# A guide to using PISA as a learning context

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Codi Safonau Ysgolion
Raising School Standards

## Programme for International Student Assessment (PISA) in Wales

# A guide to using PISA as a learning context

**Audience** Mainstream secondary school headteachers, school leadership teams, school managers and classroom teachers; local authorities and national bodies with an interest in education.

**Overview** This document provides a guide to using PISA and PISA-style questions as activities to help support and improve learning and teaching.

**Action required** School leadership teams and classroom teachers are encouraged to use this resource as part of everyday learning and teaching, to better prepare learners for these types of assessments and support a more expansive pedagogy.

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**Additional copies** This document can be accessed from the Welsh Government's website at www.wales.gov.uk/educationandskills

**Related documents** *PISA Take the Test: Sample Questions from the OECD's PISA Assessments* (OECD, 2009)

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# Contents

# Introduction

## What is PISA?

PISA is the world's biggest international education survey, involving schools and students in over 60 countries. It looks at the way in which 15-year-olds can apply knowledge and skills in mathematical literacy, reading and scientific literacy. PISA was developed jointly by member countries of the OECD (Organisation for Economic Co-operation and Development). PISA has been running since 2000, Wales has participated since 2006.

## What is involved?

Schools are selected by the international organisers of the study, 30 learners in the age group are then randomly selected to take part. At least 150 schools and 4,500 students from each of the 65 countries took part in PISA 2009.

The survey takes place in school at a convenient time for the school. The selected sample of 15-year-olds take pencil and paper tests which last around two hours. The tests include multiple choice and open-ended questions on mathematical literacy, scientific literacy and reading. There is also a questionnaire for learners to answer on their attitudes and values and experiences of learning, and a questionnaire to be completed by the school.

PISA assessments are undertaken every three years. In each round the main focus is on one domain, the other two domains are assessed but using a smaller number of questions with a sub-set of the full sample. In 2006 the main domain was scientific literacy, in 2009 it was reading and in 2012 it will be mathematical literacy.

Strict standards are applied to ensure equivalence in question translation and countries are invited to comment on the difficulty and cultural appropriateness of the questions. Schools can select which language test each individual student takes but there is no bilingual option and students cannot 'mix and match' taking for example reading questions in one language and mathematics and science in another.

## Significance of PISA

PISA seeks to answer questions like:

- Are students well prepared for future challenges?
- Can they analyse, reason and communicate effectively?
- How well do they transfer ideas and solve problems?
- Do they have the capacity to continue learning throughout life?

PISA provides internationally comparable evidence that can help drive improvement of learner outcomes and potential life-chances and support policy development for governments.

Wales' 2009 PISA results were poor in terms of comparison to prior performance, to other UK nations and internationally. The Minister for Education and Skills responded to the evidence from PISA and other indicators of educational performance by setting out a detailed plan of action to bring about improved performance for learners and schools in Wales.

## About this resource

This resource is intended to help demonstrate how PISA, and PISA-style questions, can support pedagogy and help improve learning and teaching.

The questions used in this booklet are drawn from released PISA materials published on the OECD website.

Learners who perform best are those who can apply, analyse, synthesise and evaluate in a variety of contexts. PISA assessments require learners to utilise these processes within mathematical, language and scientific contexts.

The PISA questions are rich contexts requiring a high degree of literacy to access and understand them. Many of the questions require learners to apply their problem-solving skills to new contexts. Learners therefore need to have well-developed skills, especially literacy, numeracy and problem solving, and the confidence to take on the challenge of questions that are outside their 'comfort zone'.

The main objective in producing this resource, and of the accompanying workshops and development programme, is to ensure that there is an understanding in the educational community in Wales as to how PISA assessments work in terms of contexts, demand and structure and how they can be used to support improved learning and teaching. Using PISA and PISA-style materials as part of everyday learning and teaching will better prepare learners for these types of assessments and support a more expansive pedagogy for teachers, which develop deeper levels of questioning, problem solving and use of literacy and numeracy in cross-curricular contexts.

Exposing learners to more PISA-style assessment is not about 'practising' or 'teaching to the test' it is about checking if learners understand how to access information and apply skills and knowledge. It is about creating and using an environment where they feel safe to take risks, collaborate with others to solve problems and receive formative feedback to help them improve. It is fundamentally about improving our young people's life skills.

# Key definitions

## Reading

Reading is defined in PISA as understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society.

## Mathematical literacy

Mathematical literacy is defined in PISA as an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.

## Scientific literacy

Scientific literacy is defined in PISA as the capacity to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions about science-related issues.

Developing thinking enables learners to:

- gain a deeper understanding of concepts
- understand how they arrived at an idea and the strategy they develop to do it
- be more critical about evidence
- think flexibly
- make reasoned judgements and decisions rather than jumping to conclusions.

These qualities in thinking are needed both in school and in the wider world and clearly reflect what is assessed by PISA.

PISA focuses squarely on the ability of learners to use information from texts in 'real life' scenarios. As a result, questions are highly contextualised and therefore require learners to engage with the scenario and decide how best to solve the problem. This necessitates a high degree of skills and strategy to be shown to access and interpret the information, extract relevant information and use and apply knowledge and skills to creatively solve problems. The key crucial process which drives this is metacognition. If learners are not aware of how they have solved problems previously or what strategies and skills were useful in doing this, then an independent transfer and application of skills and ideas – the capability for which is measured by PISA and required for lifelong learning and the world of work – becomes impossible.

## Metacognition and effective learning

Metacognition is defined as 'knowledge of one's own cognitive processes'. It spans several areas including:

- making sense of the task
- knowledge of strategies and methods, and how and when to use them
- knowledge and understanding of thinking processes
- monitoring and evaluating learning from the success (or otherwise) of chosen strategies or methods
- making connections across contexts.

As metacognition has a critical role to play in successful learning it is important that it is demonstrated by both learners and teachers. There is much research which shows that learners who demonstrate a wide range of metacognitive skills perform better in examinations and complete work more efficiently. They are self-regulated learners who utilise the 'right tool for the job' and modify learning strategies and skills based on their awareness of effectiveness. Individuals with a high level of metacognitive knowledge and skill identify blocks to learning as early as possible and change 'tools' or strategies to ensure goal attainment. Learners who demonstrate metacognition are aware of their own strengths and weaknesses, the nature of the task at hand, and available 'tools' or skills. In short, developing metacognition as a central process in learning creates greater learner autonomy and independence in decision-making, more effective self-regulation and increased capability.

Learners need to be exposed to and use a broad repertoire of tools/strategies as part of everyday learning. Many examples of tools/strategies to support thinking skills, decision-making and problem solving are outlined in the web-based booklet *How to develop thinking and assessment for learning in the classroom* (www.ngfl-cymru.org.uk/dtaafl/). Teachers need to be mindful of promoting metacognition across the five areas highlighted above by guiding deconstruction of the task and processes, tools and strategies used throughout. Questions such as the following should be used routinely with learners so that they start to internalise the question prompts for themselves.

- What is this task about?
- How do you know?
- Where have you used a strategy like this before?
- How did you extract the information you needed?
- How will you identify and summarise the key ideas to answer this question?

Specific metacognitive tools which support stepwise deconstruction include:

- reflection triangles
- flow charts/stepping stones
- who-what-when-why-where-how
- reflection starters
- reflection mobiles.

These are best used with the 'language of learning and thinking' to develop a shared vocabulary to enable clear expression of their thinking process. Teaching metacognition is arguably the most difficult aspect of developing a learner's thinking. It is, however, one of the key aspects to promoting deeper understanding and transfer of ideas and skills to all areas of learning.

## Assessment-taking strategies for learners

Some strategies for learners to consider.

- Always read the information for each task carefully.
- Don't be put off by the length of the text to read – break it down into sections to read and try to pick out the key points of what it is about before you jump to the questions which follow.
- Read all accompanying text first for each question to get an idea of what it is about, then read the questions you are required to answer. Look for clues in any graphs, tables and diagrams also.
- Reread the text and use strategies such as underlining, skimming, scanning, colour coding and other tools/strategies you have to identify relevant parts of the text.
- Give each question a try, even when you are not sure. Remember partial value is given for partially correct answers.
- Remember credit is given for how you arrive at your answers so try and clearly show your thinking processes. This is especially important in terms of showing your methods of working using number.
- Think about the types of questions asked, take clues from the question starters and think about sentence starters for your answers, e.g. interpretive, reflective and evaluative questions are questions that begin with:

  **Why . . . ?**

  **Why do you think . . . ?**

  **How do you know . . . ?**

  One or two word answers won't be sufficient. Reasons, usually with reference to the task, are required; often the word 'because' is used in the response.
- Non-continuous texts such as graphs, charts, diagrams and tables provide supporting information for any text. Study the axes and determine the purpose of the text before answering the questions.
- For multiple-choice questions dealing with mathematical literacy, remember you will be expected to carry out a calculation to be able to choose an answer.
- For multiple-choice questions, develop a methodical process of elimination of the alternative answers. When the list is narrowed to the best possibilities, choose one; there is no extra penalty for wrong choices.

# Suggestions for teachers

Included in this booklet are four sample tasks. It is strongly suggested that the tasks are used formatively with learners in a collaborative manner. Teachers may choose to begin a detailed discussion of each task, what it involves and the scoring criteria or they may ask learners to work collaboratively (pairs or groups of three would work best) to attempt each task as an activity (as opposed to individually attempting questions) and then discuss the processes used afterward. Tasks are best used as activities rather than simply as questions to be answered – text can be used as source material to be interrogated initially with the questions removed, if so desired, to emphasise the importance of engagement with the material and support development of strategies to deal with this.

The intention in using these tasks in the classroom as part of everyday learning and teaching is not to 'practice the test' but to expose learners to a variety of learning resources to broaden their learning experience. The long-term aim of education is to support the learner in developing a wide repertoire of sustainable strategies to access relevant information and solve problems in preparation for the adult world of work. This can only be achieved by supporting a more expansive pedagogy for teachers to develop deeper levels of questioning, problem solving and use of literacy and numeracy in cross-curricular contexts.

To aid teachers in planning use of the tasks each has been deconstructed to identify the most likely range of skills to be developed and to show relevant links to the curriculum. The appendix gives an overview of the deconstruction for each of the released PISA questions. A full deconstruction can be found at www.wales.gov.uk/educationandskills

## Sample tasks

There are four sample tasks in this booklet which have been drawn from all three PISA test areas.

Task 1 – Mobile Phone Safety (Reading)

Task 2 – Exports (Mathematical literacy)

Task 3 – Greenhouse (Scientific literacy)

Task 4 – The Best Car (Mathematical literacy)

For each task, information about the task (including level of difficulty, national curriculum contexts and links, text types, question types), Skills framework links, suggested tools/strategies and approaches to using the tasks as activities, the task itself and PISA scoring information are included.

These are intended to provide background support for teachers in planning the use of these tasks as activities within the normal range of learning and teaching activities.

## How to use this resource

- These sample tasks can be used when planning a unit of work on a topic. It is best to use them where they link appropriately to a curriculum context that you are exploring. Relevant curriculum contexts are outlined in the overview information for each task. However, be aware that they are inherently cross-curricular in nature and not limited to English/Welsh, mathematics and science only. They are best used to bring out elements of literacy (in a language sense) and mathematical and scientific literacy naturally within other subject contexts also. The pedagogy that you use contributes to the transferability of the skills and strategies developed across all areas of learning.
- To engage your learners, the sample tasks should be used as the basis for activities where appropriate in the curriculum context. It is recommended that teachers use a variety of tools and strategies which exemplify effective pedagogy and stimulate developing thinking and assessment for learning to explore the tasks (see the booklet *How to develop thinking and assessment for learning in the classroom*, www.ngfl-cymru.org.uk/dtaafl/ for further support).
- Tasks should not be graded or 'scores' attributed to questions. The intention is that learners should be involved in formative feedback and collaboration with others in order to discuss and improve ideas and methods. It will certainly be useful to share and discuss the scoring criteria with learners. The criteria are the same as those used by PISA markers to mark the actual assessment.
- Although learners will need to work with tasks in their entirety, it is suggested that a preliminary focus is made on engaging learners with strategies to extract relevant information from different forms of text. Background text (including graphical and mathematical representations) can be used as 'source' material for learners (without the subsequent questions initially) to engage and support learners in developing strategic approaches to developing higher-order literacy skills.
- As metacognition is a vital element in effective transfer of skills and strategies for learning, it is essential that learners are supported and encouraged to deconstruct, verbalise and share the processes they go through in solving a problem. Suggested reflection tools are discussed in the previous section. More ideas can be found at www.ngfl-cymru.org.uk/dtaafl/

# Skills assessed by the tasks

PISA tasks cover a wide range of skills; different tasks will draw on different combinations.

## Thinking skills

### Plan
- Asking questions
- Activating prior skills, knowledge and understanding
- Gathering information
- Determining the process/method and strategy
- Determining success criteria

### Develop
- Generating and developing ideas
- Valuing errors and unexpected outcomes
- Entrepreneurial thinking
- Thinking about cause and effect and making inferences
- Thinking logically and seeking patterns
- Considering evidence, information and ideas
- Forming opinions and making decisions
- Monitoring progress

### Reflect
- Reviewing outcomes and success criteria
- Reviewing the process/method
- Evaluate own learning and thinking
- Linking and lateral thinking

## Literacy and communication skills

### Oracy
- Developing information and ideas
- Presenting information and ideas

### Reading
- Locating, selecting and using information using reading strategies
- Responding to what has been read

### Writing
- Organising ideas and information
- Writing accurately

### Wider communication skills
- Communicating ideas and emotions
- Communicating information

## Numeracy skills

### Use mathematical information
- Using numbers
- Measuring
- Gathering information

### Calculate
- Using the number system
- Using a variety of methods

### Interpret and present findings
- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

# Tasks

## Task 1 – Mobile Phone Safety

### Information about the task

| Question | Level of difficulty | PISA identified skills | Text type | Question types | Subject matter and links |
|---|---|---|---|---|---|
| Mobile Phone Safety | Medium (Q2)<br>High (Q11)<br>Medium (Q6)<br>Medium (Q9) | Interpret<br>Reflect and evaluate<br>Reflect and evaluate<br>Interpret | Short information text presented in point format. | Multiple choice open ended. Using points to integrate, interpret, reflect and evaluate information. | Pros and cons of phone safety. General knowledge cross-curricular links to language (English and Welsh), history, geography, PSE and science. |

### Skills assessed by the task

#### Thinking skills

Plan
- Activating prior skills, knowledge and understanding
- Gathering information

Develop
- Generating and developing ideas

Reflect
- Evaluate own learning and thinking

#### Literacy and communication skills

Writing
- Organising ideas and information
- Writing accurately

Wider communication skills
- Communicating information

### Suggested tools/strategies to use question as an activity

- PMI diagram to explore and summarise points for and against evidence for 'danger' (P – positive, i.e. 'for', M – minus, i.e. 'against', I – interesting, i.e. neither for/against).
- Fishbone diagram to explore cause and effect of issues as a means of summarising and linking the two tables shown.
- Just-a-minute to summarise 1. The purpose of the two tables and 2. What conclusions can be drawn.

# Task 1 – Mobile Phone Safety

**Are mobile phones dangerous?**

| | Yes | No |
|---|---|---|
| 1. | Radio waves given off by mobile phones can heat up body tissue, having damaging effects. | Radio waves are not powerful enough to cause heat damage to the body. |
| 2. | Magnetic fields created by mobile phones can affect the way that your body cells work. | The magnetic fields are incredibly weak, and so unlikely to affect cells in our body. |
| 3. | People who make long mobile phone calls sometimes complain of fatigue, headaches, and loss of concentration. | These effects have never been observed under laboratory conditions and may be due to other factors in modern lifestyles. |
| 4. | Mobile phone users are 2.5 times more likely to develop cancer in areas of the brain adjacent to their phone ears. | Researchers admit it's unclear this increase is linked to using mobile phones. |
| 5. | The International Agency for Research on Cancer found a link between childhood cancer and power lines. Like mobile phones, power lines also emit radiation. | The radiation produced by power lines is a different kind of radiation, with much more energy than that coming from mobile phones. |
| 6. | Radio frequency waves similar to those in mobile phones altered the gene expression in nematode worms. | Worms are not humans, so there is no guarantee that our brain cells will react in the same way. |

*Key Point*

*Conflicting reports about the health risks of mobile phones appeared in the late 1990s.*

*Key Point*

*Millions of pounds have now been invested in scientific research to investigate the effects of mobile phones.*

**If you use a mobile phone …**

*Key Point*

*Given the immense numbers of mobile phone users, even small adverse effects on health could have major public health implications.*

*Key Point*

*In 2000, the Stewart Report (a British report) found no known health problems caused by mobile phones, but advised caution, especially among the young, until more research was carried out. A further report in 2004 backed this up.*

| Do | Don't |
|---|---|
| Keep the calls short. | Don't use your mobile phone when the reception is weak, as the phone needs more power to communicate with the base station, and so the radio-wave emissions are higher. |
| Carry the mobile phone away from your body when it is on standby. | Don't buy a mobile phone with a high "SAR" value[1]. This means that it emits more radiation. |
| Buy a mobile phone with a long "talk time". It is more efficient, and has less powerful emissions. | Don't buy protective gadgets unless they have been independently tested. |

[1] SAR (specific absorption rate) is a measurement of how much electromagnetic radiation is absorbed by body tissue whilst using a mobile phone.

**Question 2: MOBILE PHONE SAFETY**

What is the purpose of the **Key points**?

A To describe the dangers of using mobile phones.
B To suggest that debate about mobile phone safety is ongoing.
C To describe the precautions that people who use mobile phones should take.
D To suggest that there are no known health problems caused by mobile phones.

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**Question 11: MOBILE PHONE SAFETY**

"It is difficult to prove that one thing has definitely caused another."

What is the relationship of this piece of information to the Point 4 **Yes** and **No** statements in the table **Are mobile phones dangerous?**

A It supports the Yes argument but does not prove it.
B It proves the Yes argument.
C It supports the No argument but does not prove it.
D It shows that the No argument is wrong.

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**Question 6: MOBILE PHONE SAFETY**

Look at Point 3 in the **No** column of the table. In this context, what might one of these "other factors" be? Give a reason for your answer.

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**Question 9: MOBILE PHONE SAFETY**

Look at the table with the heading **If you use a mobile phone …**

Which of these ideas is the table based on?

A There is no danger involved in using mobile phones.
B There is a proven risk involved in using mobile phones.
C There may or may not be danger involved in using mobile phones, but it is worth taking precautions.
D There may or may not be danger involved in using mobile phones, but they should not be used until we know for sure.
E The **Do** instructions are for those who take the threat seriously, and the **Don't** instructions are for everyone else.

## Scoring information

### Question 2

Question intent

Integrate and interpret: Form a broad understanding.

Recognise the purpose of a section (a table) in an expository text.

Full credit:

B. To suggest that debate about mobile phone safety is ongoing.

### Question 11

Question intent

Reflect and evaluate: Reflect on and evaluate the content of a text.

Recognise the relationship between a generalised statement external to the text and a pair of statements in a table.

Full credit:

C. It supports the No argument but does not approve it.

### Question 6

Question intent

Reflect and evaluate: Reflect on and evaluate the content of a text.

Use prior knowledge to reflect on information presented in a text.

Full credit:

Identifies **a factor in modern lifestyles that could be related to fatigue, headaches, or loss of concentration**. The explanation may be self-evident, or explicitly stated.

- Not getting enough sleep. If you don't you will be fatigued.
- Being too busy. Makes you tired.
- Too much homework, that makes you tired **and** gives you headaches.
- Noise – that gives you headaches.
- Stress.
- Working late.
- Exams.
- The world is just too loud.

- People don't take time to relax anymore.
- People don't prioritise the things that matter, so they get grumpy and sick.
- Computers.
- Pollution.
- Watching too much TV.
- Drugs.
- Microwave ovens.
- Too much emailing.

No credit:

Gives an **insufficient or vague** response.

- Fatigue (*Repeats information in the text*).
- Tiredness (*Repeats information in the text*).
- Loss of concentration (*Repeats information in the text*).
- Headaches (*Repeats information in the text*).
- Lifestyle (*Vague*).

Shows **inaccurate comprehension** of the material or gives an **implausible or irrelevant** response.

- Sore ears.
- Egg cups.

**Question 9**

Question intent

Integrate and interpret: Develop and interpretation.

Recognise an assumption in part of an expository text.

Full credit:

C. There may or may not be danger involved in using mobile phones, but it is worth taking precautions.

# Task 2 – Exports

## Information about the task

| Question | Level of difficulty | National curriculum mathematical context | Text type | Question types |
|---|---|---|---|---|
| Exports | Low (Q13.1)<br>Medium (Q13.2) | Handling data, interpret and analyse data. | Short continuous text with pie chart and bar chart to interpret. | Graphical interpretation and calculation. Short answer calculation and multiple choice. |

## Skills assessed by the task

### Thinking skills

Plan
- Activating prior skills, knowledge and understanding
- Gathering information
- Determining the process/method and strategy

Develop
- Thinking logically and seeking patterns

### Literacy and communication skills

Reading
- Locating, selecting and using information using reading strategies
- Responding to what has been read

Wider communication skills
- Communicating information

### Numeracy skills

Use mathematical information
- Using numbers
- Measuring
- Gathering information

Calculate
- Using the number system
- Using a variety of methods

Interpret and present findings
- Comparing data
- Recording and interpreting data and presenting findings

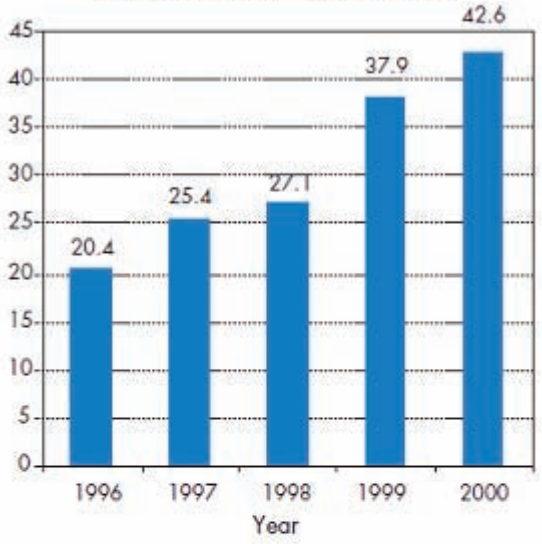
## Suggested tools/strategies to use question as an activity

- Graphs can be used in a source square and learners extract as much information as possible from the graphs before being given the questions.
- Most likely/What is the question? – learners are presented with values of exports calculated from the pie chart and total export graph (either they can generate these or they can be given them by the teacher) and their challenge is to justify which type of export does it describes and the year it was exported.

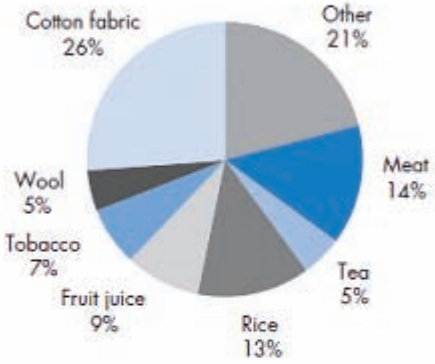
# Task 2 – Exports

The graphics below show information about exports from Zedland, a country that uses zeds as its currency.

**Total annual exports from Zedland in millions of zeds, 1996 to 2000**




**Distribution of exports from Zedland in 2000**




**QUESTION 13.1**

What was the total value (in millions of zeds) of exports from Zedland in 1998?

Answer: .....

**QUESTION 13.2**

What was the value of fruit juice exported from Zedland in 2000?

A. 1.8 million zeds.

B. 2.3 million zeds.

C. 2.4 million zeds.

D. 3.4 million zeds.

E. 3.8 million zeds.

## Scoring information

### Question 13.1

Question intent
Handling data: analysing and interpreting data in graphical form.

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

No credit:
Other responses and missing.

### Question 13.2

Question intent
Handling data: analysing, interpreting and extracting data in graphical form and calculating using percentages.

Full credit:
E. 3.8 million zeds.

No credit:
Other responses and missing.

# Task 3 – Greenhouse

## Information about the task

| Question | Level of difficulty | National curriculum mathematical context | Text type | Question types |
|---|---|---|---|---|
| Greenhouse | Medium (Q5.1)<br>High (Q5.2)<br>High (Q5.3) | Greenhouse effect – considering evidence. | Longer length continuous text incorporating line graph to interpret. | Interpret graph trends, draw comparisons, short written responses required to justify ideas<br>Identification of anomaly in data. |

## Skills assessed by the task

### Thinking skills

**Plan**
- Activating prior skills, knowledge and understanding
- Gathering information

**Develop**
- Generating and developing ideas
- Thinking about cause and effect and making inferences
- Thinking logically and seeking patterns
- Considering evidence, information and ideas
- Forming opinions and making decisions

**Reflect**
- Evaluate own learning and thinking
- Linking and lateral thinking

### Literacy and communication skills

**Reading**
- Locating, selecting and using information using reading strategies
- Responding to what has been read

**Writing**
- Organising ideas and information
- Writing accurately

**Wider communication skills**
- Communicating information

### Numeracy skills

**Use mathematical information**
- Gathering information

**Interpret and present findings**
- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

## Suggested tools/strategies to use question as an activity

- Graphs can be used in a source square and learners extract as much information as possible from the graphs to draw a conclusion which links both graphs. Then compare against Andre's conclusion and discuss extent of agreement and evidence from the graphs (Question 5.1).
- Alternative outcome – using an aspect of thinking hats, learners develop graphical evidence which would produce the opposite conclusion reached by Andre. They must justify the processes used and how they developed their evidence.
- Without showing any of the task, give Andre's conclusion and challenge learners to draw a graph/graphs which would support his conclusion. Compare with actual graphs given.
- 'Golden sentence' – Divide the task into sections (by paragraphs if preferred). Working in small groups, each group must present a 'golden sentence' summary of their given paragraph. Learners should be encouraged to describe how they developed their summary (e.g. use of keywords, skimming, scanning, etc.). They can then consider the effect of the overall conclusion drawn if certain pieces of evidence (certain 'golden sentence summaries') were missed out or purposely not included. This challenges learners' ideas and helps develop strategies in pulling together vast quantities of information and making decisions regarding their relevance.
- From the 'golden sentence' summaries and/or source square, present questions to learners and ask them to use the information they have gathered to provide group answers to the questions. Deconstruct with learners afterwards which answers originated from the actual task/text/graphs (and how these were located) and which answers drew on previous scientific knowledge and understanding and how these are linked. Using think-pair-share, invite learners to show what clues in question stems would point towards using the information given and what requires them to draw on previous experience/knowledge.

# Task 3 – Greenhouse

## SCIENCE UNIT 5: GREENHOUSE

Read the texts and answer the questions that follow.

### The greenhouse effect: fact or fiction?

Living things need energy to survive. The energy that sustains life on the Earth comes from the Sun, which radiates energy into space because it is so hot. A tiny proportion of this energy reaches the Earth.

The Earth's atmosphere acts like a protective blanket over the surface of our planet, preventing the variations in temperature that would exist in an airless world.

Most of the radiated energy coming from the Sun passes through the Earth's atmosphere. The Earth absorbs some of this energy, and some is reflected back from the Earth's surface. Part of this reflected energy is absorbed by the atmosphere.

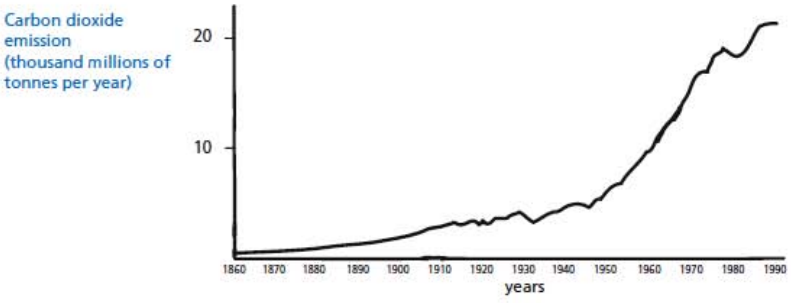
As a result of this the average temperature above the Earth's surface is higher than it would be if there were no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term *greenhouse effect*.

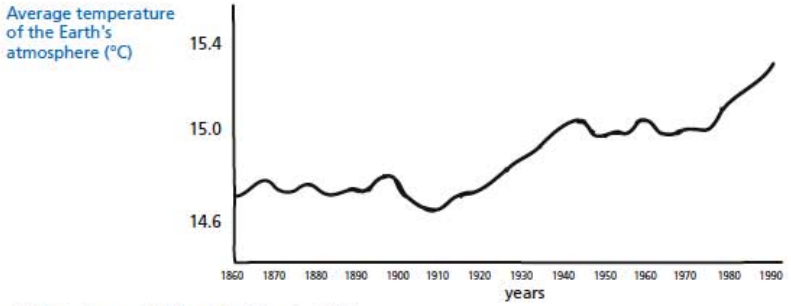
The greenhouse effect is said to have become more pronounced during the twentieth century.

It is a fact that the average temperature of the Earth's atmosphere has increased. In newspapers and periodicals the increased carbon dioxide emission is often stated as the main source of the temperature rise in the twentieth century.

A student named André becomes interested in the possible relationship between the average temperature of the Earth's atmosphere and the carbon dioxide emission on the Earth.

In a library he comes across the following two graphs.




*Source*: CSTI Environmental Information Paper 1, 1992.

André concludes from these two graphs that it is certain that the increase in the average temperature of the Earth's atmosphere is due to the increase in the carbon dioxide emission.

**QUESTION 5.1**

What is it about the graphs that supports André's conclusion?

.....

.....

**QUESTION 5.2**

Another student, Jeanne, disagrees with André's conclusion. She compares the two graphs and says that some parts of the graphs do not support his conclusion.

Give an example of a part of the graphs that does not support André's conclusion. Explain your answer.

.....

.....

.....

**QUESTION 5.3**

André persists in his conclusion that the average temperature rise of the Earth's atmosphere is caused by the increase in the carbon dioxide emission. But Jeanne thinks that his conclusion is premature. She says: "Before accepting this conclusion you must be sure that other factors that could influence the greenhouse effect are constant".

Name one of the factors that Jeanne means.

.....

.....

## Scoring information

### Question 5.1

Question intention

Analysing and interpreting data to draw scientific conclusions consistent with evidence.

Full credit:

- Responses that refer to the increase of both (average) temperature and carbon dioxide emission.
- As the emissions increased the temperature increased.
- Both graphs are increasing.
- Because in 1910 both the graphs began to increase.
- Temperature is rising as $CO_2$ is emitted.
- The information lines on the graphs rise together.
- Everything is increasing.
- The more $CO_2$ emission, the higher the temperature.
- Responses that refer (in general terms) to a positive relationship between temperature and carbon dioxide emission.
- The amount of $CO_2$ and average temperature of the Earth is directly proportional.
- They have a similar shape indicating a relationship.

No credit:

- Responses that refer to the increase of either the (average) temperature or the carbon dioxide emission.
- The temperature has gone up.
- $CO_2$ is increasing.
- It shows the dramatic change in temperatures.
- Responses that refer to temperature and carbon dioxide emission without being clear about the nature of the relationship.
- The carbon dioxide emission (graph 1) has an effect on the earth's rising temperature (graph 2).
- The carbon dioxide is the main cause of the increase in the earth's temperature.
- Missing.

- The carbon dioxide emission is greatly rising more than the average Earth's temperature. (Note: this answer is incorrect because the extent to which the $CO_2$ emission and the temperature are rising is seen as the answer, rather than that they are both increasing).
- The rise of the $CO_2$ over the years is due to the rise of the temperature of the Earth's atmosphere.
- The way the graph goes up.
- There is a rise.
- Missing.

**Question 5.2**

Question intention

Analysing and interpreting data to draw scientific conclusions consistent with evidence.

Full credit:

Responses that refer to one particular part of the graphs in which the curves are not both descending or both climbing and gives the corresponding explanation, such as:

- In 1900–1910 (about) $CO_2$ was increasing, whilst the temperature was going down.
- In 1980–1983 carbon dioxide went down and the temperature rose.
- The temperature in the 1800s is much the same but the first graph keeps climbing.
- Between 1950 and 1980 the temperature didn't increase but the $CO_2$ did.
- From 1940 until 1975 the temperature stays about the same but the carbon dioxide emission shows a sharp rise.
- In 1910 the temperature is a lot higher than in 1920 and they have similar carbon dioxide emissions.

Partial credit:

- Responses that mention a correct period, without any explanation.
- Responses that mention only one particular year (not a period of time), with an acceptable explanation.
  – In 1980 the emissions were down but the temperature still rose.
- Responses that give an example that doesn't support Andre's conclusion but makes a mistake in mentioning the period. (Note: there should be

evidence of this mistake – e.g. an area clearly illustrating a correct answer is marked on the graph and then a mistake made in transferring this information to the text.)
  - Between 1950 and 1960 the temperature decreased and the carbon dioxide emission increased.

- Responses that refer to differences between the two curves, without mentioning a specific period.
  - At some places the temperature rises even if the emission decreases.
  - Earlier there was little emission but nevertheless high temperature.
  - When there is a steady increase in graph 1, there isn't an increase in graph 2. It stays constant. (Note: it stays constant "overall".)
  - Because at the start the temperature is still high where the carbon dioxide was very low.
- Responses that refer to an irregularity in one of the graphs.
  - It is about 1910 when the temperature had dropped and went on for a certain period of time.
  - In the second graph there is a decrease in temperature of the Earth's atmosphere just before 1910.
- Responses that indicate difference in the graphs, but explanation is poor.
  - In the 1940s the heat was very high but the carbon dioxide very low.

No credit:

- Responses that refer to an irregularity in a curve without referring specifically to the two graphs.
  - It goes a little up and down.
  - It went down in 1930.
- Responses that refer to a poorly defined period or year without any explanation.
  - The middle part
  - 1910.
- Missing.
  - In 1940 the average temperature has increased, but not the carbon dioxide emission.
  - Around 1910 the temperature has increased but not the emission.
- Missing.

**Question 5.3**

Question intention

Explaining phenomena scientifically.

Full credit:

- Responses that give a factor referring to the energy/radiation coming from the Sun.
  - The sun heating and maybe the earth changing position.
  - Energy reflected back from the Earth. (Assuming that by 'Earth' the student means 'the ground').
- Responses that give a factor referring to a natural component or a potential pollutant.
  - Water vapour in the air.
  - Clouds.
  - The things such as volcanic eruptions.
  - Atmospheric pollution (gas, fuel).
  - The amount of exhaust gas.
  - CFCs.
  - The number of cars.
  - Ozone (as a component of air).

No credit:

- Responses that refer to a cause that influences the carbon dioxide concentration.
  - Clearing of rain forest.
  - The amount of $CO_2$ being let off.
  - Fossil fuels.
- Responses that refer to a non-specific factor.
  - Fertilisers.
  - Sprays.
  - How the weather has been.
- Other incorrect factors or Missing.
  - The amount of oxygen.
  - Nitrogen.
  - The hole in the ozone layer is also getting bigger.
- Missing.

# Task 4 – The Best Car

## Information about the task

| Question | Level of difficulty | National curriculum mathematical context | Text type | Question types |
|---|---|---|---|---|
| The Best Car | Low (Q25.1)<br>High (Q25.2) | Algebraic relationships and functions, patterns and relationships. | Short continuous text with tabulated data to interpret. | Closed short answer calculation and interpretation of data as formulae. |

## Skills assessed by the task

### Thinking skills

**Plan**
- Activating prior skills, knowledge and understanding
- Gathering information
- Determining the process/method and strategy

**Develop**
- Generating and developing ideas
- Thinking about cause and effect and making inferences
- Thinking logically and seeking patterns

**Reflect**
- Linking and lateral thinking

### Literacy and communication skills

**Reading**
- Locating, selecting and using information using reading strategies
- Responding to what has been read

**Wider communication skills**
- Communicating information

### Numeracy skills

**Use mathematical information**
- Using numbers
- Gathering information

**Calculate**
- Using the number system
- Using a variety of methods

**Interpret and present findings**
- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

## Suggested tools/strategies to use question as an activity

- The information table (minus the subsequent questions) can be used within a source square to allow learners to interrogate the data, extract information and make inferences on its use and meaning.
- A concept cartoon of 'correct' and 'incorrect' answers for both questions can be given and learners challenged to select the answer they most agree with and justify their decision. By providing 'answers' in this manner, learners have to deconstruct the processes used to arrive at the answer as part of their justification – this is a critical element of metacognition.
- Equations/formulae can be represented using a flowchart/stepping stones (see *How to develop thinking and assessment for learning* booklet for support). This allows learners to deconstruct calculations and make visual to peers their decision processes in developing a formula for Question 25.2.
- Learners can look at 'what would happen if' scenarios by using the ratings criteria as a whole and part activity. This would allow them to consider the purpose and construction of the formula used in Question 25.1 and to consider the effect each rating has (i.e. a form of 'weighting') to the overall outcome, as in Question 25.2.

# Task 4 – The Best Car

## MATHEMATICS UNIT 25: THE BEST CAR

A car magazine uses a rating system to evaluate new cars, and gives the award of "The Car of the Year" to the car with the highest total score. Five new cars are being evaluated, and their ratings are shown in the table.

| Car | Safety Features (S) | Fuel Efficiency (F) | External Appearance (E) | Internal Fittings (T) |
|---|---|---|---|---|
| Ca | 3 | 1 | 2 | 3 |
| M2 | 2 | 2 | 2 | 2 |
| Sp | 3 | 1 | 3 | 2 |
| N1 | 1 | 3 | 3 | 3 |
| KK | 3 | 2 | 3 | 2 |

The ratings are interpreted as follows:

3 points = Excellent

2 points = Good

1 point = Fair

### QUESTION 25.1

To calculate the total score for a car, the car magazine uses the following rule, which is a weighted sum of the individual score points:

Total Score = (3 x S) + F + E + T

Calculate the total score for Car "Ca". Write your answer in the space below.

Total score for "Ca": .....

### QUESTION 25.2

The manufacturer of car "Ca" thought the rule for the total score was unfair.

Write down a rule for calculating the total score so that Car "Ca" will be the winner.

Your rule should include all four of the variables, and you should write down your rule by filling in positive numbers in the four spaces in the equation below.

Total score = .....x S + ..... x F + ..... x E + ..... x T.

## Scoring information

### Question 25.1

Question intention

Interpretation and extraction of data, substitution into and use of given formula to make calculation.

Full credit:

15 points.

No credit:

Other responses or missing.

### Question 25.2

Question intention

Extraction and use of data, development and correct representation of a formula to make calculation to a given criterion.

Full credit:

Correct rule that will make ‘Ca’ the winner.

No credit:

Other resonses or missing.

# Appendix: PISA sample questions

## Reading

| Question | Level of difficulty | PISA identified skills | Text type | Question types | Subject matter and links |
|---|---|---|---|---|---|
| 1. Lake Chad | Low (Q1.1)<br>Medium (Q1.2)<br>High (Q1.3)<br>Low (Q1.4)<br>Medium (Q1.5) | Retrieve info<br>Retrieve info<br>Reflect and evaluate text<br>Interpret<br>Interpret | Short continuous information text with bar and line graphs. | Multiple choice.<br>Open ended short written response.<br>Require inference and calculations. | Geographical information.<br>Numeracy skills.<br>Links with geography, numeracy, science. |
| 2. Flu | Low (Q2.1)<br>Medium (Q2.2)<br>Medium (Q2.3)<br>High (Q2.4)<br>Medium (Q2.5) | Retrieve info<br>Reflect and evaluate text<br>Interpret<br>Reflect and evaluate<br>Interpret | Medium length information text in sections with illustrations. | Multiple choice.<br>Open ended longer written response.<br>Identifying and explaining features of text/style. | Medical publicity material.<br>Links with PSE, science. |
| 3. Graffiti | Low (Q3.1)<br>Medium (Q3.2)<br>Low (Q3.3)<br>Medium (Q3.4) | Interpret<br>Interpret<br>Reflect and evaluate<br>Reflect and evaluate | Medium length text.<br>Two letters expressing contrasting points of view. | Multiple choice.<br>Open ended short written response.<br>Expressing and justifying own opinions. | For and against graffiti.<br>Links with art, PSE. |
| 4. Labour | Low (Q4.1)<br>High (Q4.2)<br>High (Q4.3)<br>Low (Q4.4)<br>Low (Q4.5) | Interpret<br>Retrieve info<br>Interpret<br>Reflect and evaluate<br>Reflect and evaluate | Short non-continuous information text in a tree diagram including figures. | Multiple choice.<br>Open ended factual.<br>Categorising. | Employment information presented in figures **and** visually.<br>Links with numeracy and PSE. |
| 5. Plan International | High (Q5.2) | Reflect and evaluate | Short non-continuous information text presented in table format. | Multiple choice.<br>Open ended short written response.<br>Interpreting data expressing opinion with justification. | International aid organisation and its activities in a single year.<br>Links with art, geography, numeracy. |

| Question | Level of difficulty | PISA identified skills | Text type | Question types | Subject matter and links |
|---|---|---|---|---|---|
| 6. Police | Medium (Q6.1)<br>Medium (Q6.2)<br>Low (Q6.3)<br>Low (Q6.4) | Retrieve info<br>Interpret<br>Interpret<br>Interpret | Long information text presented in sections with headings. | Multiple choice relating to factual information, opinion and style of text. | Article on police investigation methods using DNA evidence. Links to science. |
| 7. Runners | Low (Q7.1)<br>Low (Q7.2)<br>Low (Q7.3)<br>Low (Q7.4) | Interpret<br>Retrieve info<br>Retrieve info<br>Reflect and evaluate | Medium information text in sections with headings. | Multiple choice<br>Open ended factual requiring short and longer responses | Article about sports shoes ('runners'). Links to PE and science. |
| 8. Gift | Low (Q8.1)<br>High (Q8.2)<br>High (Q8.3)<br>Low (Q8.4)<br>High (Q8.5)<br>Medium (Q8.6)<br>Medium (Q8.7) | Interpret<br>Interpret<br>Reflect and evaluate<br>Retrieve info<br>Interpret<br>Interpret<br>Reflect and evaluate | Very long descriptive story/narrative. | Multiple choice.<br>Open ended short and longer responses.<br>Using text to support answers and justify own point of view. | Story about a childhood experience in America. Contains some less familiar vocabulary for learners in Wales. Links to English and Welsh. |
| 9. Amanda and the Duchess | Low (Q9.1)<br>Medium (Q9.2)<br>Medium (Q9.3)<br>High (Q9.4)<br>Low (Q9.5) | Interpret<br>Reflect and evaluate<br>Interpret<br>Retrieve info<br>Interpret | Very long extract from play script including stage directions and second text with definitions of theatrical occupations. | Multiple choice.<br>Identifying features.<br>Categorising.<br>Visual interpretation following stage directions. | Play about a Prince, a Duchess and shop assistant – extract from a play by Jean Anouilh. Language very literary and some unfamiliar vocabulary. Links to drama, English and Welsh. |
| 10. Personnel | Low (Q10.1)<br>High (Q10.2) | Retrieve info<br>Retrieve info | Medium length information text, broken in to sections by question headings. | Open ended short and longer responses. | Work-related context about support for people changing jobs. Links with PSE, work-related education. |

| | | | | | |
|---|---|---|---|---|---|
| 11. New Rules | Medium (Q11.1)<br>High (Q11.2) | Interpret<br>Interpret | Medium length newspaper editorial. | Underlining text.<br>Listing examples. | Ethics related to frozen embryos.<br>Links with PSE, science. |
| 12. Moreland | Trial:<br>Low (Q12.1)<br>Low (Q12.2) | Retrieve info<br>Retrieve info | Short notice with non-continuous text – mainly times and days. | Identification of times. | Library opening hours.<br>Links with numeracy. |
| 13. Warranty | Trial:<br>Medium (Q13.1)<br>Low (Q13.2)<br>Low (Q13.3)<br>Medium (Q13.4) | Retrieve info<br>Retrieve info<br>Retrieve info<br>Reflect and evaluate | Short text – receipt and warranty for a purchase. | Completion of warranty form from information in receipt.<br>Open ended short and longer responses.<br>Including opinion and justification. | Camera purchase and related documentation.<br>Links numeracy and financial education. |
| 14. A Just Judge | Trial:<br>High (Q14.1)<br>Medium (Q14.2)<br>High (Q14.3)<br>Medium (Q14.4)<br>High (Q14.5)<br>High (Q14.6) | Interpret<br>Retrieve info<br>Reflect and evaluate<br>Interpret<br>Reflect and evaluate<br>Reflect and evaluate | Very long traditional story. | Multiple choice.<br>Extended responses giving opinions with reasons.<br>Comparison of law in story with own legal system. | Traditional Algerian story about crime and punishment and a requirement to have some knowledge of own laws.<br>Links with PSE, history, RE. |
| 15. In Poor Taste | Trial:<br>Low (Q15.1)<br>Medium (Q15.2) | Interpret<br>Reflect and evaluate | Short letter to newspaper. | Multiple choice.<br>Open ended short response. | Western consumption and overseas aid.<br>Links with PSE and geography. |
| 16. Bullying | Trial:<br>High (Q16.1)<br>High (Q16.2) | Interpret<br>Retrieve info | Medium length newspaper article. | Multiple choice interpretation of bar graphs. | School bullying in Japan.<br>Links with PSE. |

| Question | Level of difficulty | PISA identified skills | Text type | Question types | Subject matter and links |
|---|---|---|---|---|---|
| 17. Bees | Trial:<br>Medium (Q17.1)<br>Medium (Q17.2)<br>High (Q17.3)<br>Medium (Q17.4) | Interpret<br>Retrieve info<br>Interpret<br>Interpret | Medium length information text with illustrations/ diagram. | Multiple choice.<br>Open ended factual responses. | Bee keeping and making honey.<br>Links with science. |
| 18. Mobile Phone Safety | Trial:<br>Medium (Q2)<br>High (Q11)<br>Medium (Q6)<br>Medium (Q9) | Interpret<br>Reflect and evaluate<br>Reflect and evaluate<br>Interpret | Short information text presented in point format. | Multiple choice open ended. Using points to integrate, interpret, reflect and evaluate information. | Pros and cons of phone safety.<br>General knowledge cross-curricular links to language (English and Welsh), history, geography, PSE and science. |
| 19. Telecommuting | Trial:<br>High (Q1)<br>Low (Q7)<br>Medium (Q4) | Interpret<br>Reflect and evaluate<br>Interpret | Two short argumentative texts. | Multiple choice open ended. Two paragraphs to integrate, interpret, reflect and evaluate prior knowledge. | For and against telecommuting.<br>Links with language (English and Welsh), work-related education, PSE and science. |
| 20. The Play's the Thing | Trial:<br>Low (Q3)<br>Medium (Q4)<br>High (Q6)<br>High (Q7) | Retrieve info<br>Interpret/infer<br>Interpret<br>Interpret | Medium length text in the form of information and dialogue. | Multiple choice open ended.<br>Access and retrieve information.<br>Integrate, interpret and infer references. | Action taking place before the events of the play.<br>Links with language (English and Welsh), drama and history. |

## Mathematical literacy

*** denotes possible cross-curricular links with science**

| Question | Level of difficulty | National curriculum mathematical Context | Text type | Question types |
|---|---|---|---|---|
| 1. Farms | Low (Q1.1)<br>Medium (Q1.2) | Understand and use measures, area, shape and understand number and notation. | Short continuous text information with pictures and diagrams to interpret. | Calculation. |
| 2. Walking | High (Q2.1)<br>High (Q2.2) | Algebraic relationships, functions, understand number and notation, calculate in variety of ways. | Short continuous text information with picture to interpret. | Calculation with method to justify answer. |
| 3. Apples | Medium (Q3.1)<br>High (Q3.2)<br>High (Q3.4) | Algebraic relationships, functions, patterns and relationships. | Short continuous text information with diagrams to interpret. | Calculations showing methods in order to justify answers.<br>Open ended short written explanations required. |
| 4. Cubes | Medium (Q4.1) | Patterns and relationships, understand number and notation. | Short continuous text information with picture to interpret | Calculation required (mental or written as preferred). |
| 5. Continent Area | High (Q5.1) | Understand number and notation, calculate in variety of ways, shape, area, perimeter, interpret and use scales, estimation. | Interpretation of diagram. | Calculation required, showing workings and explaining how answer arrived at. |
| 6. Growing up | Medium (Q6.1)<br>Medium (Q6.2)<br>Medium (Q6.3) | Interpreting and analysing data, patterns and relationships, understand and use measures. | Short continuous text information with picture to interpret. | Simple calculation and graphical interpretation.<br>Open ended short written justification using graph. |

| Question | Level of difficulty | National curriculum mathematical Context | Text type | Question types |
|---|---|---|---|---|
| 7. Speed of Racing Car* | Low (Q7.1)<br>Low (Q7.2)<br>Low (Q7.3)<br>High (Q7.4) | Understand and use measures, interpret and analyse data, patterns and relationships. | Short continuous text information with picture to interpret. | Multiple choice, graphical interpretation. |
| 8. Triangles | Medium (Q8.1) | Shape. | Short continuous text information with diagrams to interpret. | Multiple choice, diagrammatical interpretation and translation of written description into diagram. |
| 9. Robberies | High (Q9.1) | Patterns and relationships, interpret and analyse data. | Short continuous text information with bar chart to interpret. | Open ended longer written response justifying opinions. |
| 10. Carpenter | High (Q10.1) | Understand and use measures, perimeter, area, shape, understand number and notation, calculate in a variety of ways. | Short continuous text information with diagrams to interpret. | Multiple choice. Interpretation of diagrams and calculation (mental/written as preferred) required. |
| 11. Internet Relay Chat | Medium (Q11.1)<br>High (Q11.2) | Understand and use measures, time, understand number and notation, calculate in a variety of ways. | Short continuous text information with diagrams to interpret. | Calculations. |
| 12. Exchange Rate | Low (Q12.1)<br>Low (Q12.2)<br>Medium (Q12.3) | Understand and use money, algebraic relationships and functions, calculate in a variety of ways, use number and notation. | Short continuous text. | Interpretation of formulae and text equivalence.<br>Calculations.<br>Open ended longer written response to justify argument. |

| | | | | |
|---|---|---|---|---|
| 13. Exports | Low (Q13.1)<br>Medium (Q13.2) | Handling data, interpret and analyse data. | Short continuous text with pie chart and bar chart to interpret. | Graphical interpretation and calculation.<br>Short answer calculation and multiple choice. |
| 14. Coloured Candles | Medium (Q14.1) | Probability, data handling. | Short continuous text with bar chart to interpret. | Multiple choice. Calculation necessary to select answer. |
| 15. Science Tests | Medium (Q15.1) | Handling data, understand number and notation, calculate in variety of ways, fractions, percentages, mean. | Short continuous text. | Closed short answer calculation. |
| 16. Bookshelves | Low (Q16.1) | Understand number and notation, algebra, calculate in variety of ways. | Short continuous text with diagram to interpret. | Interpretation of diagram and calculation required for closed short answer. |
| 17. Litter* | Medium (Q17.1) | Handling data, interpret and analyse data. | Short continuous text with table of data to interpret. | Open ended short written response to justify opinion. |
| 18. Earthquake | Medium (Q18.1) | Probability, patterns and relationships, understand number and notation, calculate in variety of ways. | Short continuous text. | Multiple choice. Interpretation of text and translation to mathematical reasoning, including some calculation. |
| 19. Choices | Medium (Q19.1) | Combinations, patterns and relationships, understand number and notation. | Short continuous text. | Short answer calculation. |
| 20. Test Scores | High (Q20.1) | Handling data, probability, understand and use measures. | Short continuous text with bar chart to interpret. | Open ended longer written response to justify opinion and set out mathematical argument. |

| Question | Level of difficulty | National curriculum mathematical Context | Text type | Question types |
|---|---|---|---|---|
| 21. Skateboard | Low (Q21.1)<br>Medium (Q21.2)<br>Medium (Q21.3) | Combinations, patterns and relationships, understand and use money, understand number and notation, calculate in variety of ways. | Short continuous text with pictures and tabulated data to interpret. | Multiple choice and sort answer calculation. |
| 22. Staircase | Low (Q22.1) | Shape, perimeter, area, use measures, calculate in variety of ways. | Short continuous text with diagram to interpret. | Short answer calculation. |
| 23. Number Cubes | Medium (Q23.1) | Shape, patterns and relationships. | Short continuous text with pictures and diagrams to interpret. | Multiple choice. |
| 24. Support for the President | High (Q24.1) | Handling data, patterns and relationships, understand number and notation, calculate in variety of ways. | Medium length continuous text with mathematical data included. | Open ended longer length written response to justify opinions and set out reasoned mathematical argument. |
| 25. The Best Car | Low (Q25.1)<br>High (Q25.2) | Algebraic relationships and functions, patterns and relationships. | Short continuous text with tabulated data to interpret. | Closed short answer calculation and interpretation of data as formulae. |
| 26. Step Pattern | Low (Q26.1) | Patterns and relationships. | Short continuous text with diagrams to interpret. | Closed short answer calculation. |
| 27. Lichen | Trial:<br>Medium (Q27.1)<br>Medium (Q27.2) | Algebraic relationships and functions, patterns and relationships, understand and use number and notation, calculate in variety of ways. | Medium length continuous text with mathematical formulae to interpret. | Calculations with workings to justify answers. |

| | | | | |
|---|---|---|---|---|
| 28. Coins | Trial:<br>High (Q28.1) | Patterns and relationships, understand number and notation, understand and use money, calculate in variety of ways, understand and use measures. | Medium length text with mathematical data and pictures to interpret. | Calculations required. |
| 29. Pizzas | Trial:<br>Low (Q29.1) | Combinations, patterns and relationships, understand and use money, understand number and notation, calculate in variety of ways. | Short continuous text containing mathematical information. | Short answer written response to justify opinions. |
| 30. Shapes | Trial:<br>Medium (Q30.1)<br>Low (Q30.2)<br>Low (Q30.3) | Shape, understand and use measures, area, perimeter, estimation, calculate in a variety of ways. | Short text and pictures to interpret. | Open ended longer length written response to explain reasoning. |
| 31. Braking* | Trial:<br>High (Q31.1)<br>High (Q31.2)<br>High (Q31.3)<br>High (Q31.4)<br>High (Q31.5) | Algebraic relationships and functions, handling data, analyse and interpret data, understand and use number and notation, calculate in a variety of ways. | Medium length continuous text with detailed diagram to interpret. | Longer length written responses involving calculations and interpreting and extracting data from diagram. |
| 32. Patio | Trial:<br>Low (Q32.1) | Shape, understand and use measures, area, understand number and notation, calculate in a variety of ways. | Short continuous text containing mathematical data. | Short answer calculation. |
| 33. Drug Concentrations* | Trial:<br>Medium (Q33.1)<br>Low (Q33.2)<br>Low (Q33.3) | Patterns and relationships, understand number and notation, calculate in a variety of ways, handling data, analyse and interpret data. | Medium length continuous text containing mathematical data and tabulated data, and line graph to interpret. | Calculation and multiple choice. Interpretation from graphical information given. |

| Question | Level of difficulty | National curriculum mathematical Context | Text type | Question types |
|---|---|---|---|---|
| 34. Building Blocks | Trial:<br>Low (Q34.1)<br>Low (Q34.2)<br>Low (Q34.3)<br>Low (Q34.4) | Patterns and relationships, shape, understand and use measures, calculate in a variety of ways. | Medium length continuous data and diagrams to interpret. | Short answer calculations. |
| 35. Reaction Time* | Trial:<br>Low (Q35.1)<br>Medium (Q35.2) | Patterns and relationships, understand and use number and notation, calculate in a variety of ways, understand and use measures, time, handling data, interpret and analyse data. | Longer length continuous data with tabulated data to interpret. | Calculation and open ended longer length written response to justify opinions and show mathematical reasoning. |
| 36. Water Tank* | Trial:<br>Low (Q36.1) | Shape, understand and use measures, patterns and relationships, handling data, analyse and interpret data. | Short length continuous data with diagram and line graphs to interpret. | Multiple choice. |
| 37. Spring Fair | Trial:<br>Low (Q37.1) | Probability. | Short continuous text and pictures to interpret. | Multiple choice. |
| 38. Swing* | Trial:<br>Low (Q38.1) | Handling data, analyse and interpret data, patterns and relationships. | Short continuous text and line graphs to interpret. | Multiple choice. |
| 39. Student Heights | Trial:<br>Low (Q39.1) | Handling data, analyse and interpret data, patterns and relationships. | Medium length continuous text incorporating mathematical data. | Multiple choice. |

| | | | | |
|---|---|---|---|---|
| 40. Payments by Area | Trial:<br>Low (Q40.1)<br>Medium (Q40.2) | Patterns and relationships, understand and use number and notation, understand and use measures, area, money, calculate in a variety of ways. | Medium length continuous text incorporating mathematical data. | Multiple choice and calculation, showing workings to present mathematical argument. |
| 41. Shoes for Kids | Trial:<br>Low (Q41.1) | Handling data, analyse and interpret data. | Short continuous text with tabulated data to interpret. | Short answer – interpretation from table. |
| 42. Table Tennis Tournament | Trial:<br>Medium (Q42.2) | Patterns and relationships, combinations, sequences, understand and use number and notation. | Short continuous text. | Short written answers – completion of table, although much reasoning and calculation required. |
| 43. Lighthouse | Trial:<br>Medium (Q43.1)<br>Medium (Q43.2)<br>Medium (Q43.3) | Patterns and relationships, sequences, understand and use measures, time, handling data, analyse and interpret data. | Medium length continuous text with graph to interpret. | Multiple choice and graph plotting. Calculation needed. |
| 44. Decreasing $CO_2$ levels* | Trial:<br>High (Q44.1)<br>High (Q44.2)<br>High (Q44.3) | Patterns and relationships, understand and use number and notation, calculate in a variety of ways, handling data, analyse and interpret data. | Longer length continuous text with bar chart and mathematical data incorporated for interpretation. | Longer length answers – calculation with workings and open ended written response to justify opinions. |
| 45. Twisted Building | Trial:<br>High (Q45.1)<br>High (Q45.2)<br>High (Q45.3)<br>High (Q45.4) | Shape, understand and use position and movement, understand and use measures, area, estimation, analyse and interpret data, scale. | Longer length continuous text with pictures and diagrams to interpret. | Multiple choice, calculation with longer length written justification and explanation, diagrammatical representation of ideas. |

| Question | Level of difficulty | National curriculum mathematical Context | Text type | Question types |
|---|---|---|---|---|
| 46. Heartbeat* | Trial:<br>High (Q46.1)<br>High (Q46.2) | Algebraic relationships and functions, patterns and relationships, interpret and use formulae, understand and use number and notation, calculate in a variety of ways. | Longer length continuous text with mathematical formulae to interpret. | Longer length written response to show calculation and justify answer.<br>Translation of text to mathematical formulae. |
| 47. Space Flight* | Trial:<br>Medium (Q47.1) | Algebraic relationships and functions, understand and use number and notation, calculate in a variety of ways. | Short continuous text containing mathematical information. | Multiple choice. |
| 48. Rock Concert | Trial:<br>Low (Q48.1) | Shape, understand and use number and notation, understand and use measures, estimation, calculate in a variety of ways. | Short continuous text containing mathematical information. | Multiple choice. |
| 49. Moving Walkways* | Trial:<br>Low (Q49.1) | Patterns and relationships, understand and use measures, handling data, analyse and interpret data. | Medium length continuous text with picture and line graph to interpret. | Graphical representation of outcome of reasoning. |
| 50. Postal Charges | Trial:<br>Medium (Q50.1) | Patterns and relationships, use money, handling data, analyse and interpret data. | Longer length text involving tabulated data and line graphs to interpret. | Multiple choice and calculation showing workings to justify mathematical argument. |

## Scientific literacy

| Question | Level of difficulty | National curriculum science context | Text type | Question types |
|---|---|---|---|---|
| 1. Semmelweis' Diary | High (Q1.1)<br>Low (Q1.2)<br>Low (Q1.3)<br>Medium (Q1.4) | Health, disease, drugs to treat disease. | Longer length continuous text with graph to interpret. | Inference from text, multiple choice.<br>Short written responses to explain and justify opinions. |
| 2. Ozone | High (Q2.1)<br>High (Q2.2)<br>Medium (Q2.3) | Atoms and molecules, bonding. | Longer length continuous text with picture strip to interpret. | Access/retrieve information from text, interpret cartoon stimulus information.<br>Open ended short written response to explain ideas.<br>Multiple choice to retrieve information from text. |
| 3. Daylight | Medium (Q3.1)<br>High (Q3.2) | Earth in space – day and night. | Short continuous text information with diagram to interpret. | Multiple choice.<br>Access/use information from text, present/draw on diagram. |
| 4. Cloning | Low (Q4.1)<br>Medium (Q4.2)<br>Medium (Q4.3) | Genetics and cloning. | Medium length continuous text for information. | Multiple choice to access/retrieve information and infer from text. |
| 5. Greenhouse | Medium (Q5.1)<br>High (Q5.2)<br>High (Q5.3) | Greenhouse effect – considering evidence. | Longer length continuous text incorporating line graph to interpret. | Interpret graph trends, draw comparisons, short written responses required to justify ideas.<br>Identification of anomaly in data. |
| 6. Clothes | Medium (Q6.1)<br>Low (Q6.2) | Properties of materials. | Medium length continuous text for information. | Multiple choice answers.<br>Access/retrieve information from text. |

| Question | Level of difficulty | National curriculum science context | Text type | Question types |
|---|---|---|---|---|
| 7. The Grand Canyon | Low (Q7.1)<br>Low (Q7.2)<br>Low (Q7.3) | Rocks and rock cycle. | Short continuous text with photograph to interpret. | Multiple choice to explain ideas and express viewpoint. |
| 8. Sunscreens | Medium (Q8.1)<br>Low (Q8.2)<br>Medium (Q8.3)<br>High (Q8.4) | Scientific method – testing sunscreens. | Medium length text for information with diagrams. | Access/interpret information from text and diagrams, interpret data and draw conclusions. Multiple choice and open ended longer answer response to justify opinions and ideas. |
| 9. Mary Montagu | Low (Q9.1)<br>Low (Q9.2)<br>Medium (Q9.3) | Spread and prevention of disease. | Short continuous text for information. | Multiple choice and short written response to give reasons for answer. |
| 10. Acid Rain | Medium (Q10.1)<br>Low (Q10.2)<br>High (Q10.3) | Environmental impact of acid rain, pollution. | Short continuous text for information with numerical information included. | Multiple choice to reason using numerical information. Short written responses required to explain ideas. |
| 11. Physical Exercise | Medium (Q11.1)<br>Low (Q11.2)<br>Medium (Q11.3) | Factors related to human health. | Short continuous text. | Multiple choice, closed questions. Short written response. |
| 12. Genetically Modified Crops | Low (Q12.1)<br>Low (Q12.2) | Genetic engineering. | Medium length continuous text for information. | Closed responses as multiple choice. Access/retrieve information and reasoning. |

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| 13. Biodiversity | Trial:<br>Low (Q13.1)<br>Low (Q13.2) | Food webs and chains and interdependence of organisms. | Medium length continuous text and diagram (food web) to interpret. | Multiple choice. Access/retrieve and interpreting information from diagram. |
| 14. Buses | Trial:<br>Low (Q14.1)<br>Medium (Q14.2) | Forces, burning fossil fuels, environmental issues. | Medium length continuous text with diagram to interpret. | Multiple choice and longer written open response to justify argument. |
| 15. Climate Change | Trial:<br>Medium (Q15.1) | Evidence for global warming. | Longer length continuous text with bar chart to interpret. | Longer written open response, using graph/information to support argument. |
| 16. Flies | Trial:<br>Medium (Q16.1)<br>High (Q16.2) | Insecticide use – considering evidence. | Medium length continuous text. | Longer written open responses to consider the information and explain ideas and justify. |
| 17. Calf Clones | Trial:<br>Medium (Q17.1)<br>Low (Q17.2) | Genetics and cloning. | Longer length continuous text. | Short written response and multiple choice to extract information from text. |
| 18. Corn | Trial:<br>Low (Q18.1)<br>Low (Q18.2)<br>Medium (Q18.3) | Combustion of fuels, environmental issues. | Longer length continuous text for information with word equation. | Multiple choice responses to consider information and draw conclusions. Completion of word equation. |
| 19. Fit for drinking | Trial:<br>Low (Q19.1)<br>Low (Q19.2)<br>Low (Q19.3)<br>Low (Q19.4)<br>Low (Q19.5) | Disease prevention – cleaning water. | Short continuous text and diagram to interpret. | Short written responses to explain and justify ideas. Multiple choice also. |
| 20. Tooth Decay | Trial:<br>Low (Q20.1)<br>Medium (Q20.2)<br>Medium (Q20.3) | Disease prevention, bacteria. | Short continuous text with diagram and scatter graph to interpret. | Multiple choice responses to retrieve information from text and draw conclusions from graph and text. |

| Question | Level of difficulty | National curriculum science context | Text type | Question types |
|---|---|---|---|---|
| 21. Hot Work | Trial:<br>Low (Q21.1)<br>Medium (Q21.2) | Heat loss from containers. | Short continuous text with numerical information to interpret. | Multiple choice responses to infer and reason. |
| 22. Mousepox | Trial:<br>High (Q22.1)<br>Medium (Q22.2)<br>Medium (Q22.3) | Genetic engineering and viruses. | Short continuous text. | Multiple choice to infer from text and explore opinions. |
| 23. Stickleback Behaviour | Trial:<br>High (Q23.1)<br>High (Q23.2)<br>High (Q23.3) | Scientific method – planning experiments. | Longer length continuous text with diagrams and bar charts to interpret. | Multiple choice and longer open written response to test inference and interpretation of results. |
| 24. Tobacco Smoking | Trial:<br>Low (Q24.1)<br>Low (Q24.2)<br>Medium (Q24.3)<br>Medium (Q24.4) | Disease prevention, use of drugs, smoking and lungs. | Medium length continuous text. | Multiple choice responses to test understanding of scientific ideas and process. |
| 25. Starlight | Trial:<br>Low (Q25.1)<br>Medium (Q25.2) | Astronomy. | Short continuous data. | Multiple choice. Statements to test interpretation and inference. |
| 26. Ultrasound | Trial:<br>Low (Q26.1)<br>Low (Q26.2)<br>Low (Q26.3) | EM spectrum, ultrasound. | Short continuous text with photograph. | Longer length written responses required to explain ideas and show understanding.<br>Multiple choice to test inference. |
| 27. Lip Gloss | Trial:<br>Low (Q27.1)<br>Medium (Q27.2)<br>Medium (Q27.3) | Separating techniques, properties of materials. | Short continuous text with numerical data in form of recipe to interpret. | Longer length written response and multiple choice to test interpretation of information, inference and understanding. |

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| 28. Evolution | Trial:<br>Medium (Q28.1)<br>Low (Q28.2)<br>Medium (Q28.3) | Evidence for evolution. | Short continuous text with tabulated data and diagrams to interpret. | Short written response and multiple choice to test access/retrieve information from text, inference and interpretation. |
| 29. Bread Dough | Trial:<br>Low (Q29.1)<br>Medium (Q29.2)<br>Medium (Q29.3)<br>Low (Q29.4) | Chemical reactions, fermentation. | Short continuous text with diagrams to interpret. | Multiple choice responses to test access/retrieve information from text, interpretation, understanding of scientific method and modelling. |
| 30. Transit of Venus | Trial:<br>Low (Q30.1)<br>Medium (Q30.2)<br>High (Q30.3) | Astronomy, planetary motion. | Short continuous text with photograph. | Multiple choice to test understanding of ideas and application. |
| 31. Health Risk? | Trial:<br>High (Q31.1)<br>High (Q31.2) | Environmental effects on health. | Medium length continuous text. | Longer length written responses to explain reasons for ideas. |
| 32. Catalytic Converter | Trial:<br>Medium (Q32.1)<br>High (Q32.2)<br>Medium (Q32.3) | Chemical reactions, atoms and molecules, pollutants. | Short continuous text with diagram containing numerical data to interpret. | Longer length written responses to explain ideas. |
| 33. Major Surgery | Trial:<br>Low (Q33.1)<br>Low (Q33.2)<br>Low (Q33.3)<br>Medium (Q33.4) | Treatment of disease and drug use. | Short continuous text with photograph and bar chart to interpret. | Mostly multiple choice to test interpretation and ideas and drawing conclusions.<br>Short written response also to set out explanation. |
| 34. Wind Farms | Trial:<br>Medium (Q34.1)<br>High (Q34.2)<br>High (Q34.3)<br>Low (Q34.4) | Alternative energy resources, generating electricity. | Short continuous text with line graphs to interpret. | Mostly multiple choice to analyse and interpret graphs and draw conclusions.<br>Short written response to consider advantages and disadvantages. |