
PISA SCIENCE SAMPLE ITEMS

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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.

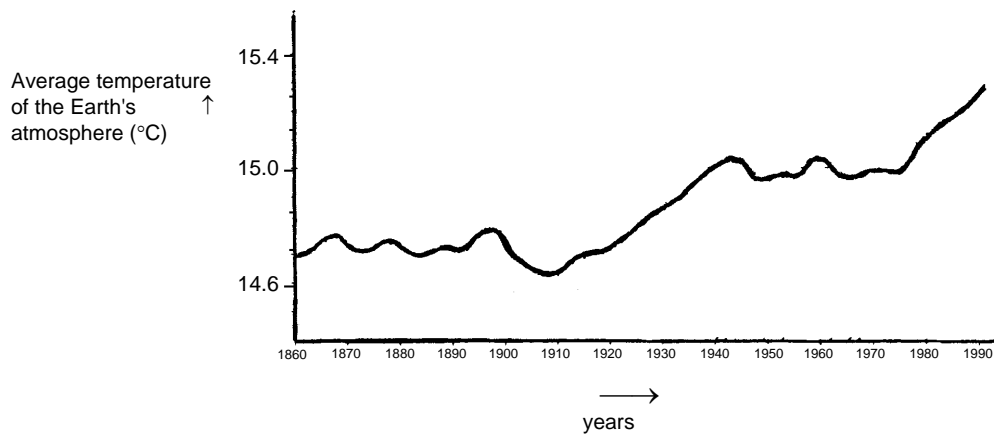
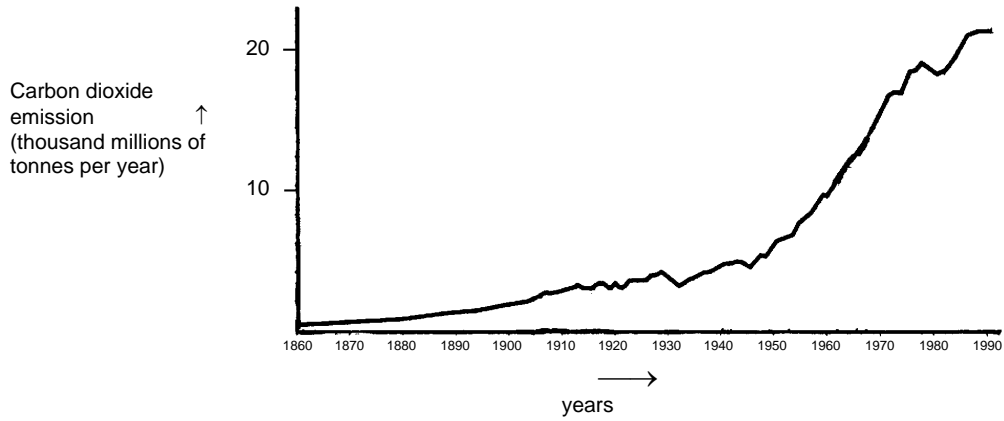
As a result of this the average temperature above the Earth's surface is higher than it would be if there were no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term *greenhouse effect*.

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.



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 1: GREENHOUSE

S114Q03 – 01 02 11 12 99

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

.....

.....

GREENHOUSE SCORING 3**Full Credit**

Code 11: Refers 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 CO₂ is emitted.
- The information lines on the graphs rise together.
- Everything is increasing.
- The more CO₂ emission, the higher the temperature.

Code 12: Refers (in general terms) to a positive relationship between temperature and carbon dioxide emission.

[Note: This code is intended to capture students' use of terminology such as 'positive relationship', 'similar shape' or 'directly proportional'; although the following sample response is not strictly correct, it shows sufficient understanding to be given credit here.]

- The amount of CO₂ and average temperature of the Earth is directly proportional.
- They have a similar shape indicating a relationship.

No Credit

Code 01: Refers to the increase of either the (average) temperature or the carbon dioxide emission.

- The temperature has gone up.
- CO₂ is increasing.
- It shows the dramatic change in the temperatures.

Code 02: Refers 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.

OR

Other responses.

- 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 CO₂ emission and the temperature are rising is seen as the answer, rather than that they are both increasing.]*

- The rise of CO₂ 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.

Code 99: Missing.

