

Y1. Electrical energy is used to power a lamp.

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

The amount of light energy produced is

_____ more than

_____ less than

(check one)

_____ the same as
the amount of electrical energy used.

Give a reason to support your answer.

Y-1

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Science	next page	Physics	Theorizing, Analyzing, and Solving Problems	8%	4%	963

Y-1 Coding Guide

Y1. Electrical energy is used to power a lamp.

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

The amount of light energy produced is

___ more than

___ less than

(check one)

___ the same as
the amount of electrical energy used.

Give a reason to support your answer.

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

Energy released from car engine					B02
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Physics	Understanding Simple Information	B	1	58	Y

Most of the chemical energy released when gasoline burns in a car engine is not used to move the car, but is changed into

A. electricity

B. heat

C. magnetism

D. sound

Sequence of energy changes					D04
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Physics	Understanding Complex Information	C	1	59	Y

Chemical Energy
→
Heat Energy
→
Mechanical Energy
(with wasted heat)

The sequence of energy changes shown in the diagram explains which event?

A. A flashlight is on.

B. A candle burns.

C. Gasoline burns to power a car.

D. Electric current runs a refrigerator.

Energy stored in food					H05
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Physics	Understanding Simple Information	B	1	24	Y

People get energy from the food they eat. Where does the energy stored in food come from?

