ANSWERS

FARMS SCORING 1.1

Full credit: 144 (unit already given)

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 492 score points on the PISA mathematics scale. Across OECD countries, 61% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

3

FARMS SCORING 1.2

Full credit: 6 (unit already given)

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 524 score points on the PISA mathematics scale. Across OECD countries, 55% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

WALKING SCORING 2.1

Full credit:

0.5 m or 50 cm, $\frac{1}{2}$ (unit not required)

$$70/p = 140$$

$$70 = 140 p \qquad 70/140$$

$$p = 0.5$$

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 611 score points on the PISA mathematics scale. Across OECD countries, 34% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

WALKING SCORING 2.2

Full credit: Correct answers (unit not required) for both metres/minute and km/hour:

- $n = 140 \times .80 = 112$.
- Per minute he walks $112 \times .80$ metres $= 89.6$ metres.
- His speed is 89.6 metres per minute.
- So his speed is 5.38 or 5.4 km/hr.

- As long as both correct answers are given (89.6 and 5.4), whether working out is shown or not. Note that errors due to rounding are acceptable. For example, 90 metres per minute and 5.3 km/hr (89 X 60) are acceptable.

  - 89.6, 5.4.
  - 90, 5.376 km/h.
  - 89.8, 5376 m/hour.

Partial credit (2-point):

- Fails to multiply by 0.80 to convert from steps per minute to metres per minute. For example, his speed is 112 metres per minute and 6.72 km/hr.

  - 112, 6.72 km/h.

- The speed in metres per minute correct (89.6 metres per minute) but conversion to kilometres per hour incorrect or missing.

  - 89.6 metres/minute, 8960 km/hr.
  - 89.6, 5376.
  - 89.6, 53.76.
  - 89.6, 0.087 km/h.
  - 89.6, 1.49 km/h.

- Correct method (explicitly shown) with minor calculation error(s). No answers correct.

  - n=140 x .8 = 1120; 1120 x 0.8 = 896. He walks 896 m/min, 53.76km/h.
  - n=140 x .8 = 116; 116 x 0.8 =92.8. 92.8 m/min -> 5.57km/h.

- Only 5.4 km/hr is given, but not 89.6 metres/minute (intermediate calculations not shown).

  - 5.4.
  - 5.376 km/h.
  - 5376 m/h.

Partial credit (1-point):

- $n = 140$ x .80 = 112. No further working out is shown or incorrect working out from this point.

  - 112.
  - n=112, 0.112 km/h.
  - n=112, 1120 km/h.
  - 112 m/min, 504 km/h.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 708 score points on the PISA mathematics scale. The difficulty of the higher partial credit response corresponds to a difficulty of 659 score points on the mathematics scale. The difficulty of the lower partial credit response corresponds to a difficulty of 600 score points on the mathematics scale. Across OECD countries, 19% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

APPLES SCORING 3.1

Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	16
3	9	24
4	16	32
5	25	40

Full credit: All 7 entries correct.

No credit: Two or more errors.

- Correct entries for n=2,3,4, but BOTH cells for n=5 incorrect.

    - Both '25' and '40' are incorrect; everything else is correct.

- Other responses.

- Missing.

> Answering this question correctly corresponds to a difficulty of 548 score points on the PISA mathematics scale. Across OECD countries, 49% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

APPLES SCORING 3.2

Full credit: Responses with the correct answer, n=8, such as:

- $n^2 = 8n$, $n^2 - 8n = 0$, $n(n - 8)=0$, $n = 0$ & $n = 8$, so $n =8$.
- $n^2 = 8^2 = 64$, $8n = 8 \cdot 8 = 64$.
- $n^2 = 8n$. This gives $n=8$.
- $8 \times 8 = 64$, $n=8$
- $n = 8$.
- $8 \times 8 = 8^2$.

- Responses including both the answers n=8 AND n=0.

No credit:

- Other responses, including just the response n=0.

    - $n^2 = 8n$ (a repeat of the statement from the question).
    - $n^2 = 8$.
    - n=0. You can't have the same number, because for every apple tree, there are 8 conifer trees.

- Missing.

3

> Answering this question correctly corresponds to a difficulty of 655 score points on the PISA mathematics scale. Across OECD countries, 25% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

APPLES SCORING 3.3

Full credit: Correct response (apple trees) accompanied by a valid explanation. For example:

- Apple trees = n X n and conifer trees = 8 X n both formulas have a factor n, but apple trees have another n which will get larger where the factor 8 stays the same. The number of apple trees increases more quickly.
- The number of apple trees increases faster because that number is being squared instead of multiplied by 8.
- Number of apple trees is quadratic. Number of conifer trees is linear. So apple trees will increase faster.
- Response uses graph to demonstrate that n^2 exceeds $8n$ after n=8.

Partial credit: Correct response (apple trees) based on specific examples or based on extending the table.

- The number of apple trees will increase more quickly because, if we use the table (previous page), we find that the no. of apple trees increases faster than the no. of conifer trees. This happens especially after the no. of apple trees and the number of conifer trees are equivalent.
- The table shows that the number of apple trees increases faster.

OR

Correct response (apple trees) with SOME evidence that the relationship between n^2 and $8n$ is understood, but not very clearly expressed.

- Apple trees after n > 8.
- After 8 rows, the number of apple trees will increase more quickly than conifer trees.
- Conifer trees until you get to 8 rows, then there will be more apple trees.

No credit:

- Correct response (apple trees) with no, insufficient or wrong explanation.

    - Apple trees.

- Apple trees because they are populating the inside which is bigger than just the perimeter.
- Apples trees because they are surrounded by conifer trees.

- Other responses.

- Conifer trees.
- Conifer trees because for every additional row of apple trees, you need lots of conifer trees.
- Conifer trees. Because for every apple tree there are 8 conifer trees.
- I don't know.

- Missing.

3

Answering this question correctly corresponds to a difficulty of 723 score points on the PISA mathematics scale. Giving a partially correct answer corresponds to a difficulty of 672 score points on the mathematics scale. Across OECD countries, 13% of students answered correctly. To answer the question correctly students have to draw on skills from the reflection competency cluster.


CUBES SCORING 4.1

Full credit: Top row (1 5 4) Bottom Row (2 6 5). Equivalent answer shown as dice faces is also acceptable.

1	5	4
2	6	5

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 516 score points on the PISA mathematics scale. Across OECD countries, 58% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

157

3
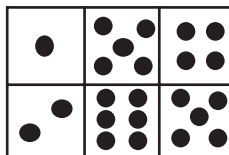
CONTINENT AREA SCORING 5.1

Full credit: Responses using the correct method AND getting the correct answer.

- Estimated by drawing a square or rectangle - between 12 000 000 sq kms and 18 000 000 sq kms (units not required).

- Estimated by drawing a circle - between 12 000 000 sq kms and 18 000 000 sq kms.

- Estimated by adding areas of several regular geometric figures - between 12 000 000 and 18 000 000 sq kms.

- Estimated by other correct method – between 12 000 000 sq kms and 18 000 000 sq kms.

- Correct answer (between 12 000 000 sq kms and 18 000 000 sq kms) but no working out is shown.

Partial credit: Responses using the correct method BUT getting incorrect or incomplete answer.

- Estimated by drawing a square or rectangle – correct method but incorrect answer or incomplete answer.
    - Draws a rectangle and multiplies width by length, but the answer is an over estimation or an under estimation (e.g., 18 200 000).
    - Draws a rectangle and multiplies width by length, but the number of zeros are incorrect (e.g., 4000 X 3500 = 140 000).
    - Draws a rectangle and multiplies width by length, but forgets to use the scale to convert to square kilometres (e.g., 12cm X 15cm = 180).
    - Draws a rectangle and states the area is 4000km x 3500km. No further working out.

- Estimated by drawing a circle – correct method but incorrect answer or incomplete answer.

- Estimated by adding areas of several regular geometric figures – correct method but incorrect answer or incomplete answer.

- Estimated by other correct method – but incorrect answer or incomplete answer.

No credit:

- Calculated the perimeter instead of area.
    - E.g., 16 000 km as the scale of 1000km would go around the map 16 times.

- Other responses.
    - E.g., 16 000 km (no working out is shown, and the answer is incorrect).

- Missing.

Answering this question correctly corresponds to a difficulty of 712 score points on the PISA mathematics scale. Giving a partially correct answer corresponds to a difficulty of 629 score points on the mathematics scale. Across OECD countries, 19% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

GROWING UP SCORING 6.1

Full credit: 168.3 cm (unit already given).

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 506 score points on the PISA mathematics scale. Across OECD countries, 61% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

GROWING UP SCORING 6.2

Full credit: The key here is that the response should refer to the "change" of the gradient of the graph for female. This can be done explicitly or implicitly.

- Refers to the reduced steepness of the curve from 12 years onwards, using daily-life language, not mathematical language.

  - It does no longer go straight up, it straightens out.
  - The curve levels off.
  - It is more flat after 12.
  - The line of the girls starts to even out and the boys line just gets bigger.
  - It straightens out and the boys graph keeps rising.

- Refers to the reduced steepness of the curve from 12 years onwards, using mathematical language.

  - You can see the gradient is less.
  - The rate of change of the graph decreases from 12 years on.
  - *[The student computed the angles of the curve with respect to the x-axis before and after 12 years.]*

  In general, if words like "gradient", "slope", or "rate of change" are used, regard it as using mathematical language.

- Comparing actual growth (comparison can be implicit).

  - From 10 to 12 the growth is about 15 cm, but from 12 to 20 the growth is only about 17 cm.
  - The average growth rate from 10 to 12 is about 7.5 cm per year, but about 2 cm per year from 12 to 20 years.

No credit:

- Student indicates that female height drops below male height, but does NOT mention the steepness of the female graph or a comparison of the female growth rate before and after 12 years.

  - The female line drops below the male line.

  If the student mentions that the female graph becomes less steep, AS WELL AS the fact that the graph falls below the male graph, then full credit should be given. We are not

159

3

looking for a comparison between male and female graphs here, so ignore any reference on such a comparison, and make a judgement based on the rest of the response.

- Other incorrect responses. For example, the response does not refer to the characteristics of the graph, as the question clearly asks about how the GRAPH shows …

    - Girls mature early.
    - Because females go through puberty before males do and they get their growth spurt earlier.
    - Girls don't grow much after 12. *[Gives a statement that girls' growth slows down after 12 years of age, and no reference to the graph is mentioned.]*

- Missing.

Answering this question correctly corresponds to a difficulty of 559 score points on the PISA mathematics scale. Across OECD countries, 46% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

GROWING UP SCORING 6.3

Full credit:

- Gives the correct interval, from 11-13 years.

    - Between age 11 and 13.
    - From 11 years old to 13 years old, girls are taller than boys on average.
    - 11-13.

- States that girls are taller than boys when they are 11 and 12 years old. (This answer is correct in daily-life language, because it means the interval from 11 to 13).

    - Girls are taller than boys when they are 11 and 12 years old.
    - 11 and 12 years old.

Partial credit: Other subsets of (11, 12, 13), not included in the full credit section.

    - 12 to 13.
    - 12.
    - 13.
    - 11.
    - 11.2 to 12 .8.

No credit:

- Other responses.

      ▪ 1998.
      ▪ Girls are taller than boys when they're older than 13 years.
      ▪ Girls are taller than boys from 10 to 11.

- Missing.

> Answering this question correctly corresponds to a difficulty of 529 score points on the PISA mathematics scale. Giving a partially correct answer corresponds to a difficulty of 415 score points on the mathematics scale. Across OECD countries, 69% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

3

SPEED OF RACING CAR SCORING 7.1

Full credit: B. 1.5 km

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 492 score points on the PISA mathematics scale. Across OECD countries, 67% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

SPEED OF RACING CAR SCORING 7.2

Full credit: C. at about 1.3 km.
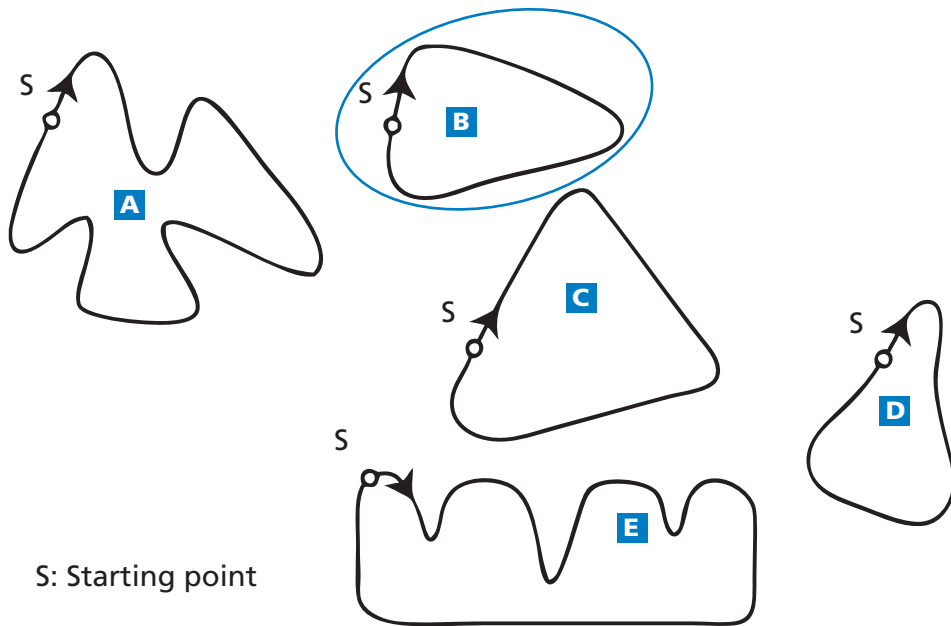
No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 403 score points on the PISA mathematics scale. Across OECD countries, 83% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

SPEED OF RACING CAR SCORING 7.3

Full credit: B. The speed of the car is increasing.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 413 score points on the PISA mathematics scale. Across OECD countries, 83% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

S: Starting point

SPEED OF RACING CAR SCORING 7.4

Full credit: B

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 655 score points on the PISA mathematics scale. Across OECD countries, 28% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

TRIANGLES SCORING 8.1

Full credit: Answer D.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 537 score points on the PISA mathematics scale. Across OECD countries, 58% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

ROBBERIES SCORING 9.1

Full credit:

- No, not reasonable. Focuses on the fact that only a **small part** of the graph is shown.

    - 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.

- No, because he has used the top bit of the graph and if you looked at the whole graph from 0 – 520, it wouldn't have risen so much.
- No, because the graph makes it look like there's been a big increase but you look at the numbers and there's not much of an increase.

- No, not reasonable. Contains correct arguments in terms of ratio or percentage increase.

- No, not reasonable. 10 is not a huge increase compared to a total of 500.
- No, not reasonable. According to the percentage, the increase is only about 2%.
- No. 8 more robberies is 1.5% increase. Not much in my opinion!
- No, only 8 or 9 more for this year. Compared to 507, it is not a large number.

- Trend data is required before a judgement can be made.

- We can't tell whether the increase is huge or not. If in 1997, the number of robberies is the same as in 1998, then we could say there is a huge increase in 1999.
- There is no way of knowing what "huge" is because you need at least two changes to think one huge and one small.

Partial credit:

Note: As the scale on the graph is not that clear, accept between 5 and 15 for the increase of the exact number of robberies.

- No, not reasonable, but explanation lacks detail.

- Focuses ONLY on an increase given by the exact number of robberies, but does not compare with the total.
- Not reasonable. It increased by about 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".
- From 508 to 515 is not a large increase.
- No, because 8 or 9 is not a large amount.
- Sort of. From 507 to 515 is an increase, but not huge.

- No, not reasonable, with correct method but with minor computational errors.

- Correct method and conclusion but the percentage calculated is 0.03%.

No credit:

- No, with no, insufficient or incorrect explanation.

- No, I don't agree.
- The reporter should not have used the word "huge".
- No, it's not reasonable. Reporters always like to exaggerate.

- Yes, focuses on the appearance of the graph and mentions that the number of robberies doubled.

    ▪ Yes, the graph doubles its height.
    ▪ Yes, the number of robberies has almost doubled.

- Yes, with no explanation or other explanations than above.

- Other responses.

- Missing.

3

Answering this question correctly corresponds to a difficulty of 710 score points on the PISA mathematics scale. Giving a partially correctly answer corresponds to a difficulty of 609 score points on the mathematics scale. Across OECD countries, 26% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

CARPENTER SCORING 10.1

Full credit: All four correct: Yes, No, Yes, Yes in that order.

No credit: Two or fewer correct and missing.

Answering this question correctly corresponds to a difficulty of 700 score points on the PISA mathematics scale. Across OECD countries, 20% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

INTERNET RELAY CHAT SCORING 11.1

Full credit: 10 AM or 10:00.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 533 score points on the PISA mathematics scale. Across OECD countries, 54% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

INTERNET RELAY CHAT SCORING 11.2

Full credit: Any time or interval of time satisfying the 9 hours time difference and taken from one of these intervals:

Sydney: 4:30 PM – 6:00 PM; Berlin: 7:30 AM – 9:00 AM

OR

Sydney: 7:00 AM – 8:00 AM; Berlin: 10:00 PM – 11:00 PM

    ▪ Sydney 17:00, Berlin 8:00.

Note: If an interval is given, the entire interval must satisfy the constraints. Also, if morning (AM) or evening (PM) is not specified, but the times could otherwise be regarded as correct, the response should be given the benefit of the doubt, and counted as correct.

No credit:

- Other responses, including one time correct, but corresponding time incorrect.

   ▪ Sydney 8 am, Berlin 10 pm.

- Missing.

Answering this question correctly corresponds to a difficulty of 636 score points on the PISA mathematics scale. Across OECD countries, 29% of students answered correctly. To answer the question correctly students have to draw on skills from the reflection competency cluster.

3

EXCHANGE RATE SCORING 12.1

Full credit: 12 600 ZAR (unit not required).

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 406 score points on the PISA mathematics scale. Across OECD countries, 80% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

EXCHANGE RATE SCORING 12.2

Full credit: 975 SGD (unit not required).

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 439 score points on the PISA mathematics scale. Across OECD countries, 74% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

EXCHANGE RATE SCORING 12.3

Full credit: 'Yes', with adequate explanation.

   ▪ Yes, by the lower exchange rate (for 1 SGD) Mei-Ling will get more Singapore dollars for her South African rand.
   ▪ Yes, 4.2 ZAR for one dollar would have resulted in 929 ZAR. *[Note: student wrote ZAR instead of SGD, but clearly the correct calculation and comparison have been carried out and this error can be ignored]*
   ▪ Yes, because she received 4.2 ZAR for 1 SGD, and now she has to pay only 4.0 ZAR to get 1 SGD.
   ▪ Yes, because it is 0.2 ZAR cheaper for every SGD.

165

3

- Yes, because when you divide by 4.2 the outcome is smaller than when you divide by 4.
- Yes, it was in her favour because if it didn't go down she would have got about $50 less.

No credit:

- 'Yes', with no explanation or with inadequate explanation.

    - Yes, a lower exchange rate is better.
    - Yes it was in Mei-Ling's favour, because if the ZAR goes down, then she will have more money to exchange into SGD.
    - Yes it was in Mei-Ling's favour.

- Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 586 score points on the PISA mathematics scale. Across OECD countries, 40% of students answered correctly. To answer the question correctly students have to draw on skills from the reflection competency cluster.

EXPORTS SCORING 13.1

Full credit: 27.1 million zeds or 27 100 000 zeds or 27.1 (unit not required).

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 427 score points on the PISA mathematics scale. Across OECD countries, 79% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

EXPORTS SCORING 13.2

Full credit: E. 3.8 million zeds.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 565 score points on the PISA mathematics scale. Across OECD countries, 48% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

COLOURED CANDIES SCORING 14.1

Full credit: B. 20%.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 549 score points on the PISA mathematics scale. Across OECD countries, 50% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

166

3

SCIENCE TESTS SCORING 15.1

Full credit: 64.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 556 score points on the PISA mathematics scale. Across OECD countries, 47% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

BOOKSHELVES SCORING 16.1

Full credit: 5.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 499 score points on the PISA mathematics scale. Across OECD countries, 61% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

LITTER SCORING 17.1

Full credit: Reason focuses on big variance in data.

- The difference in the lengths of the bars of the bar graph would be too big.
- If you make a bar with length 10 centimetres for polystyrene, the one for cardboard boxes would be 0.05 centimetres.

OR
Reason focuses on the variability of the data for some categories.

- The length of the bar for "polystyrene cups" is undetermined.
- You cannot make one bar for 1–3 years or one bar for 20–25 years.

No credit:

- Other responses.

  - Because it will not work.
  - A pictogram is better.
  - You cannot verify the info.
  - Because the numbers in the table are only approximations.

- Missing.

Answering this question correctly corresponds to a difficulty of 551 score points on the PISA mathematics scale. Across OECD countries, 52% of students answered correctly. To answer the question correctly students have to draw on skills from the reflection competency cluster.

167

EARTHQUAKE SCORING 18.1

Full credit: C. The likelihood that there will be an earthquake in Zed City at some time during the next 20 years is higher than the likelihood of no earthquake.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 557 score points on the PISA mathematics scale. Across OECD countries, 46% of students answered correctly. To answer the question correctly students have to draw on skills from the reflection competency cluster.

3

CHOICES SCORING 19.1

Full credit: 6.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 559 score points on the PISA mathematics scale. Across OECD countries, 49% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

TEST SCORES SCORING 20.1

Full credit: One valid argument is given. Valid arguments could relate to the number of students passing, the disproportionate influence of the outlier, or the number of students with scores in the highest level.

- More students in Group A than in Group B passed the test.
- If you ignore the weakest Group A student, the students in Group A do better than those in Group B.
- More Group A students than Group B students scored 80 or over.

No credit:

- Other responses, including responses with no mathematical reasons, or wrong mathematical reasons, or responses that simply describe differences but are not valid arguments that Group B may not have done better.

- Group A students are normally better than Group B students in science. This test result is just a coincidence.
- Because the difference between the highest and lowest scores is smaller for Group B than for Group A.
- Group A has better score results in the 80-89 range and the 50-59 range.
- Group A has a larger inter-quartile range than Group B.

- Missing.

> Answering this question correctly corresponds to a difficulty of 620 score points on the PISA mathematics scale. Across OECD countries, 32% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

3

SKATEBOARD SCORING 21.1

Full credit: Both the minimum (80) and the maximum (137) correct.

Partial credit: Only the minimum (80) correct or only the maximum (137) correct.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 496 score points on the PISA mathematics scale. Giving a partially correct answer corresponds to a difficulty of 464 score points on the mathematics scale. Across OECD countries, 72% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

SKATEBOARD SCORING 21.2

Full credit: D. 12.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 570 score points on the PISA mathematics scale. Across OECD countries, 46% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

SKATEBOARD SCORING 21.3

Full credit: 65 zeds on a deck, 14 on wheels, 16 on trucks and 20 on hardware.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 554 score points on the PISA mathematics scale. Across OECD countries, 50% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

STAIRCASE SCORING 22.1

Full credit: 18.

No credit: Other responses and missing.

> Answering this question correctly corresponds to a difficulty of 421 score points on the PISA mathematics scale. Across OECD countries, 78% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

NUMBER CUBES SCORING 23.1

Full credit: No, Yes, Yes, No, in that order.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 503 score points on the PISA mathematics scale. Across OECD countries, 63% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

3

SUPPORT FOR THE PRESIDENT SCORING 24.1

Full credit: Newspaper 3. The poll is more recent, with larger sample size, a random selection of the sample, and only voters were asked. (Give at least two reasons). Additional information (including irrelevant or incorrect information) should be ignored.

- Newspaper 3, because they have selected more citizens randomly with voting rights.
- Newspaper 3 because it has asked 1000 people, randomly selected, and the date is closer to the election date so the voters have less time to change their mind.
- Newspaper 3 because they were randomly selected and they had voting rights.
- Newspaper 3 because it surveyed more people closer to the date.
- Newspaper 3 because the 1000 people were randomly selected.

No credit:

- Other responses.

- Newspaper 4. More people means more accurate results, and people phoning in will have considered their vote better.

- Missing.

Answering this question correctly corresponds to a difficulty of 615 score points on the PISA mathematics scale. Across OECD countries, 36% of students answered correctly. To answer the question correctly students have to draw on skills from the connections competency cluster.

THE BEST CAR SCORING 25.1

Full credit: 15 points.

No credit: Other responses and missing.

Answering this question correctly corresponds to a difficulty of 447 score points on the PISA mathematics scale. Across OECD countries, 73% of students answered correctly. To answer the question correctly students have to draw on skills from the reproduction competency cluster.

THE BEST CAR SCORING 25.2

Full credit: Correct rule that will make "Ca" the winner.

No credit: Other responses and missing.

STEP PATTERN SCORING 26.1

Full credit: 10.

No credit: Other responses and missing.

LICHEN SCORING 27.1

Full credit: 14mm (units not required). Full credit should be given as long as the correct answer is 14 whether working out is shown or not.

$$d = 7.0 \times \sqrt{16-12}$$
$$d = 14$$

14mm   14

$$d = 7.0 \times \sqrt{16-12}$$
$$d = 7.0 \times \sqrt{4}$$
$$d = 14 \; years$$

(Note that here the calculations are all correct, but the unit is wrong. We will assume for now that it is the slip of the pen)

Partial credit: Partial responses including:

- Correct substitution of value in the formula but incorrect answer Or missing answer.
- Incomplete answers (eg, $7\sqrt{4}$).

$$d = 7.0 \times \sqrt{16-12}$$ (wrong answer but correct substitution)
$$d = 16$$
$$d = 7.0 \times \sqrt{16-12}$$ (incomplete answer)
$$d = 7\sqrt{4}$$

No credit: Other responses and missing.

LICHEN SCORING 27.2

Full credit: 37 years (unit not required) whether working out is shown or not.

$35 = 7 \times \sqrt{t-12}$

$5 = \sqrt{t-12}$

$25 = t-12$

$t = 37$

$35 \div 7 = 5$

$7 \times 5 = 7 \times \sqrt{25}$

$= 7 \times \sqrt{25+12}$

$= 7 \times 37$

$\therefore 37 \ years$

$35/7 = 5$

$5^2 = 25$ (Strictly incorrect algebraic representation, but we know what the student is trying to do)

$25+12 = 37$

t = 15 d = 12.1

t = 25 d = 25.2   (Note that here the answer 37 is embedded in an equation that is correct)

t = 40 d = 37.0

t = 35 d = 33.6

t = 37 d = 35

So 37 years after the ice disappeared

$756 = 35 = 7 X \sqrt{(37-12)} = 7 X \sqrt{25} = 7 X 5 = 35$

Partial credit: Correct substitution of values in the formula but incorrect answer or missing answer.
OR
36 years or 38 years. (Students may arrive at these answers using the trial and error method)

$35 = 7.0 \times \sqrt{t-12}$

$35^2 = 7^2 \times t - 12$

$49t = 1237$

$t = 25$

$35 = 7.0 \times \sqrt{t-12}$

$5 = \sqrt{t-12}$

$25 = t^2 - 12^2$

$t = 13$

$35 = 7.0 \times \sqrt{t-12}$

$5 = \sqrt{t-12}$

$5 = \sqrt{t} - \sqrt{12}$

Too hard!

No credit: Other responses and missing.

$35 = 7.0 \times \sqrt{t-12}$

$28 = \sqrt{t-12}$

$784 = t-12$

$t = 796$

40 years

To answer the question correctly students have to draw on skills from the connections competency cluster.

COINS SCORING 28.1

Full credit: 15 – 20 – 26 – 34 – 45. It is possible that the response could be presented as actual drawings of the coins of the correct diameters. This should be coded as 1 as well.

Partial credit: Gives a set of coins that satisfy the three criteria, but not the set that contains as many coins as possible, eg., 15 – 21 – 29 – 39, or 15 – 30 – 45
OR
The first three diameters correct, the last two incorrect (15 – 20 – 26 -)
OR
The first four diameters correct, the last one incorrect (15 – 20 – 26 – 34 -)

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

3

PIZZAS SCORING 29.1

Full credit: Gives general reasoning that the surface area of pizza increases more rapidly than the price of pizza to conclude that the larger pizza is better value.

- The diameter of the pizzas is the same number as their price, but the amount of pizza you get is found using diameter^2 , so you will get more pizza per zeds from the larger one

Partial credit: Calculates the area and amount per zed for each pizza to conclude that the larger pizza is better value.

- Area of smaller pizza is $0.25 \times \pi \times 30 \times 30 = 225\pi$; amount per zed is 23.6 cm^2 area of larger pizza is $0.25 \times \pi \times 40 \times 40 = 400\pi$; amount per zed is 31.4 cm^2 so larger pizza is better value

No credit:

- They are the same value for money.

- Other incorrect responses
  OR
- A correct answer without correct reasoning.

- Missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

SHAPES SCORING 30.1

Full credit: Shape B, supported with plausible reasoning.

- It's the largest area because the others will fit inside it.
- B. It doesn't have indents in it which decreases the area. A and C have gaps.
- B, because it's a full circle, and the others are like circles with bits taken out.
- B, because it has no open areas:

3

No credit: Shape B, without plausible support.

- B. because it has the largest surface area
- The circle. It's pretty obvious.
- B, because it is bigger.

Other responses and missing.

> To answer the question correctly students have to draw on skills from the reproduction competency cluster.
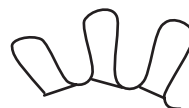
SHAPES SCORING 30.2

Full credit: Reasonable method:

- Draw a grid of squares over the shape and count the squares that are more than half filled by the shape.
- Cut the arms off the shape and rearrange the pieces so that they fill a square then measure the side of the square.
- Build a 3D model based on the shape and fill it with water. Measure the amount of water used and the depth of the water in the model. Derive the area from the information.
- You could fill the shape with lots of circles, squares and other basic shapes so there is not a gap. Work out the area of all of the shapes and add together.
- Redraw the shape onto graph paper and count all of the squares it takes up.
- Drawing and counting equal size boxes. Smaller boxes = better accuracy *(Here the student's description is brief, but we will be lenient about student's writing skills and regard the method offered by the student as correct)*
- Make it into a 3D model and filling it with exactly 1cm of water and then measure the volume of water required to fill it up.

Partial credit:

- The student suggests to find the area of the circle and subtract the area of the cut out pieces. However, the student does not mention about how to find out the area of the cut out pieces.

174

- Add up the area of each individual arm of the shape
- Find the area of B then find the areas of the cut out pieces and subtract them from the main area.
- Minus the shape from the circle
- Add up the area of each individual piece e.g.,
- Use a shape like that and pour a liquid into it.
- Use graph
- Half of the area of shape B
- Figure out how many mm^2 are in one little leg things and times it by 8.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

3

SHAPES SCORING 30.3

Full credit: Reasonable method:

- Lay a piece of string over the outline of the shape then measure the length of string used.
- Cut the shape up into short, nearly straight pieces and join them together in a line, then measure the length of the line.
- Measure the length of some of the arms to find an average arm length then multiply by 8 (number of arms) X 2.
- Wool or string!!!
  (Here although the answer is brief, the student did offer a METHOD for measuring the perimeter)
- Cut the side of the shape into sections. Measure each then add them together. (Here the student did not explicitly say that each section needs to be approximately straight, but we will give the benefit of the doubt, that is, by offering the METHOD of cutting the shape into pieces, each piece is assumed to be easily measurable)

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

BRAKING SCORING 31.1

Full credit: 22.9 metres (units not required)

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

175

BRAKING SCORING 31.2

Full credit: 101 metres (units not required)

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

BRAKING SCORING 31.3

Full credit: 5.84 seconds (units not required)

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

BRAKING SCORING 31.4

Full credit: 78.1 metres (units not required)

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

BRAKING SCORING 31.5

Full credit: 90 kmph (units not necessary)

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

PATIO SCORING 32.1

Full credit: 1275, 1276 or 1275.75 (unit not required).

- 5.25 X 3 = 15.75 X 81 = 1276

Partial credit:
15.75 (units not required)
OR
1215 bricks for 5m X 3m
(This score is used for students who are able to calculate the number of bricks for an integer number of square metres, but not for fractions of square metres. See example response.)
OR
Error in calculating the area, but multiplied by 81 correctly
OR
Rounded off the area and then multiplied by 81 correctly

- 5.25 X 3 = 15.75
- 15.75 X 81 = 9000
- 81 X 15 = 1215; 1215 + 21 = 1236
- 5.25 X 3.0 = 15.75 m2; so 15.75 X 1275.75 = 1376 bricks.
  (Here the student got the first part right, but the second part wrong. Give credit for the first part and ignore the second part. So score as 1)

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

DRUG CONCENTRATIONS SCORING 33.1

Full credit: All three table entries correct.

Time	0800	0900	1000	1100
Penicillin (mg)	300	180	108	64.8 or 65

Partial credit: One or two table entries correct.

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

DRUG CONCENTRATIONS SCORING 33.2

Full credit: D. 32mg.

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the reproduction competency cluster.

DRUG CONCENTRATIONS SCORING 33.3

Full credit: C. 40%.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

BUILDING BLOCKS SCORING 34.1

Full credit: 12 cubes.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reproduction competency cluster.

BUILDING BLOCKS SCORING 34.2

Full credit: 27 cubes.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reproduction competency cluster.

BUILDING BLOCKS SCORING 34.3

Full credit: 26 cubes.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

BUILDING BLOCKS SCORING 34.4

Full credit: 96 cubes.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reflection competency cluster.

REACTION TIME SCORING 35.1

Full credit:

Medal	Lane	Reaction time (secs)	Final time (secs)
GOLD	3	0.197	9.87
SILVER	2	0.136	9.99
BRONZE	6	0.216	10.04

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reproduction competency cluster.

3

REACTION TIME SCORING 35.2

Full credit: Yes, with adequate explanation.

- Yes. If he had a reaction time of 0.05 sec faster, he would have equalled second place.
- Yes, he would have a chance to win the Silver medal if his reaction time was less than or equal to 0.166 sec.
- Yes, with the fastest possible reaction time he would have done a 9.93 which is good enough for silver medal.

No credit: Other responses (including yes without adequate explanation) and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

WATER TANK SCORING 36.1

Full credit: B.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

SPRING FAIR SCORING 37.1

Full credit: B. Not very likely.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

3

SWING SCORING 38.1

Full credit: A.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

STUDENT HEIGHTS SCORING 39.1

Full credit: 'No' for all conclusions.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reflection competency cluster.

PAYMENTS BY AREA SCORING 40.1

Full credit: Incorrect, Correct, Incorrect, Correct, in that order.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

PAYMENTS BY AREA SCORING 40.2

Full credit: 102,000 zeds, with or without the calculation shown, and unit not required.

- Apartment 2: 102 000 zeds.
- $Apt-2 : \dfrac{85}{250} \times 300000 = 102000 zeds$.
- $\dfrac{300000}{250} = 1200$ zeds for each square metre, so Apartment 2 is 102 000.

Partial credit: Correct method, but minor computational error/s.

- $Apt-2 : \dfrac{85}{250} \times 300000 = 10200 \, zeds$.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

SHOES FOR KIDS SCORING 41.1

Full credit: 26.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reproduction competency cluster.

TABLE TENNIS TOURNAMENT SCORING 42.1

Full credit: Four remaining matches correctly described and distributed over rounds 2 and 3.

- E.g.

	Practice Table 1	Practice Table 2
Round 1	Teun – Riek	Bep – Dirk
Round 2	Teun – Bep	Riek – Dirk
Round 3	Teun – Dirk	Riek – Bep

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reproduction competency cluster.

LIGHTHOUSE SCORING 43.1

Full credit: C. 5 seconds.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

LIGHTHOUSE SCORING 43.2

Full credit: D. 24.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

LIGHTHOUSE SCORING 43.3

Full credit: The graph shows a pattern of light and dark with flashes for 3 seconds in every 6 seconds, and with a period of 6 seconds. This can be done in the following ways:

- 1 one-second flash and a two-second flash (and this can be shown in several ways), OR
- 1 three-second flash (which can be shown in four different ways).
- If two periods are shown, the pattern must be identical for each period.

Partial credit: The graph shows a pattern of light and dark with flashes for 3 seconds in every 6 seconds, but the period is not 6 seconds. If two periods are shown, the pattern must be identical for each period.

- Three one-second flashes, alternating with 3 one-second dark periods.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reflection competency cluster.

DECREASING CO_2 LEVELS SCORING 44.1

Full credit: Correct subtraction, and correct calculation of percentage.

- $6727 - 6049 = 678$, $\dfrac{678}{6049} \times 100\% \approx 11\%$.

Partial credit: Subtraction error and percentage calculation correct, or subtraction correct but dividing by 6727.

- $\dfrac{6049}{6727} \times 100 = 89.9\%$, and $100 - 89.9 = 10.1\%$.

No credit: Other responses, including just 'Yes' or 'No', and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

DECREASING CO_2 LEVELS SCORING 44.2

Full credit: No, with correct argumentation.

- No, other countries from the EU can have increases e.g. the Netherlands so the total decrease in the EU can be smaller than the decrease in Germany.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

DECREASING CO$_2$ LEVELS SCORING 44.3

Full credit: Response identifies both mathematical approaches (the largest absolute increase and the largest relative increase), and names the USA and Australia.

- USA has the largest increase in millions of tons, and Australia has the largest increase in percentage.

Partial credit: Response identifies or refers to both the largest absolute increase and the largest relative increase, but the countries are not identified, or the wrong countries are named.

- Russia had the biggest increase in the amount of CO$_2$ (1078 tons), but Australia had the biggest percentage increase (15%).

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the reflection competency cluster.

TWISTED BUILDING SCORING 45.1

Full credit: Accept answers from 50 to 90 metres if a correct explanation is given.

- One floor of the building has a height of about 2.5 meters. There is some extra room between floors. Therefore an estimate is 21 x 3 = 63 metres.
- Allow 4 m for each story, so 20 of these gives 80 m, plus 10 m for the ground floor, so a total of 90 m.

Partial credit: Correct calculation method and explanation, but using 20 stories instead of 21.

- Each apartment could be 3.5 metres high, 20 stories of 3.5 metres gives a total height of 70 m.

No credit:

- Other responses, including answer without any explanation, answers with other incorrect number of floors, and answers with unreasonable estimates of the height of each floor (4 m would be the upper limit).

- Each floor is around 5 m high, so 5 x 21 equals 105 metres.
- 60 m.

- Missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.
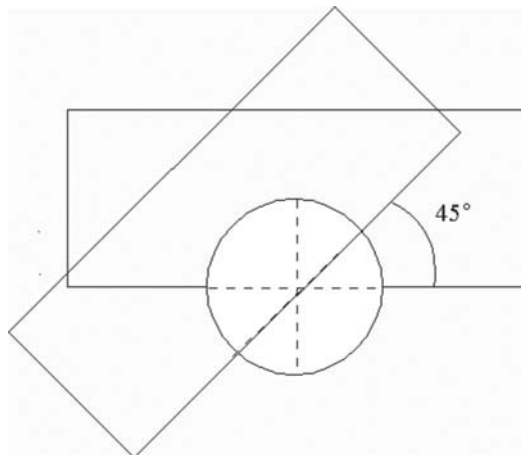
183

TWISTED BUILDING SCORING 45.2

Full credit: C. From the East.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

3

TWISTED BUILDING SCORING 45.3

Full credit: D. From the South East.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

TWISTED BUILDING SCORING 45.4

Full credit: A correct drawing, meaning correct rotation point and anti-clockwise rotation. Accept angles from 40° to 50°.

Partial credit: One of the rotation angle, the rotation point, or the rotation direction incorrect.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

HEARTBEAT SCORING 46.1

Full credit: Accept 41, or 40.

- $220 - age = 208 - 0.7$ x *age* results in *age* = 40, so people above 40 will have a higher recommended maximum heart rate under the new formula.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

3

HEARTBEAT SCORING 46.2

Full credit: Any formula that is the equivalent of multiplying the formula for recommended maximum heart rate by 80%.

- heart rate = 166 – 0.56 x age.
- heart rate = 166 – 0.6 x age.
- h = 166 – 0.56 x a.
- h = 166 – 0.6 x a.
- heart rate = (208 – 0.7age) x 0.8.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

SPACE FLIGHT SCORING 47.1

Full credit: C. 11 000.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

ROCK CONCERT SCORING 48.1

Full credit: C. 20 000.

No credit: Other responses and missing.

> To answer the question correctly students have to draw on skills from the connections competency cluster.

3

MOVING WALKWAYS SCORING 49.1

Full credit: Accept a line below the two lines, but it must be closer to the line of "A person walking on the ground" than to the baseline.

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the reflection competency cluster.

Distance from the start of the moving walkway

A person walking on the moving walkway

A person walking on the ground

A person standing still on the moving walkway

time
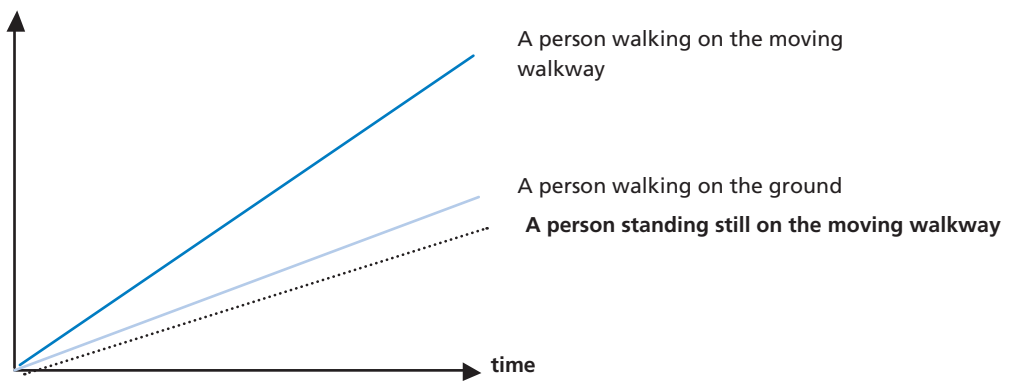
POSTAL CHARGES SCORING 50.1

Full credit: C.

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.

POSTAL CHARGES SCORING 50.2

Full credit: It will be cheaper to send the items as two separate parcels. The cost will be 1.71 zeds for two separate parcels, and 1.75 zeds for one single parcel containing both items.

No credit: Other responses and missing.

To answer the question correctly students have to draw on skills from the connections competency cluster.