S114Q03 Student Response

Code	Hong Kong (%)	% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
12	8.4						
11	67.5						
02	12.1						
01	6.9						
99	5.0	79.2	69.9	75.0	76.9	76.0	54.3

Question 2: GREENHOUSE

S114Q04 – 0 1 2 9

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.

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.....

.....

GREENHOUSE SCORING 4

Full Credit

Code 2: Refers to one particular part of the graphs in which the curves are not both descending or both climbing and gives the corresponding explanation.

- In 1900–1910 (about) CO₂ was increasing, whilst the temperature was going down.
- In 1980–1983 carbon dioxide went down and the temperature rose.
- The temperature in the 1800's is much the same but the first graph keeps climbing.
- Between 1950 and 1980 the temperature didn't increase but the CO₂ did.
- From 1940 until 1975 the temperature stays about the same but the carbon dioxide emission shows a sharp rise.
- In 1940 the temperature is a lot higher than in 1920 and they have similar carbon dioxide emissions.

Partial Credit

Code 1: Mentions a correct period, without any explanation.

- 1930–1933.
- before 1910.

Mentions only one particular year (not a period of time), with an acceptable explanation.

- In 1980 the emissions were down but the temperature still rose.

Gives an example that doesn't support André'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.

Refers 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.

Refers 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.

Indicates difference in the graphs, but explanation is poor.

- In the 1940's the heat was very high but the carbon dioxide very low. *[Note: The explanation is very poor, but the difference that is indicated is clear.]*

No Credit

Code 0: Refers 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.

Refers to a poorly defined period or year without any explanation.

- The middle part.
- 1910.

Other responses.

- In 1940 the average temperature increased, but not the carbon dioxide emission.
- Around 1910 the temperature has increased but not the emission.

Code 9: Missing.

S114Q04 Student Response

Code	Hong Kong (%)	% Correct					OECD
		Hong Kong					
		F.4	F.1-F.3	Girls	Boys	Overall	
2	40.3						
1	26.3						
0	22.8						
9	10.6	59.7	42.0	52.2	54.8	53.5	34.9

Question 3: GREENHOUSE

S114Q05 – 01 02 03 11 12 99

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.

.....
.....

GREENHOUSE SCORING 5

Full Credit

Code 11: Gives a factor referring to the energy/radiation coming from the Sun.

- The sun heating and maybe the earth changing position.
- Energy reflected back from Earth. [Assuming that by "Earth" the student means "the ground".]

Code 12: Gives 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.
- CFC's.
- The number of cars.
- Ozone (as a component of air). [Note: for references to depletion, use Code 03.]

No Credit

Code 01: Refers to a cause that influences the carbon dioxide concentration.

- Clearing of rain forest.
- The amount of CO₂ being let off.
- Fossil fuels.

Code 02: Refers to a non-specific factor.

- Fertilisers.
- Sprays.
- How the weather has been.

Code 03: Other incorrect factors or other responses.

- Amount of oxygen.
- Nitrogen.
- The hole in the ozone layer is also getting bigger.

Code 99: Missing.

S114Q05 Student Response

Code	Hong Kong (%)						
12	21.3						
11	10.6						
03	28.4	% Correct					
02	12.0	Hong Kong					
01	11.7	F.4	F.1-F.3	Girls	Boys	Overall	OECD
99	16.0	34.0	28.1	33.1	30.6	31.9	19.1

CLOTHES

Read the text and answer the questions that follow.

CLOTHES TEXT

A team of British scientists is developing “intelligent” clothes that will give disabled children the power of “speech”. Children wearing waistcoats made of a unique electrotexile, linked to a speech synthesiser, will be able to make themselves understood simply by tapping on the touch-sensitive material.

The material is made up of normal cloth and an ingenious mesh of carbon-impregnated fibres that can conduct electricity. When pressure is applied to the fabric, the pattern of signals that passes through the conducting fibres is altered and a computer chip can work out where the cloth has been touched. It then can trigger whatever electronic device is attached to it, which could be no bigger than two boxes of matches.

“The smart bit is in how we weave the fabric and how we send signals through it – and we can weave it into existing fabric designs so you cannot see it’s in there,” says one of the scientists.

Without being damaged, the material can be washed, wrapped around objects or scrunched up. The scientist also claims it can be mass-produced cheaply.

