response
10	Introducing species which eat the pests. *Examples: Have a house cat in your house to rid mice as a biological control.* *Ladybugs are introduced to eat aphids.* *To control several different pests on plants, living organisms that feed on those could be introduced.* *Birds eat bugs, so if you have a bug problem get birds.*
11	Introducing species which parasitise pests. *Example: Ichneumon flies lay their eggs in caterpillars, which then die.*
12	Transmitting infection (viruses/bacteria) to the pests. *Example: Myxomatosis is introduced to kill rabbits.*
19	Other correct.
	Incorrect Response
70	Includes chemical control.
71	Incomplete: omits one of the species involved; i.e. mentions either the controlled or the controlling organism, but not both. *Example: Hawk.*
76	Merely repeats information given in stem.
79	Other incorrect. *Example: Protect some animals from the other one when they are in the minority.*
	Nonresponse
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

A6. When an animal or plant species is introduced to an area where it has never previously existed, it frequently creates a problem by multiplying out of control and displacing established species. One way of fighting introduced species is to poison them. This may be impractical, be very costly or carry heavy risks. Another method, called *biological control*, involves the use of living organisms, other than human beings, to control the pest species.

a) Give an actual example of biological control.

b) Describe one serious problem that can occur as a result of implementing biological control.

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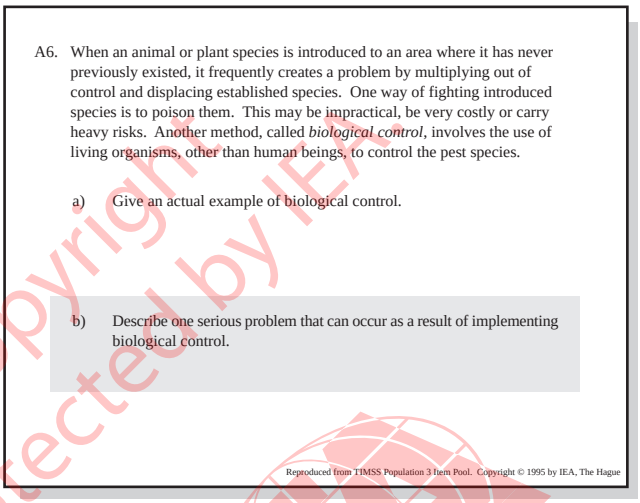
Part b

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Understanding	44%	594



A6. When an animal or plant species is introduced to an area where it has never previously existed, it frequently creates a problem by multiplying out of control and displacing established species. One way of fighting introduced species is to poison them. This may be impractical, be very costly or carry heavy risks. Another method, called *biological control*, involves the use of living organisms, other than human beings, to control the pest species.

a) Give an actual example of biological control.

b) Describe one serious problem that can occur as a result of implementing biological control.

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B: Codes for Problem

Code	Response
	Correct Response
10	Control organism itself may grow out of control. With or without examples. *Example: This could get out of hand and the other species may begin to overrun the other ones and they will have to implement a new species to control them.*
11	Control organism may attack other organisms than the one it was introduced to control. With or without examples.
12	Control organism may completely destroy or cause the extinction of the organism it was introduced to control. With or without examples. *Example: One serious problem might be the death of a species. The species brought to control could kill off the species it is controlling.*
13	An ecological imbalance may be created. With or without examples. *Example: The whole ecosystem may become imbalanced if first one, then another species is introduced.*
14	Any combination of Codes 10, 11, 12 or 13. *Example: One problem is that the spiders would be multiplying very rapidly because of the food source and environment. They may destroy all the insects and end up having nothing to eat and eventually kill themselves, which would destroy the whole environment.*
19	Other correct.
	Incorrect Response
79	Any unacceptable response. *Examples: You can add another problem that would create the same problem.* *Reproduction higher for some animals*
	Nonresponse
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

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A7. Some high heeled shoes are claimed to damage floors. The base diameter of these very high heels is about 0.5 cm and of ordinary heels about 3 cm. Briefly explain why the very high heels may cause damage to floors.

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	41%	596

A7. Some high heeled shoes are claimed to damage floors. The base diameter of these very high heels is about 0.5 cm and of ordinary heels about 3 cm. Briefly explain why the very high heels may cause damage to floors.

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Note: Do not deduct for mistakes in the ratio of the areas or pressures (even if they are extreme).