A. Fertilizers

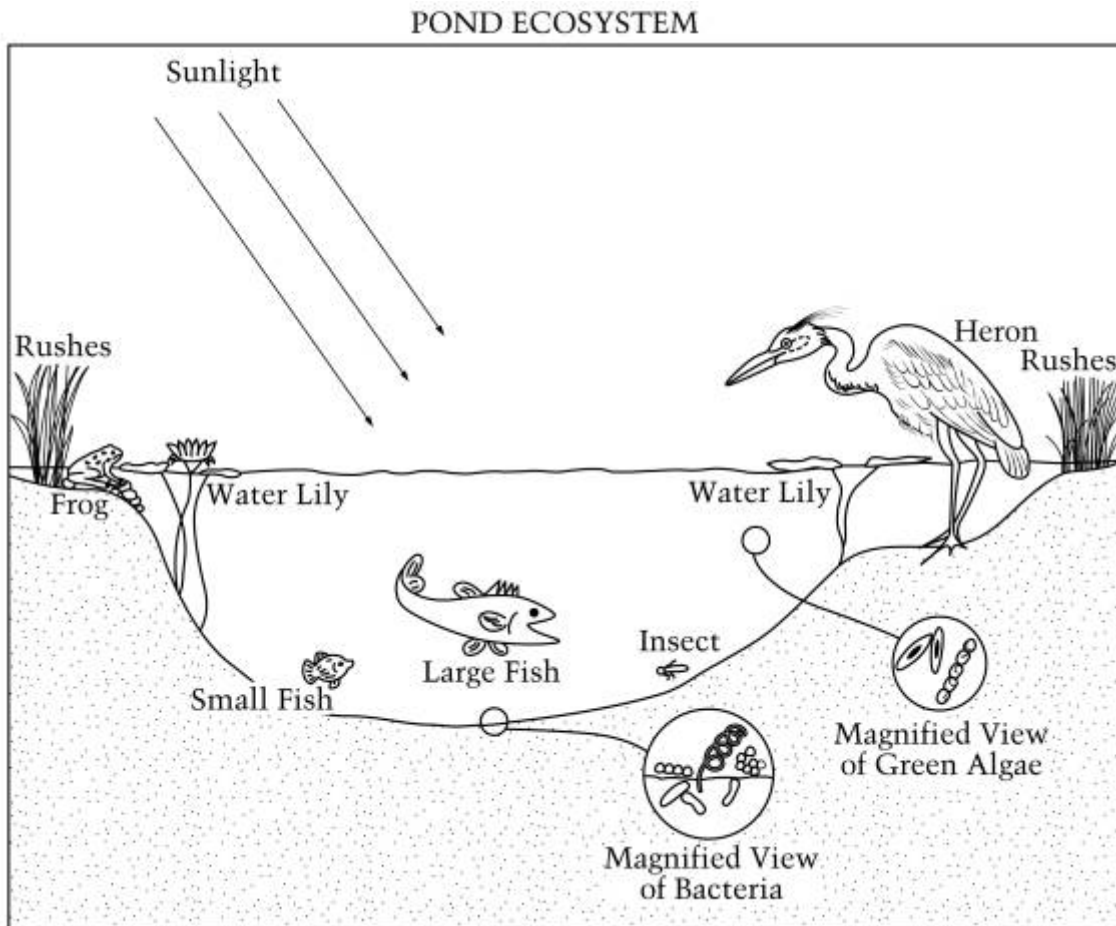
B. The Sun

C. Vitamins

D. The soil

Additional Information (1)**Questions 1-13**

The picture below shows a pond ecosystem. Use this picture and what you know about the things in it to answer the questions in this section.



1. Household appliances convert electricity into one or more different forms of energy. An electric fan can best be described as converting electricity into

- A) heat energy only
- B) heat energy and sound energy only
- C) heat energy, sound energy, and mechanical energy only
- D) heat energy, sound energy, mechanical energy, and chemical energy

2. Is a hamburger an example of stored energy? Explain why or why not.

3. Right before Anna was about to run in a long race, she drank a large glass of orange juice to get energy. Tell how the energy that was in the orange juice actually came from the Sun.

/U> refer to the way electricity is conducted.

-

4. Suppose that you have one of the items from the list in Question 7 that you believe conducts electricity, and that you also have a battery, several wires, and a light bulb.

Explain how you could use these things to do a test to find out if the item you chose from the list in Question 7 does conduct electricity. Draw a picture to help explain your answer.

5. Household appliances convert electricity into one or more different forms of energy. An electric fan can best be described as converting electricity into

- A) heat energy only
- B) heat energy and sound energy only
- C) heat energy, sound energy, and mechanical energy only
- D) heat energy, sound energy, mechanical energy, and chemical energy

6. When propane gas reacts with oxygen in the air to form carbon dioxide and water, heat is released. What is the source of this heat energy?

- A) The kinetic energy of the oxygen
- B) The kinetic energy of the propane
- C) The nuclear energy stored in the oxygen and propane
- D) The chemical energy stored in the oxygen and propane

Question 7 refers to Additional Information (1)

7. Which of the following living things in the pond system uses the energy from sunlight to make its own food?

- A) Insect
- B) Frog

- C) Water lily
- D) Small fish

Question 8 refers to Additional Information (1)

8. Each of the animals in the pond needs food. What are two things that the animals get from their food that keep them alive?

9. Why would a person be cooler on a hot sunny day in a light-colored T-shirt and shorts than in a dark-colored T-shirt and shorts made of the same material?

Some people have proposed that ethyl alcohol (ethanol), which can be produced from corn, should be used in automobiles as a substitute for gasoline.

10. Discuss two environmental impacts that could result from substituting ethyl alcohol for gasoline.

Some people have proposed that ethyl alcohol (ethanol), which can be produced from corn, should be used in automobiles as a substitute for gasoline.

11. Assuming that gasoline and ethyl alcohol cost the same per gallon, outline a plan for comparing the cost of using gasoline to the cost of using ethyl alcohol.

Some people have proposed that ethyl alcohol (ethanol), which can be produced from corn, should be used in automobiles as a substitute for gasoline.

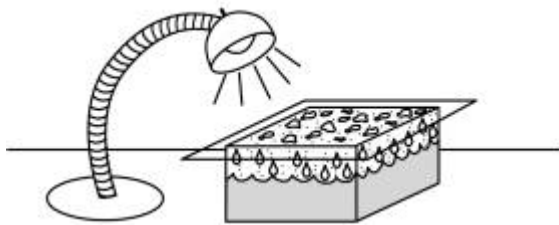
12. Discuss two factors other than environmental concerns and fuel costs that should be considered before making a decision to use ethyl alcohol as an automobile fuel.

13. Which of the following is designed to convert energy into mechanical work?

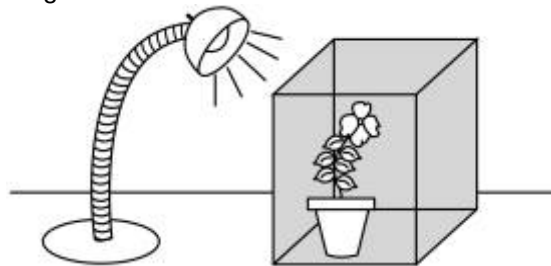
- A) Electric fan
- B) Kerosene heater
- C) Flashlight
- D) Baking oven

14. Which of the following would be the best model to show the interactions between water and the Sun's heat energy in cycles of precipitation?

- A) A light shines on an aquarium covered with glass, and water droplets form on the inside of the glass.



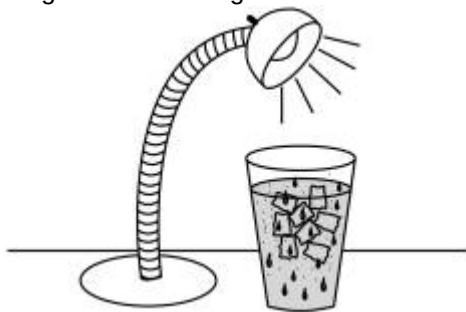
- B) A light shines on a closed cardboard box containing a plant.



- C) A light shines on a man's face. Droplets of sweat form on his face as he exercises.



D) A light shines on a glass of iced tea. Water droplets form on the outside of the glass.



The following question refer to the way electricity is conducted.

15. Look at each item in the list below. Decide if it conducts electricity or does not conduct electricity. Put an X in the box to show what you decided.

Item	Conducts Electricity	Does Not Conduct Electricity
House Key		
Rubber Band		
Coin		
Wooden Toothpick		
Metal Fork		
Plastic Spoon		
Aluminum Foil		

Question 1**Key**

1. Household appliances convert electricity into one or more different forms of energy. An electric fan can best be described as converting electricity into
 - A) heat energy only
 - B) heat energy and sound energy only
 -  C) heat energy, sound energy, and mechanical energy only
 - D) heat energy, sound energy, mechanical energy, and chemical energy

Question 2**Scoring Guide**

Score & Description
Complete Student response indicates "yes" and states that a hamburger contains fat (grease), protein, carbohydrate, nutrients and gives some indication of energy transfer. OR Student response indicates "yes" and traces the energy through the food chain.
Partial Student response indicates "yes" and states that a hamburger contains fat (grease), protein, carbohydrates, nutrients. OR Student response indicates "yes" and states that transfer of energy takes place. OR Student response indicates "yes" and states that food is energy/meat is energy/ meat contains energy.
Unsatisfactory/Incorrect Student demonstrates no understanding of the concept of stored energy by answering "no", or answers "yes" and gives no or an incorrect or irrelevant response.

Question 3**Scoring Guide**

Score & Description
Complete Student correctly explains energy transference from the Sun to orange juice.
Partial Student traces part of the path of energy from the Sun to the orange juice.
Unsatisfactory/Incorrect Student does not trace any part of the path of energy from the Sun to the orange juice.

Question 4**Scoring Guide**

Score & Description
Complete Student draws and/or describes how a battery, wires, and a light bulb could be used to test for electrical conductivity.
Partial Student describes some elements of a complete circuit, but does not clearly describe how the circuit could be modified to test for electrical conductivity (e.g., "hook up the wires to the battery and light bulb"), or student draws a partially correct picture or diagram, or draws an incorrect diagram but specifies that the lighting of the bulb would indicate conductivity.
Unsatisfactory/Incorrect Student is unable to describe an electrical circuit or to explain accurately how to test an item for electrical conductivity.

Question 5**Key**

5. Household appliances convert electricity into one or more different forms of energy. An electric fan can best be described as converting electricity into
- A) heat energy only
 - B) heat energy and sound energy only
 -  C) heat energy, sound energy, and mechanical energy only
 - D) heat energy, sound energy, mechanical energy, and chemical energy

Question 6**Key**

6. When propane gas reacts with oxygen in the air to form carbon dioxide and water, heat is released. What is the source of this heat energy?