Source: Steve Farrer, ‘Interactive fabric promises a material gift of the garb’, *The Australian*, 10 August 1998.

Question 4: CLOTHES

S213Q01

Can these claims made in the article be tested through scientific investigation in the laboratory?

Circle either “Yes” or “No” for each.

The material can be	Can the claim be tested through scientific investigation in the laboratory?
washed without being damaged.	Yes / No
wrapped around objects without being damaged.	Yes / No
scrunched up without being damaged.	Yes / No
mass-produced cheaply.	Yes / No

CLOTHES SCORING 1***Full Credit***

Code 1: Yes, Yes, Yes, No, in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

S213Q01a Student Response

Code	Hong Kong (%)
1	93.6
0	6.0
9	0.4

S213Q01b Student Response

Code	Hong Kong (%)
1	85.5
0	14.2
9	0.4

S213Q01c Student Response

Code	Hong Kong (%)
1	87.9
0	11.6
9	0.5

S213Q01d Student Response

Code	Hong Kong (%)
1	77.7
0	22.0
9	0.3

% Correct					
Hong Kong					OECD
F.4	F.1-F.3	Girls	Boys	Overall	
70.1	54.0	66.3	62.6	64.5	48.4

Question 5: CLOTHES

S213Q02

Which piece of laboratory equipment would be among the equipment you would need to check that the fabric is conducting electricity?

- A Voltmeter
- B Light box
- C Micrometer
- D Sound meter

CLOTHES SCORING 2

Full Credit

Code 1: A. Voltmeter.

No Credit

Code 0: Other responses.

Code 9: Missing.

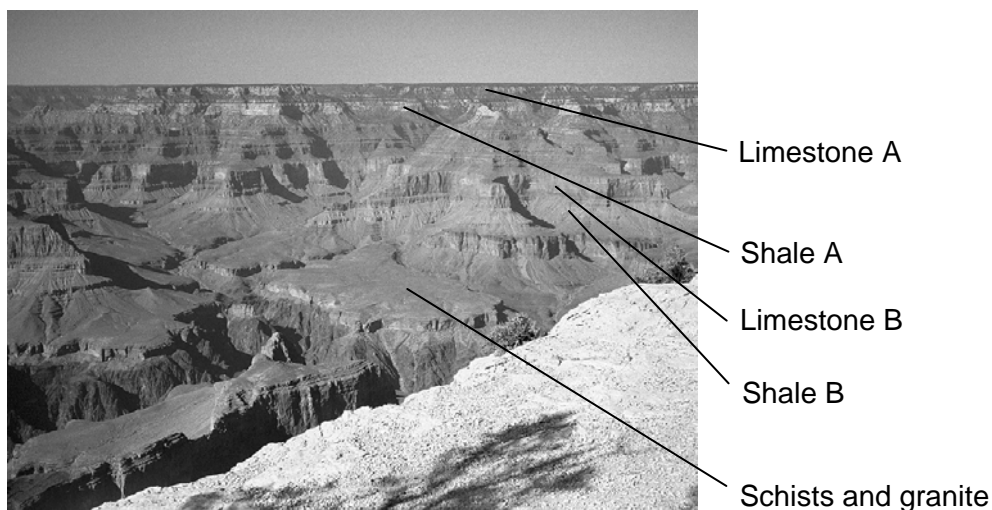
S213Q02 Student Response

	Hong Kong (%)	% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	92.2	93.7	89.5	90.7	93.8	92.2	79.4
B	4.5						
C	1.9						
D	0.7						

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.



Question 6: THE GRAND CANYON

S426Q07

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.

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

THE GRAND CANYON SCORING 7

Full Credit

Code 1: Both correct: Yes, No in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

S426Q07a Student Response

Code	Hong Kong (%)
1	81.5
0	17.6
9	0.9

S426Q07b Student Response

Code	Hong Kong (%)
1	76.5
0	22.5
9	0.9

% Correct					
Hong Kong					OECD
F.4	F.1-F.3	Girls	Boys	Overall	
69.6	62.7	69.5	64.7	67.1	61.1

Question 7: THE GRAND CANYON

S426Q03

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 smoothes the surface of rocks.
- D Freezing water expands in the rock cracks.

THE GRAND CANYON SCORING 3**Full Credit**

Code 1: D. Freezing water expands in the rock cracks.

No Credit

Code 0: Other responses.

Code 9: Missing.

S426Q03 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	14.2						
B	6.6						
C	5.4						
D	72.3	75.8	65.9	73.4	71.2	72.3	67.6

Question 8: THE GRAND CANYON

S426Q05

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.

THE GRAND CANYON SCORING 5**Full Credit**

Code 1: C. An ocean covered this area at that time and then receded later.

No Credit

Code 0: Other responses.

Code 9: Missing.

S426Q05 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	3.3						
B	14.9						
C	74.7						
D	3.9	79.3	66.5	73.5	76.0	74.7	75.8

SUNSCREENS

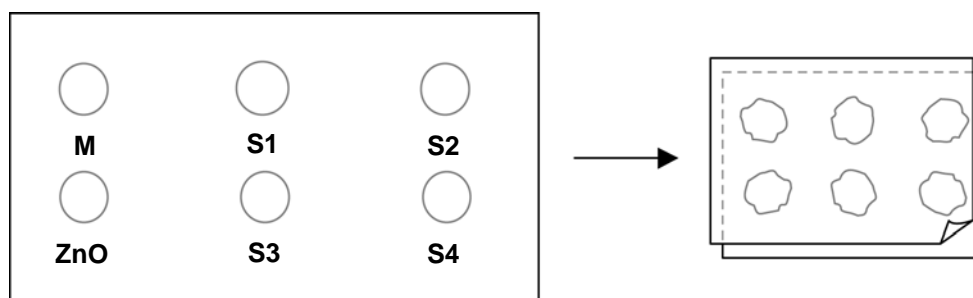
Mimi and Dean wondered which sunscreen product provides the best protection for their skin. Sunscreen products have a *Sun Protection Factor (SPF)* that shows how well each product absorbs the ultraviolet radiation component of sunlight. A high SPF sunscreen protects skin for longer than a low SPF sunscreen.

Mimi thought of a way to compare some different sunscreen products. She and Dean collected the following:

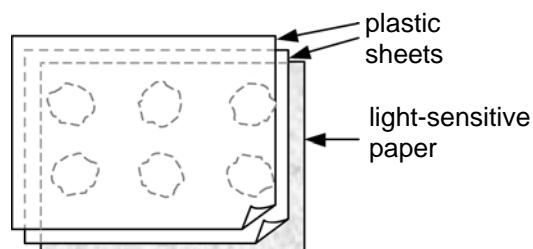
- two sheets of clear plastic that do not absorb sunlight;
- one sheet of light-sensitive paper;
- mineral oil (M) and a cream containing zinc oxide (ZnO); and
- four different sunscreens that they called S1, S2, S3, and S4.

Mimi and Dean included mineral oil because it lets most of the sunlight through, and zinc oxide because it almost completely blocks sunlight.

Dean placed a drop of each substance inside a circle marked on one sheet of plastic, then put the second plastic sheet over the top. He placed a large book on top of both sheets and pressed down.



Mimi then put the plastic sheets on top of the sheet of light-sensitive paper. Light-sensitive paper changes from dark grey to white (or very light grey), depending on how long it is exposed to sunlight. Finally, Dean placed the sheets in a sunny place.



Question 9: SUNSCREENS

S447Q02

Which one of these statements is a scientific description of the role of the mineral oil and the zinc oxide in comparing the effectiveness of the sunscreens?

- A Mineral oil and zinc oxide are both factors being tested.
- B Mineral oil is a factor being tested and zinc oxide is a reference substance.
- C Mineral oil is a reference substance and zinc oxide is a factor being tested.
- D Mineral oil and zinc oxide are both reference substances.

SUNSCREENS SCORING 2**Full Credit**

Code 1: D. Mineral oil and zinc oxide are both reference substances.

No Credit

Code 0: Other responses.

Code 9: Missing.

S447Q02 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	15.7						
B	16.7						
C	19.9						
D	46.0	52.0	35.2	48.5	43.3	46.0	40.4

Question 10: SUNSCREENS

S447Q03

Which one of these questions were Mimi and Dean trying to answer?

- A How does the protection for each sunscreen compare with the others?
- B How do sunscreens protect your skin from ultraviolet radiation?
- C Is there any sunscreen that gives less protection than mineral oil?
- D Is there any sunscreen that gives more protection than zinc oxide?

SUNSCREENS SCORING 3**Full credit**

Code 1: A. How does the protection for each sunscreen compare with the others?

No credit

Code 0: Other responses.

Code 9: Missing.

S447Q03 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	59.8						
B	20.8						
C	6.0						
D	11.6	64.3	51.7	60.1	59.6	59.8	58.0

Question 11: SUNSCREENS

S447Q04

Why was the second sheet of plastic pressed down?

- A To stop the drops from drying out.
- B To spread the drops out as far as possible.
- C To keep the drops inside the marked circles.
- D To make the drops the same thickness.

SUNSCREENS SCORING 4

Full Credit

Code 1: D. To make the drops the same thickness.

No Credit

Code 0: Other responses.

Code 9: Missing.

S447Q04 Student Response

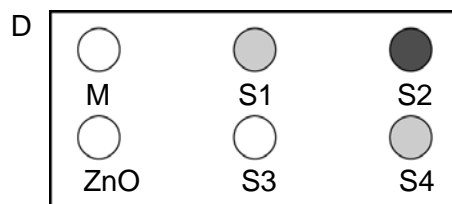
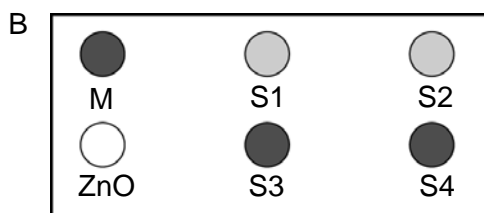
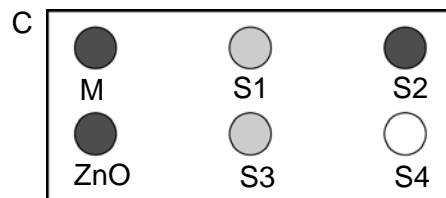
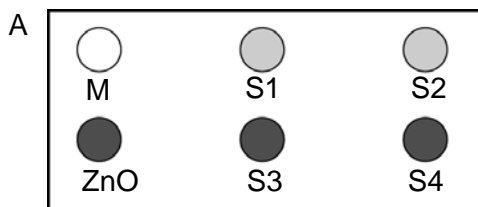
Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	11.6						
B	18.4						
C	18.8						
D	49.6	52.7	43.8	51.5	47.5	49.6	42.7

Question 12: SUNSCREENS

S447Q05 – 0 1 2 9

The light-sensitive paper is a dark grey and fades to a lighter grey when it is exposed to some sunlight, and to white when exposed to a lot of sunlight.

Which one of these diagrams shows a pattern that might occur? Explain why you chose it.



Answer:

Explanation:

.....

SUNSCREENS SCORING 5

Full Credit

Code 2: A. With explanation that the ZnO spot has stayed dark grey (because it blocks sunlight) **and** the M spot has gone white (because mineral oil absorbs very little sunlight).

*[It is **not** necessary (though it is sufficient) to include the further explanations that are shown in parentheses.]*

- A. ZnO has blocked the sunlight as it should and M has let it through.
- I chose A because the mineral oil needs to be the lightest shade while the zinc oxide is the darkest.

Partial Credit

Code 1: A. Gives a correct explanation for either the ZnO spot **or** the M spot, but **not** both.

- A. Mineral oil provides the lowest resistance against UVL. So with other substances the paper would not be white.
- A. Zinc oxide absorbs practically all rays and the diagram shows this.

- A because ZnO blocks the light and M absorbs it.

No Credit

Code 0: Other responses.

- A. *[No reason given.]*
- B. ZnO blocks the sunlight and mineral oil lets it through.

Code 9: Missing.

S447Q05 Student Response

Code	Hong Kong (%)	% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
2	44.1						
1	1.5						
0	42.3						
9	9.1	54.7	31.1	46.3	46.4	46.3	27.4

MARY MONTAGU

Read the following newspaper article and answer the questions that follow.

THE HISTORY OF VACCINATION

Mary Montagu was a beautiful woman. She survived an attack of smallpox in 1715 but she was left covered with scars. While living in Turkey in 1717, she observed a method called inoculation that was commonly used there. This treatment involved scratching a weak type of smallpox virus into the skin of healthy young people who then became sick, but in most cases only with a mild form of the disease.

Mary Montagu was so convinced of the safety of these inoculations that she allowed her son and daughter to be inoculated.

In 1796, Edward Jenner used inoculations of a related disease, cowpox, to produce antibodies against smallpox. Compared with the inoculation of smallpox, this treatment had less side effects and the treated person could not infect others. The treatment became known as vaccination.

Question 13: MARY MONTAGU

S477Q02

What kinds of diseases can people be vaccinated against?

- A Inherited diseases like haemophilia.
- B Diseases that are caused by viruses, like polio.
- C Diseases from the malfunctioning of the body, like diabetes.
- D Any sort of disease that has no cure.

MARY MONTAGU SCORING 2

Full Credit

Code 1: B. Diseases that are caused by viruses, like polio.

No Credit

Code 0: Other responses.

Code 9: Missing.

S477Q02 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	9.4						
B	78.8						
C	4.0						
D	6.2	81.4	74.2	78.7	79.0	78.8	75.0

Question 14: MARY MONTAGU

S477Q03

If animals or humans become sick with an infectious bacterial disease and then recover, the type of bacteria that caused the disease does not usually make them sick again.

What is the reason for this?

- A The body has killed all bacteria that may cause the same kind of disease.
- B The body has made antibodies that kill this type of bacteria before they multiply.
- C The red blood cells kill all bacteria that may cause the same kind of disease.
- D The red blood cells capture and get rid of this type of bacteria from the body.

MARY MONTAGU SCORING 3**Full Credit**

Code 1: B. The body has made antibodies that kill this type of bacteria before they multiply.

No Credit

Code 0: Other responses.

Code 9: Missing.

S477Q03 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	3.2						
B	89.0						
C	4.2						
D	2.3	93.1	81.7	87.6	90.5	89.0	75.0

Question 15: MARY MONTAGU

S477Q04 – 0 1 9

Give one reason why it is recommended that young children and old people, in particular, should be vaccinated against influenza (flu).

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MARY MONTAGU SCORING 4

Full Credit

Code 1: Responses referring to young and/or old people having weaker immune systems than other people, or similar.

Scoring Comment: The reason(s) given must refer to young or old people *in particular* – not to everyone in general. Also, the response must indicate, directly or indirectly, that these people have weaker immune systems than other people– not just that they are generally “weaker”.

- These people have less resistance to getting sick.
- The young and old can't fight off disease as easily as others.
- They are more likely to catch the flu.
- If they get the flu the effects are worse in these people.
- Because organisms of young children and older people are weaker.
- Old people get sick more easily.

No Credit

- Code 0: Other responses.
- So they don't get the flu.
 - They are weaker.
 - They need help to fight the flu.

Code 9: Missing.

S477Q04 Student Response

Code	Hong Kong (%)	% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
1	87.9						
0	9.0						
9	3.1	90.1	83.7	89.0	86.6	87.9	62.1

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.



Question 16: ACID RAIN

S485Q02 – 0 1 9

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 sulfur oxides and nitrogen oxides in the air come from?

.....

.....

ACID RAIN SCORING 2

Full Credit

Code 1: Any one of car exhausts, factory emissions, *burning* fossil fuels such as oil and coal, gases from volcanoes or other similar things.

- Burning coal and gas.
- Oxides in the air come from pollution from factories and industries.

- Volcanoes.
- Fumes from power plants. [*“Power plants” is taken to include power plants that burn fossil fuels.*]
- They come from the burning of materials that contain sulfur and nitrogen.

Responses that include an incorrect as well as a correct source of the pollution.

- Fossil fuel and nuclear power plants. [*Nuclear power plants are not a source of acid rain.*]
- The oxides come from the ozone, atmosphere and meteors coming toward Earth. Also the burning of fossil fuels.

Responses that refer to “pollution” but do not give a source of pollution that is a significant cause of acid rain.

- Pollution.
- The environment in general, the atmosphere we live in – e.g., pollution.
- Gasification, pollution, fires, cigarettes. [*It is not clear what is meant by “gasification”; “fires” is not specific enough; cigarette smoke is not a significant cause of acid rain.*]
- Pollution such as from nuclear power plants.

Scoring Comment: Just mentioning “pollution” is sufficient for Code 1.

No Credit

Code 0: Other responses, including responses that do not mention “pollution” and do not give a significant cause of acid rain.

- They are emitted from plastics.
- They are natural components of air.
- Cigarettes.
- Coal and oil. [*Not specific enough – no reference to “burning”.*]
- Nuclear power plants.
- Industrial waste. [*Not specific enough.*]

Code 9: Missing.

S485Q02 Student Response

Code	Hong Kong (%)	% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
2	65.2						
1	8.0						
0	19.3						
9	7.4	71.7	64.7	66.1	72.4	69.2	50.2

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.

Question 17: ACID RAIN

S485Q03

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

ACID RAIN SCORING 3

Full Credit

Code 1: A. Less than 2.0 grams

No Credit

Code 0: Other responses.

Code 9: Missing.

S485Q03 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	80.5	83.2	75.6	80.8	80.1	80.5	65.8
B	4.7						
C	11.0						
D	1.6						

Question 18: ACID RAIN

S485Q05 – 0 1 2 9

Students who did this experiment also placed marble chips in pure (distilled) water overnight.

Explain why the students included this step in their experiment.

.....
.....

ACID RAIN SCORING 5**Full Credit**

- Code 2: To show that the acid (vinegar) is necessary for the reaction.
- To make sure that rainwater must be acidic like acid rain to cause this reaction.
 - To see whether there are other reasons for the holes in the marble chips.
 - Because it shows that the marble chips don't just react with any fluid since water is neutral.

Partial Credit

- Code 1: To compare with the test of vinegar and marble, but it is not made clear that this is being done to show that the acid (vinegar) is necessary for the reaction.
- To compare with the other test tube.
 - To see whether the marble chip changes in pure water.
 - The students included this step to show what happens when it rains normally on the marble.
 - Because distilled water is not acid.
 - To act as a control.
 - To see the difference between normal water and acidic water (vinegar).

No Credit

- Code 0: Other responses.
- To show the distilled water wasn't an acid.

Code 9: Missing.

S485Q05 Student Response

Code	Hong Kong (%)	% Correct					OECD
		Hong Kong					
		F.4	F.1-F.3	Girls	Boys	Overall	
2	21.3						
1	44.7						
0	23.6						
9	10.4	48.4	35.1	44.3	43.0	43.7	35.3

PHYSICAL EXERCISE

Regular but moderate physical exercise is good for our health.



Question 19: PHYSICAL EXERCISE

S493Q01

What are the advantages of regular physical exercise? Circle "Yes" or "No" for each statement.

Is this an advantage of regular physical exercise?	Yes or No?
Physical exercise helps prevent heart and circulation illnesses.	Yes / No
Physical exercise leads to a healthy diet.	Yes / No
Physical exercise helps to avoid becoming overweight.	Yes / No

PHYSICAL EXERCISE SCORING 1

Full Credit

Code 1: All three correct: Yes, No, Yes in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

S493Q01a Student Response

Code	Hong Kong (%)
1	97.8
0	1.8
9	0.4

S493Q01b Student Response

Code	Hong Kong (%)
1	80.8
0	18.6
9	0.5

S493Q01c Student Response

Code	Hong Kong (%)	% Correct					OECD
		Hong Kong					
		F.4	F.1-F.3	Girls	Boys	Overall	
1	92.7						
0	6.8						
9	0.4	79.5	66.7	78.6	71.4	75.0	53.1

Question 20: PHYSICAL EXERCISE

S493Q03

What happens when muscles are exercised? Circle "Yes" or "No" for each statement.

Does this happen when muscles are exercised?	Yes or No?
Muscles get an increased flow of blood.	Yes / No
Fats are formed in the muscles.	Yes / No

PHYSICAL EXERCISE SCORING 3**Full Credit**

Code 1: Both correct: Yes, No in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

S493Q03a Student Response

Code	Hong Kong (%)
1	94.7
0	4.7
9	0.5

S493Q03b Student Response

Code	Hong Kong (%)
1	87.2
0	12.2
9	0.6

% Correct					
Hong Kong					OECD
F.4	F.1-F.3	Girls	Boys	Overall	
87.0	81.3	84.1	86.0	85.0	82.3

Question 21: PHYSICAL EXERCISE

S493Q05 – 01 11 12 99

Why do you have to breathe more heavily when you're doing physical exercise than when your body is resting?

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.....

.....

PHYSICAL EXERCISE SCORING 5**Full Credit**

Code 11: To remove *increased* levels of carbon dioxide **and** to supply *more* oxygen to your body. *[Do not accept "air" instead of "carbon dioxide" or "oxygen".]*

- When you exercise your body needs more oxygen and produces more carbon dioxide. Breathing does this.
- Breathing faster allows more oxygen into the blood and more carbon dioxide to be removed.

Code 12: To remove *increased* levels of carbon dioxide from your body **or** to supply *more* oxygen to your body, but not both. *[Do not accept "air" instead of "carbon dioxide" or "oxygen".]*

- Because we must get rid of the carbon dioxide that builds up.
- Because the muscles need oxygen. *[The implication is that your body needs more oxygen when you are exercising (using your muscles).]*
- Because physical exercise uses up oxygen.
- You breathe more heavily because you are taking more oxygen into your lungs. *[Poorly expressed, but recognises that you are supplied with more oxygen.]*
- Since you are using so much energy your body needs double or triple the amount of air intake. It also needs to remove the carbon dioxide in your body. *[Code 12 for the second sentence – the implication is that more carbon dioxide than usual has to be removed from your body; the first sentence is not contradictory, though by itself it would get Code 01.]*

No Credit

Code 01: Other responses.

- To get more air in your lungs.
- Because muscles consume more energy. *[Not specific enough.]*
- Because your heart beats faster.
- Your body needs oxygen. *[Does not refer to the need for more oxygen.]*

Code 99: Missing.

S493Q05 Student Response**Code Hong Kong (%)**

12	59.2	<hr/>					
		% Correct					
11	2.3	<hr/>					
		Hong Kong					
01	35.4	F.4	F.1-F.3	Girls	Boys	Overall	OECD
99	3.0	68.0	49.5	59.0	64.1	61.5	45.7

GENETICALLY MODIFIED CROPS

GM CORN SHOULD BE BANNED

Wildlife conservation groups are demanding that a new genetically modified (GM) corn be banned.

This GM corn is designed to be unaffected by a powerful new herbicide that kills conventional corn plants. This new herbicide will kill most of the weeds that grow in cornfields.

The conservationists say that because these weeds are feed for small animals, especially insects, the use of the new herbicide with the GM corn will be bad for the environment. Supporters of the use of the GM corn say that a scientific study has shown that this will not happen.

Here are details of the scientific study mentioned in the above article:

- Corn was planted in 200 fields across the country.
- Each field was divided into two. The genetically modified (GM) corn treated with the powerful new herbicide was grown in one half, and the conventional corn treated with a conventional herbicide was grown in the other half.
- The number of insects found in the GM corn, treated with the new herbicide, was about the same as the number of insects in the conventional corn, treated with the conventional herbicide.

Question 22: GENETICALLY MODIFIED CROPS

S508Q02

What factors were deliberately varied in the scientific study mentioned in the article? Circle "Yes" or "No" for each of the following factors.

Was this factor deliberately varied in the study?	Yes or No?
The number of insects in the environment	Yes / No
The types of herbicide used	Yes / No

GENETICALLY MODIFIED CROPS SCORING 2

Full Credit

Code 1: Both correct: No, Yes in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

S508Q02a Student Response

Code	Hong Kong (%)
1	67.9
0	31.5
9	0.6

S508Q02b Student Response

Code	Hong Kong (%)
1	75.7
0	23.8
9	0.6

% Correct**Hong Kong**

F.4	F.1-F.3	Girls	Boys	Overall	OECD
68.5	53.3	64.0	62.2	63.1	61.0

Question 23: GENETICALLY MODIFIED CROPS

S508Q03

Corn was planted in 200 fields across the country. Why did the scientists use more than one site?

- A So that many farmers could try the new GM corn.
- B To see how much GM corn they could grow.
- C To cover as much land as possible with the GM crop.
- D To include various growth conditions for corn.

GENETICALLY MODIFIED CROPS SCORING 3**Full Credit**

Code 1: D. To include various growth conditions for corn.

No Credit

Code 0: Other responses.

Code 9: Missing.

S508Q03 Student Response

Hong Kong (%)		% Correct					
		Hong Kong					OECD
		F.4	F.1-F.3	Girls	Boys	Overall	
A	10.4						
B	16.8						
C	5.2						
D	65.6	70.7	56.3	66.1	65.0	65.6	74.0