Code	Response
	Correct Response
20	Refers to greater pressure on the floor because of smaller area of the heels. *Examples: The pressure from the heel is greater because the area is smaller.* *Because of the narrow diameter of very high heels, all the body weight is spread over a greater area. There is greater pressure exerted on the floor with the higher heels because it is all placed on a small area. The pressure is less on a wider heel because the weight is distributed over a greater area causing less damage.*
21	Refers to weight or force acting on smaller area or heel size, without using the term pressure. *Examples: The weight is distributed over a smaller area.* *The heels have a very small point on the shoes. It is holding the same amount of weight as much wider heels. This causes dents in the floor.*
29	Other correct.
	Partial Response
10	Refers to greater pressure without mentioning area of the heels.
11	Refers to an increasing "force" instead of "pressure" with a smaller area. *Example: The force increases as the area of the heel gets smaller.*
12	Misuse of "pressure" instead of "force" but correct thinking. *Examples: The pressure is distributed over a smaller area.* *There is more direct pressure on a smaller surface area of the floor with very high heels, while ordinary heels put pressure on the floor that is more spread or not so concentrated.*
13	Misuse of "mass" instead of "force" or "weight" but correct thinking. *Example: The mass is distributed over a smaller area.*
19	Other partial. *Example: The weight on .5 cm heel is more forceful than on an evenly balanced 3 cm heel.*

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Continued Next Page

	Incorrect Response
70	Refers only to the hardness of the material or sharpness of high heels. *Examples: They are made of much harder material like steel.* *Because they are sharper and they poke into the floor.*
76	Merely repeats information in the stem. *Example: They have a smaller area, that's why they cause damage to floors.*
79	Other incorrect.
	Nonresponse
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

A9. One measure of a country's industrial creativity that is sometimes used is the number of patents applied for annually relative to the number of researchers in the country. (Note: a patent is the legal right to exclusive use of a new idea, product or process.) The following table shows these data for six countries:

Measurement of industrial creativity

Country	Number of patent applications per year	Number of researchers	Number of patents applied for per year per researcher
Austria	2 600	23 000	0.11
Canada	1 850	52 600	0.03
France	14 000	139 000	0.10
Germany	33 000	270 000	0.12
Japan	78 500	386 000	0.19
USA	76 000	752 000	0.10

(Source: Science Council of Canada, 1983)

a) Do these data support each of the following statements?
(Circle either Yes or No for each .)

1: The more researchers a country has, the more patents will be applied for. YES NO

2: German industrial research is superior to that in the U.S.A. YES NO

b) Give one reason why the number of patents applied for per year per researcher may or may not be a good measure of a country's industrial creativity.

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Part a

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
	Data for part A of Item A-9 was deleted prior to analysis due to poor performing statistics.				

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b) Give one reason why the number of patents applied for per year per researcher may or may not be a good measure of a country's industrial creativity.

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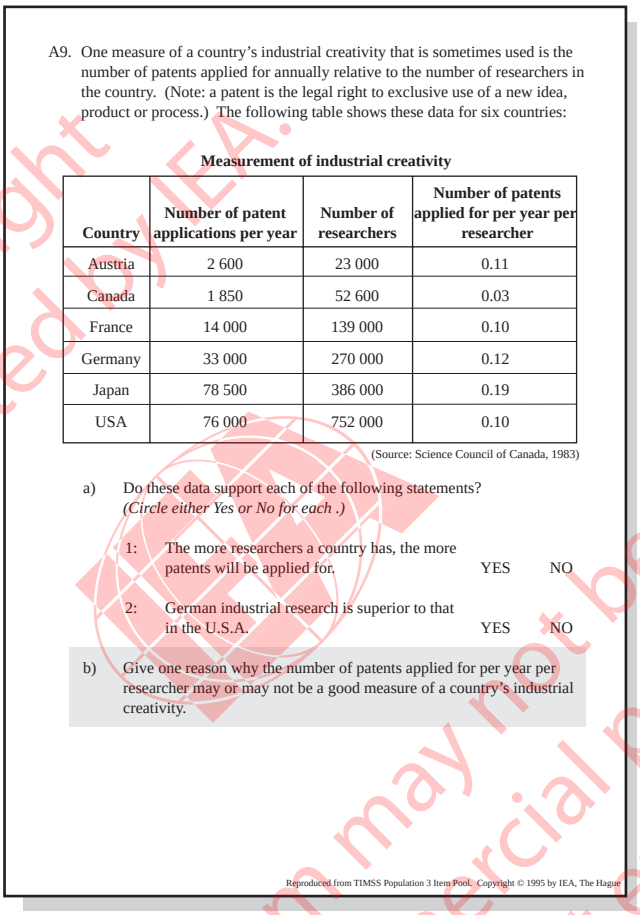
Part b

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Using Tools, Routine Procedures, and Science Processes	33%	660



A9. One measure of a country's industrial creativity that is sometimes used is the number of patents applied for annually relative to the number of researchers in the country. (Note: a patent is the legal right to exclusive use of a new idea, product or process.) The following table shows these data for six countries:

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Japan	78 500	386 000	0.19
USA	76 000	752 000	0.10

(Source: Science Council of Canada, 1983)

a) Do these data support each of the following statements?
(Circle either Yes or No for each .)

1: The more researchers a country has, the more patents will be applied for. YES NO

2: German industrial research is superior to that in the U.S.A. YES NO

b) Give one reason why the number of patents applied for per year per researcher may or may not be a good measure of a country's industrial creativity.

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B: Codes Reason May or May not be Good Measure

Code	Response
	Correct Response
10	Supports the suggested ratio as a good measure of creativity and provides any logical reason.
11	Does NOT support the suggested ratio as a good measure of creativity; refers to lack of information about quality or significance of patents. *Example: Because maybe the patents aren't as good as a country without so many patents.*
12	Does NOT support the suggested ratio as a good measure of creativity; refers to development occurring without patents applied for. *Example: This chart has no bearing as to how much industrial creativity was produced by the end of the year.*
13	Does NOT support the suggested ratio as a good measure of creativity; refers to policy and/or lack of opportunity impeding implementation of developments.
14	Does NOT support the suggested ratio as a good measure of creativity; refers to non-representative data in table. *Examples: The data in the table may come from a year where there were more applications than normal.* *One country may not have had very many one year because of lots the year before.* *This statistic is not a good measure of a country's industrial creativity because patents may be more difficult to apply for in one country than another.*

Continued Next Page

Correct Response	
19	Other logical reasons not supporting the suggested ratio as a good measure of creativity. *Examples: Patents applied for is not the same as patents granted.* *This chart doesn't say whether or not they had actually received these patents.*
Incorrect Response	
70	Suggests a better measure, but does not explain why. *Example: Countries may be helping each other out.*
71	Any statement not supported by a logical reason. *Examples: It is unfair.* *The graph is biased. It does get both sides of the situation.* *Lots of people have good ideas but don't think they are good.*
79	Other incorrect.
Nonresponse	
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

A11. It takes 10 painters 2 years to paint a steel bridge from one end to the other. The paint that is used lasts about 2 years, so when the painters have finished painting at one end of the bridge, they go back to the other end and start painting again.

a. Why MUST steel bridges be painted?

b. A new paint that lasts 4 years has been developed and costs the same as the old paint. Describe 2 consequences of using the new paint.

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Part a

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	74%	436

A11. It takes 10 painters 2 years to paint a steel bridge from one end to the other. The paint that is used lasts about 2 years, so when the painters have finished painting at one end of the bridge, they go back to the other end and start painting again.

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A: Codes Reason for Painting

Code	Response
	Correct Response
10	Explicitly refers to rusting or corrosion.
19	Other correct.
	Incorrect Response
70	Mentions only aesthetic reasons. *Examples: It looks nicer.* *It is ugly.*
71	Refers to protecting or improving the bridge for reasons other than code 10 above: *Examples: The paint must be renewed.* *It is a long time since it was painted.*
72	Any combination of codes 70, 71.
73	Challenges the information in the question. *Example: You don't need to paint steel bridges.*
79	Other incorrect.
	Nonresponse
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

A11. It takes 10 painters 2 years to paint a steel bridge from one end to the other. The paint that is used lasts about 2 years, so when the painters have finished painting at one end of the bridge, they go back to the other end and start painting again.

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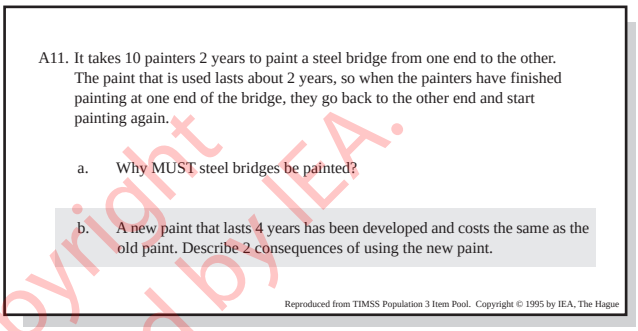
First Consequence

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	64%	496

Second Consequence

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	46%	587

Part b



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a. Why MUST steel bridges be painted?

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B: Codes Painting Lasting 4 Years

Note: Each of the two consequences must be coded separately.
The same codes can be used twice.
However, if the consequences described are essentially the same, the second should be coded as 79.
Example: They don't need to go back and start again. (code 11) The can wait before they start paining again. (code 79)

Code	Response
	Correct Response
10	Student includes the fact that there is more profit [for the painting company or the community]. *Examples: It is cheaper for the company* *Less painters are needed.* *They can paint more bridges.*
11	The painters don't need to paint so often or work so hard. *Examples: They can wait two years before starting again.* *Longer vacations for the workers.* *They can have another job in the meantime.*
12	Mentions increased unemployment or lower salary for the workers.
19	Other correct: *Example: Fewer problems for the traffic.*
	Incorrect Response
70	The paint will last for a longer time.
76	Merely repeats information in the stem. *Examples: It will last for four years.* *It will cost the same*
79	Other incorrect.
	Nonresponse
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

D1. It is often claimed that "cooked vegetables are not as nutritious as the same kinds of vegetables uncooked." What could be done to find out if this statement is true?

A. Compare the weight of the vegetables before and after they are cooked.

B. Compare the colour of the cooked and uncooked vegetables.

C. Test the acidity of the water in which the vegetables are cooked.

D. Compare the vitamin content of the cooked and uncooked vegetables.

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D-1

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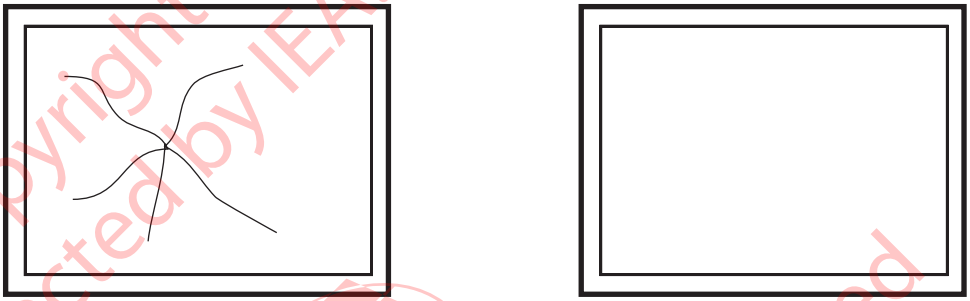
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	D	Science Literacy	Investigating the Natural World	87%	337

D2. The sketch below shows two windows. The left window has been cracked by a flying stone. A tennis ball, with the same mass and speed as the stone, strikes the adjacent, similar window, but does not crack it.



What is one important reason why the impact of the stone cracks the window but the impact of the tennis ball does not?

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D-2

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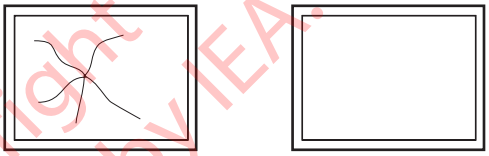
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	57%	528

D2. The sketch below shows two windows. The left window has been cracked by a flying stone. A tennis ball, with the same mass and speed as the stone, strikes the adjacent, similar window, but does not crack it.



What is one important reason why the impact of the stone cracks the window but the impact of the tennis ball does not?

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Code	Response
	Correct Response
20	Refers to collision time or longer impact time and (therefore) smaller force for ball than stone.
21	Refers to kinetic energy of the ball being used partly to compress the ball and kinetic energy of the stone being used to break the glass, since the stone cannot be compressed. *Example: The surface area struck is greater on the tennis ball than on the stone. Also the structure of the object thrown: the rock is hard and penetrates the glass causing the crack, but the ball is soft and when it strikes the window is absorbs some of its own velocity and rebounds back.*
	Partial Response
10	Refers to the softness or deformation of the ball versus the hardness or solidness of the stone without mentioning kinetic energy. *Examples: The ball has give and the rock does not. A tennis ball is rubber and changes shape when it hits; a rock is hard solid and does not change shape.* *The tennis ball is not solid and has a soft outside. The rock is hard and solid.* *The tennis ball has air or a hollow inside, giving it some leeway when it hits the window, but the rock is solid and just hits with full force.*
11	Refers to the larger impact area of the ball versus the smaller area or higher density of the stone, which gives a more concentrated force on impact. *Examples: The tennis ball hits a larger area, spreading the blow across the window.* *The size of the stone is smaller causing less surface area to strike the window, whereas the tennis ball has a larger surface area causing it to even out the absorption.*
19	Other partial.

Continued Next Page

	Incorrect Response
70	Refers only to differences in mass/weight or density.
72	Refers only to the “sharpness” of the stone. *Examples: The shape of the stone has ridges and edges and can crack things.*
76	Merely repeats information in the stem.
79	Other incorrect.
	Nonresponse
90	Crossed-out/erased, illegible, or impossible to interpret.
99	BLANK

D3. José caught influenza. Write down one way he could have caught it.

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D-3

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Understanding	68%	475

D3. José caught influenza. Write down one way he could have caught it.

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Code	Response
	Correct Response
10	Refers explicitly to transmission of germs.
11	Refers implicitly to transmission of germs by sneezing/coughing or close contact. *Examples: Drinking from the same cup.* *Shaking hands.* *Eating together or from same utensils.*
12	States only that he got it from someone who had the flu.
19	Other correct.
	Incorrect Response
70	Refers to being too cold. *Examples: He got it from being out in the cold.* *He got it from getting wet [or freezing].* *He got it because he did not wear enough clothes.*
79	Other incorrect.
	Nonresponse
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

D4. Electrical energy is used to power a lamp.

Is the amount of light energy produced more than, less than, or the same as the amount of electrical energy used?

The amount of light energy produced is

____ more than

____ less than (check one)

____ the same as

the amount of electrical energy used.

Give a reason to support your answer.

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D-4

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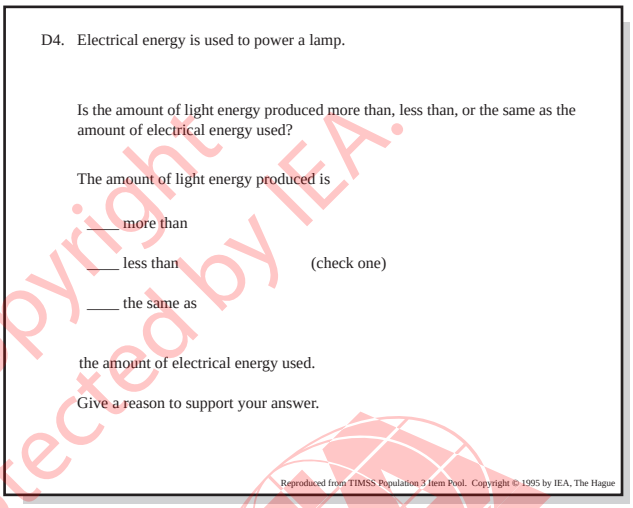
Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	21%	727

D-4 Coding Guide



D4. Electrical energy is used to power a lamp.

Is the amount of light energy produced more than, less than, or the same as the amount of electrical energy used?

The amount of light energy produced is

____ more than

____ less than (check one)

____ the same as

the amount of electrical energy used.

Give a reason to support your answer.

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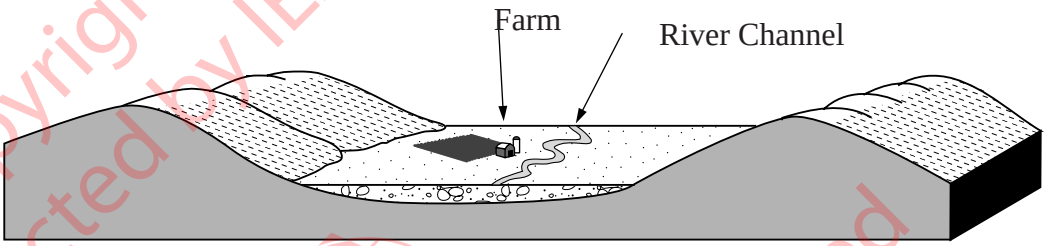
Code	Response
	Correct Response
20	Less. Mentions that (much) energy is transformed to heat.
21	Less. Mentions that energy is needed to warm up the lamp.
22	Less. Mentions that energy (heat) is lost to the surroundings.
29	Less. Other correct.
	Partial Response
10	Less. No explanation.
11	Less. Energy is lost in transport. *Example: Electricity is lost in the wire*
19	Other partially correct: Less. Other erroneous explanations.
	Incorrect Response
70	The same. With erroneous explanation. *Examples: Energy is always preserved.* *When the sun is out you don't need electrical energy.*
71	The same. No explanation is given.
72	More. With or without explanation.
79	Other incorrect.
	Nonresponse
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

D5. The diagram shows a river flowing through a wide plain. The plain is covered with several layers of soil and sediment.



a. Write down one reason why this plain is a good place for farming.

b. Write down one reason why this plain is NOT a good place for farming.

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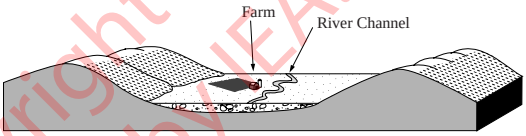
D-5a

Part a

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	72%	440

D5. The diagram shows a river flowing through a wide plain. The plain is covered with several layers of soil and sediment.



a. Write down one reason why this plain is a good place for farming.

b. Write down one reason why this plain is NOT a good place for farming.

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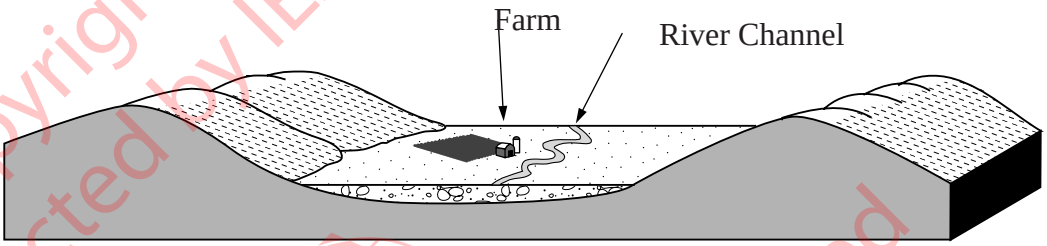
A: Codes Good Place

Code	Response
	Correct Response
10	Mentions that the soil is fertile (good), abundant.
11	Mentions that there is a river (for irrigation, water for animals).
12	Mentions that there is plenty of space or flat areas for farm land.
19	Other correct: *Example: The goats can find grass in the mountains.*
	Incorrect Response
70	Does not address the issue of farming. *Examples: It is silent, a peaceful place to live.* *You can swim in the river.*
76	Merely repeats information in stem.
79	Other incorrect.
	Nonresponse
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

D5. The diagram shows a river flowing through a wide plain. The plain is covered with several layers of soil and sediment.



a. Write down one reason why this plain is a good place for farming.

b. Write down one reason why this plain is NOT a good place for farming.

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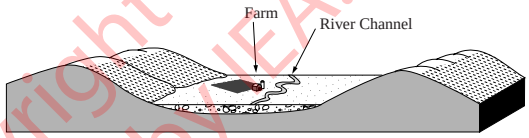
D-5b

Part b

Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly	International Difficulty Index
Science Literacy	next page	Science Literacy	Theorizing, Analyzing, and Solving Problems	51%	558

D5. The diagram shows a river flowing through a wide plain. The plain is covered with several layers of soil and sediment.



a. Write down one reason why this plain is a good place for farming.

b. Write down one reason why this plain is NOT a good place for farming.

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B: Codes Not a Good Place

Code	Response
	Correct Response
10	Mentions the possibility of flooding, or that the soil will be too wet.
11	Mentions the possibility of wind or water erosion.
19	Other correct: *Examples They might not get a lot of sunlight.* *The farmer would have to climb the hills to sell or trade his meat, vegetables, or fruit.* *It might be in the rain shadow of one of the mountains or hills.*
	Incorrect Response
70	Mentions that it is an undesirable place to live: boring/lonesome/ugly... *Example: Too far from the city.*
71	Does not address the issue of farming. *Example: The river is dangerous [for children].*
72	Refers to problems due to surrounding mountains. *Examples: Avalanches (snow or rocks) from the mountains.* *Goats get lost in the mountains.*
73	Refers to sediment, soil, being rocky and negative.
76	Merely repeats information in stem.
79	Other incorrect.
	Nonresponse
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

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