- A) The kinetic energy of the oxygen
- B) The kinetic energy of the propane
- C) The nuclear energy stored in the oxygen and propane
- D) The chemical energy stored in the oxygen and propane



Question 7**Key**

7. Which of the following living things in the pond system uses the energy from sunlight to make its own food?

- A) Insect
- B) Frog
- C) Water lily
- D) Small fish



Question 8**Scoring Guide**

Score & Description
Complete Student demonstrates an understanding that living things require energy and raw materials to sustain them by naming two things animals need from their food. Response consists of one of the following: - Response states that animals get both energy and nutrients. - Response states that animals get energy and names one specific nutrient. - Response names two specific nutrients. Examples of specific nutrients include proteins, carbohydrates, lipids, vitamins, and minerals.
Partial Student response names one thing animals need from their food. Response consists of one of the following: - Response states that animals get energy. - Response states that animals get nutrients and names one specific nutrient. - Response names one specific nutrient.
Unsatisfactory/Incorrect Student response provides no reasonable answer about what animals get from their food. Response may state that animals get nutrients from their food without naming a specific nutrient, or may give examples of different types of food the animals eat.

Question 9**Scoring Guide**

Score & Description
Complete Student response compares the reflective and/or absorptive properties of light-colored and dark-colored clothes when such clothes are exposed to the heat from sunlight. Response explains either that light-colored clothes reflect more sunlight than dark-colored clothes, or that dark-colored clothes absorb more sunlight than light-colored clothes.
Partial Student response provides a partial explanation that lacks a comparison between light and dark clothing, or provides an explanation that contains some technically incorrect terminology.
Unsatisfactory/Incorrect Student provides no evidence of understanding why light-colored clothes are cooler on a hot sunny day than dark clothes.

Question 10**Scoring Guide**

Score & Description
Complete Student response must discuss two ways that substituting ethyl alcohol for gasoline could impact the environment in either negative and/or positive ways. For example, less air pollutants may result leading to improved air quality; forests may have to be cleared for crop growth resulting in habitat destruction and increased carbon dioxide concentrations in the atmosphere; and stocks of fresh water may be depleted due to increased crop irrigation.
Partial Student response discusses one positive or one negative environmental impact that could result from substituting ethyl alcohol for gasoline.
Unsatisfactory/Incorrect Student response does not discuss any environmental impacts that could result from substituting ethyl alcohol for gasoline.

Question 11**Scoring Guide**

Score & Description
Complete Student response provides an appropriate plan to compare the cost of using the two fuels by comparing the miles per gallon obtained. The plan must include appropriate controls such as using the same car and driving it the same distance.
Partial Student response provides a partially appropriate plan to compare the costs of using the two fuels. Appropriate controls are not discussed.
Unsatisfactory/Incorrect Student provides no appropriate plan to compare the cost of using the two fuels.

Question 12**Scoring Guide**

Score & Description
Complete Student discusses or explains two factors that should be considered before making a decision to use ethyl alcohol as an automobile fuel. Factors include performance of car, need to convert cars, possible car damage, miles per gallon, effect on jobs, marketing/acceptability, health/safety of people, abundance of supply, reduction of dependence on foreign oil supply.
Partial Student discusses or explains one factor that should be considered before making a decision to use ethyl alcohol as an automobile fuel.
Unsatisfactory/Incorrect Student provides little or no information of the factors that should be considered prior to deciding whether to use ethyl alcohol as a fuel.

Question 13**Key**

13. Which of the following is designed to convert energy into mechanical work?

-  A) Electric fan
B) Kerosene heater
C) Flashlight
D) Baking oven

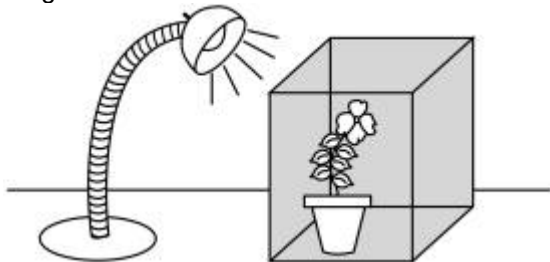
Question 14**Key**

14. Which of the following would be the best model to show the interactions between water and the Sun's heat energy in cycles of precipitation?

- ▶ A) A light shines on an aquarium covered with glass, and water droplets form on the inside of the glass.



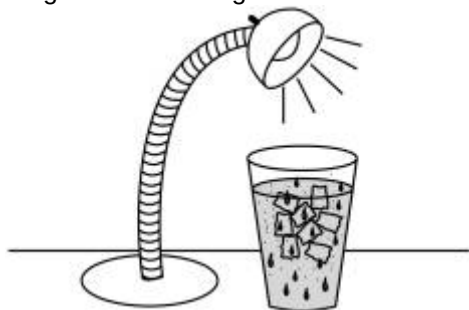
- B) A light shines on a closed cardboard box containing a plant.



- C) A light shines on a man's face. Droplets of sweat form on his face as he exercises.



- D) A light shines on a glass of iced tea. Water droplets form on the outside of the glass.



Question 15**Scoring Guide**

Score & Description
Complete Student places all 7 items in the correct classification: Conductors: coin, metal fork, aluminum foil, house key Non-conductors: rubber band, toothpick, plastic spoon
Essential Student places 4 – 6 items in the correct classification.
Partial Student places 1 – 3 items in the correct classification.
Unsatisfactory/Incorrect Student places no items in the correct classification.

K15. Fossil fuels were formed from

- A. uranium
- B. sea water
- C. sand and gravel
- D. dead plants and animals

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Science	D	Earth Science	Understanding Simple Information	62%	55%	526

P2. A flashlight close to a wall produces a small circle of light compared to the circle it makes when the flashlight is far from the wall. Does more light reach the wall when the flashlight is further away?

___ Yes

___ No (Check one)

Explain your answer.

P-2

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Science	next page	Physics	Theorizing, Analyzing, and Solving Problems	23%	18%	770

P-2 Coding Guide

P2. A flashlight close to a wall produces a small circle of light compared to the circle it makes when the flashlight is far from the wall. Does more light reach the wall when the flashlight is further away?

☐ Yes

☐ No (Check one)

Explain your answer.

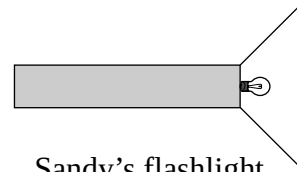
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Code	Response
Correct Response	
10	No. Explains that the same amount reaches the wall.
11	No. Explains that the same amount of light reaches the wall but more spread out.
12	No. Less light reaches the wall because of light absorption by the air.
19	Other correct.
Incorrect Response	
70	Yes. Because light covers a bigger area. <i>Examples: Because the light covers a bigger area.</i> <i>Because light can expand.</i> <i>Because light spreads out.</i>
71	Yes. No explanation.
72	No. There is less light at a greater distance.
73	No. No explanation.
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

Q12. Jim and Sandy each make a flashlight from identical batteries and bulbs. Sandy's flashlight contains a reflector, while Jim's does not.



Jim's flashlight



Sandy's flashlight

Which flashlight shines more light on a wall 5 meters away?
(check one)

_____ Jim's

_____ Sandy's

Explain your answer.

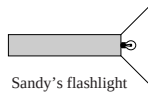
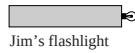
Q-12

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Subject	Item Key	Content Category	Performance Expectation	International Average Percent of Students Responding Correctly		International Difficulty Index
				Upper Grade	Lower Grade	
Science	next page	Physics	Theorizing, Analyzing, and Solving Problems	47%	41%	608

Q-12 Coding Guide

Q12. Jim and Sandy each make a flashlight from identical batteries and bulbs. Sandy's flashlight contains a reflector, while Jim's does not.



Which flashlight shines more light on a wall 5 meters away?
(check one)

_____ Jim's

_____ Sandy's

Explain your answer.

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Code	Response
Correct Response	
10	Sandy's. The reflector reflects all the light towards the wall.
11	Sandy's. In Jim's flashlight the light shines in all directions.
12	Any combination of codes 10, 11.
19	Sandy's. