This booklet contains examples of PISA questions which are released to the public and based on material at www.oecd.org/pisa. Questions are organized into units.

The percentage of students in Ireland and the OECD getting the question correct, and the content area and process assessed, are shown after each question.

More example questions, as well as the frameworks underpinning the PISA assessments, are available at the OECD’s PISA website at www.oecd.org/pisa.

Prepared by the Educational Research Centre

Drumcondra, Dublin 9

September 2014
Mathematics Sample Questions

(Taken from Appendix B of the PISA 2012 National Report at www.erc.ie/documents/p12main_report.pdf)

MATHEMATICS UNIT 1: Charts

In January, the new CDs of the bands 4U2Rock and The Kicking Kangaroos were released. In February, the CDs of the bands No One’s Darling and The Metalfolkies followed. The following graph shows the sales of the bands’ CDs from January to June.

![Sales of CDs per month chart]

**Charts – Question 1**

How many CDs did the band The Metalfolkies sell in April?

A 250  
B 500  
C 1000  
D 1270

Response | Ireland | OECD | Item Difficulty
---|---|---|---
Correct (option B) | 84.2 | 87.3 | Scale Score: 347.7  
Proficiency Level <1
Incorrect | 2.0 | 1.3 |
Missing/Not reached | 13.8 | 11.4 |

Description: Read a bar chart

Mathematical content area: Uncertainty and data

Context: Societal

Process: Interpret
### Charts – Question 2

In which month did the band *No One’s Darling* sell more CDs than the band *The Kicking Kangaroos* for the first time?

A  No month  
B  March  
C  April  
D  May  

<table>
<thead>
<tr>
<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item Difficulty</th>
</tr>
</thead>
<tbody>
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<td>19.9</td>
<td>19.4</td>
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<tr>
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<td>2.9</td>
<td>2.1</td>
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</table>

Description: *Read a bar chart and compare the height of two bars*

Mathematical content area: *Uncertainty and data*

Context: *Societal*

Process: *Interpret*

### Charts – Question 3

The manager of *The Kicking Kangaroos* is worried because the number of their CDs that sold decreased from February to June.

What is the estimate of their sales volume for July if the same negative trend continues?

A  70 CDs  
B  370 CDs  
C  670 CDs  
D  1340 CDs  

<table>
<thead>
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<th>Ireland</th>
<th>OECD</th>
<th>Item Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
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<td>23.3</td>
<td></td>
</tr>
<tr>
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<td>0.2</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

Description: *Interpret a bar chart and estimate the number of CDs sold in the future assuming that the linear trend continues*

Mathematical content area: *Uncertainty and data*

Context: *Societal*

Process: *Employ*
MATHEMATICS UNIT 2: Sailing ships

Ninety-five percent of world trade is moved by sea, by roughly 50,000 tankers, bulk carriers and container ships. Most of these ships use diesel fuel.

Engineers are planning to develop wind power support for ships. Their proposal is to attach kite sails to ships and use the wind’s power to help reduce diesel consumption and the fuel’s impact on the environment.

Sailing Ships – Question 1

One advantage of using a kite sail is that it flies at a height of 150 m. There, the wind speed is approximately 25% higher than down on the deck of the ship.

At what approximate speed does the wind blow into a kite sail when a wind speed of 24 km/h is measured on the deck of the ship?

A 6 km/h
B 18 km/h
C 25 km/h
D 30 km/h
E 49 km/h

Response | Ireland | OECD | Item Difficulty
--- | --- | --- | ---
Correct (option D) | 60.9 | 59.5 | Scale Score: 511.7
Incorrect | 37.4 | 37.4 | Proficiency Level 3
Missing/Not reached | 1.7 | 3.1 |

Description: Apply calculation of percentage within a given real world situation
Mathematical content area: Quantity
Context: Scientific
Process: Employ
### Sailing Ships – Question 2

Approximately what is the length of the rope for the kite sail, in order to pull the ship at an angle of 45° and be at a vertical height of 150 m, as shown in the diagram opposite?

A 173 m  
B 212 m  
C 285 m  
D 300 m

![Diagram](https://example.com/diagram.png)

Note: Drawing not to scale. © by skysails

<table>
<thead>
<tr>
<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item Difficulty</th>
</tr>
</thead>
</table>
| Correct (option B)      | 47.8    | 49.8 | Scale Score: 538.5  
Proficiency Level 3    |
| Incorrect               | 49.6    | 46.2 |                                      |
| Missing/Not reached     | 2.6     | 4.0  |                                      |

Description: Use Pythagorean Theorem within a real geometric context  
Mathematical content area: Space and shape  
Context: Scientific  
Process: Employ
IWANTTOHELP – Question 1

Read Maika’s blog entry for January 1. What does the entry say about Maika’s experience of volunteering?

A  She has been a volunteer for many years.
B  She only volunteers in order to be with her friends.
C  She has done a little volunteering but would like to do more.
D  She has tried volunteering but does not think it is worthwhile.

Response  | Ireland | OECD | Item difficulty
Correct (option C) | 89 | 85 | Scale score: 362 Below proficiency level 2
Incorrect | 10 | 14 |
Missing/Not reached | 2 | 1 |

Situation: Occupational
Environment: Message-based
Text Format: Continuous
Text type: Description
Aspect: Access and retrieve – Retrieve information
Question Format: Multiple choice
IWANTTOHELP: Question 2

Go to Maika’s ‘About’ page.

What kind of work does Maika want to do when she leaves school?

   A  Photography.
   B  Web design.
   C  Banking.
   D  Social work.

<table>
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<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item difficulty</th>
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<td>78</td>
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<tr>
<td>Incorrect</td>
<td>22</td>
<td>20</td>
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<tr>
<td>Missing/Not reached</td>
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<td>2</td>
<td></td>
</tr>
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</table>

Situation: Educational
Environment: Message-based
Text Format: Multiple
Text type: Description
Aspect: Access and retrieve – Retrieve information
Question Format: Multiple choice
IWANTTOHELP – Question 3:
Read Maika's blog for January 1. Go to the iwanttohelp site and find an opportunity for Maika. Use the email button on the ‘Opportunity Details’ page for this opportunity to tell Maika about it. Explain in the email why the opportunity is suitable for her. Then send your email by clicking on the ‘Send’ button.

Examples of correct answers (full credit):
Students get credit for locating the place to set up and send the email and refer to ongoing position or future or web design or art, e.g.
You’re a great artist and it is ongoing - you said you wanted a longer type of work right?
It’s ongoing and it would help you get experience for your future.
You are obviously interested in graphic design, and want to pursue this when you finish school, and you would also love to volunteer. This would be a great opportunity to do both these things, and will look great on your CV too!

Examples of correct answers (partial credit):
Students get credit for locating the place to set up and send the email and the message in the email is vague, incomplete, irrelevant or missing.

Examples of incorrect answers:
Other responses.

<table>
<thead>
<tr>
<th>Response</th>
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<th>OECD</th>
<th>Scale score</th>
<th>Proficiency level</th>
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</thead>
<tbody>
<tr>
<td>Full credit</td>
<td>49</td>
<td>44</td>
<td>567</td>
<td>4</td>
</tr>
<tr>
<td>Partial credit</td>
<td>15</td>
<td>14</td>
<td>525</td>
<td>3</td>
</tr>
<tr>
<td>Incorrect</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing/Not reached</td>
<td>33</td>
<td>37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Situation: Educational  
Environment: Mixed  
Text Format: Multiple  
Text type: Not specified  
Aspect: Complex  
Question Format: Open constructed response
READING PASSAGE 2: Smell

The role of smell is to give information about the environment. Sometimes our sense of smell can warn of potential dangers. For example, the smell of smoke indicates fire. Sometimes it gives more general information, for example, whether or not there is food nearby. It can also give information about the identity of other living creatures. We all have our own uniquely identifiable smell (some more pleasant than others!).

Dogs can use smell to distinguish between garments worn by non-identical twins (but not those of identical twins – presumably because they smell identical). Children can distinguish their siblings from other children of the same age, again using smell.

Elephants’ sense of smell is considered to be better than that of any other land mammal. Animal trainers have been getting use of this powerful sense of smell to train them.
Smell – Question 1:

Go to the ‘Smell: A Guide’ web page. Which of these statements best expresses the main idea on this page?

A  Smell can interfere with normal patterns of behaviour.
B  Smell warns humans and animals of danger.
C  The primary purpose of smell is to help animals to find food.
D  The development of smell takes place early in life.
E  The basic function of smell is recognition.

<table>
<thead>
<tr>
<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item difficulty</th>
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</thead>
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<tr>
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</table>

Situation: Educational
Environment: Authored
Text Format: Multiple
Text type: Exposition
Aspect: Integrate and Interpret – Form a broad understanding
Question Format: Multiple choice
**Smell – Question 2:**

There is information about the smell of lemon on the pages ‘Food in the news’ and ‘Psychology Now’.

Which statement summarises the conclusions of the two studies about the smell of lemon?

A. Both studies suggested that the smell of lemon helps you work quickly.
B. Both studies suggested that most people like the smell of lemon.
C. Both studies suggested that the smell of lemon helps you to concentrate.
D. Both studies suggested that females are better at detecting the smell of lemon than males.

<table>
<thead>
<tr>
<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct (option C)</td>
<td>61</td>
<td>64</td>
<td>Scale score: 485</td>
</tr>
<tr>
<td>Incorrect</td>
<td>34</td>
<td>31</td>
<td>Proficiency level 3</td>
</tr>
<tr>
<td>Missing/Not reached</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Situation: Educational
Environment: Authored
Text Format: Multiple
Text type: Exposition
Aspect: Integrate and Interpret – Develop an interpretation
Question Format: Multiple choice
**Science Sample Questions**


**SCIENCE PASSAGE 1: The Grand Canyon**

The Grand Canyon is located in a desert in the USA. It is a very large and deep canyon containing many layers of rock. Sometime in the past, movements in the Earth’s crust lifted these layers up. The Grand Canyon is now 1.6 km deep in parts. The Colorado River runs through the bottom of the canyon. See the picture below of the Grand Canyon taken from its south rim. Several different layers of rock can be seen in the walls of the canyon.

**The Grand Canyon – Question 1**

About five million people visit the Grand Canyon national park every year. There is concern about the damage that is being caused to the park by so many visitors. Can the following questions be answered by scientific investigation? Circle ‘Yes’ or ‘No’ for each question.

<table>
<thead>
<tr>
<th>Can this question be answered by scientific investigation?</th>
<th>Yes or No?</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much erosion is caused by use of the walking tracks?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Is the park area as beautiful as it was 100 years ago?</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct (Yes, No)</td>
<td>74</td>
<td>61</td>
<td>Scale Score: 485</td>
</tr>
<tr>
<td>Incorrect</td>
<td>25</td>
<td>37</td>
<td>Proficiency Level: 3</td>
</tr>
<tr>
<td>Missing/Not reached</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Situation: Social
Aspect: Identifying scientific issues; Scientific enquiry
Question format: Complex multiple choice
The Grand Canyon – Question 2

The temperature in the Grand Canyon ranges from below 0 °C to over 40 °C. Although it is a desert area, cracks in the rocks sometimes contain water. How do these temperature changes and the water in rock cracks help to speed up the breakdown of rocks?

A  Freezing water dissolves warm rocks.
B  Water cements rocks together.
C  Ice smooths the surface of rocks.
D  Freezing water expands in the rock cracks.

<table>
<thead>
<tr>
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<th>Ireland</th>
<th>OECD</th>
<th>Item Difficulty</th>
</tr>
</thead>
</table>
| Correct (option D)          | 87      | 68   | Scale Score: 451
| Incorrect                    | 11      | 29   | Proficiency Level: 2
| Missing/Not reached         | 2       | 3    |

Situation: Social
Aspect: Explaining phenomena scientifically; Earth and space systems
Question format: Multiple choice

The Grand Canyon – Question 3

There are many fossils of marine animals, such as clams, fish and corals, in the Limestone A layer of the Grand Canyon. What happened millions of years ago that explains why such fossils are found there?

A  In ancient times, people brought seafood to the area from the ocean.
B  Oceans were once much rougher and sea life washed inland on giant waves.
C  An ocean covered this area at that time and then receded later.
D  Some sea animals once lived on land before migrating to the sea.

<table>
<thead>
<tr>
<th>Response</th>
<th>Ireland</th>
<th>OECD</th>
<th>Item Difficulty</th>
</tr>
</thead>
</table>
| Correct (option C)          | 70      | 76   | Scale Score: 411
| Incorrect                    | 26      | 20   | Proficiency Level: 2
| Missing/Not reached         | 4       | 4    |
SCIENCE PASSAGE 2: Acid Rain

Below is a photo of statues called Caryatids that were built on the Acropolis in Athens more than 2500 years ago. The statues are made of a type of rock called marble. Marble is composed of calcium carbonate. In 1980, the original statues were transferred inside the museum of the Acropolis and were replaced by replicas. The original statues were being eaten away by acid rain.

Acid Rain – Question 1

Normal rain is slightly acidic because it has absorbed some carbon dioxide from the air. Acid rain is more acidic than normal rain because it has absorbed gases like sulfur oxides and nitrogen oxides as well. Where do these sulphur oxides and nitrogen oxides in the air come from?

Examples of correct answers (full credit only):
- Gives any one of car exhausts, factory emissions, burning fossil fuels, or similar, or just refers to pollution.

Examples of incorrect answers:
- Responses that do not mention ‘pollution’ and do not give a significant cause of acid rain.

<table>
<thead>
<tr>
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<th>OECD</th>
<th>Item Difficulty</th>
</tr>
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<tbody>
<tr>
<td>Correct</td>
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<tr>
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</table>

Situation: Social
Aspect: Explaining phenomena scientifically; Physical systems
Question format: Short constructed response
**Acid Rain – Question 2**

The effect of acid rain on marble can be modelled by placing chips of marble in vinegar overnight. Vinegar and acid rain have about the same acidity level. When a marble chip is placed in vinegar, bubbles of gas form. The mass of the dry marble chip can be found before and after the experiment.

A marble chip has a mass of 2.0 grams before being immersed in vinegar overnight. The chip is removed and dried the next day. What will the mass of the dried marble chip be?

A. Less than 2.0 grams  
B. Exactly 2.0 grams  
C. Between 2.0 and 2.4 grams  
D. More than 2.4 grams

<table>
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<tr>
<th>Response</th>
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</tr>
</tbody>
</table>

Situation: Personal  
Aspect: Using scientific evidence; Physical systems  
Question format: Multiple choice

**Acid Rain – Question 3**

Students who did this experiment also placed marble chips in pure (distilled) water overnight. Explain why the students include this step in their experiment.

*Examples of correct answers (full credit only):*  
Response explains that the students used water to show that acid (vinegar) is necessary for the reaction.

*Examples of incorrect answers:*  
Refers to a comparison with the vinegar and marble test, without clarifying that vinegar is necessary for the reaction; other insufficient, vague, or irrelevant responses.

<table>
<thead>
<tr>
<th>Response</th>
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<th>OECD</th>
<th>Item Difficulty</th>
</tr>
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Situation: Personal  
Aspect: Identifying scientific issues; Scientific enquiry  
Question format: Open constructed response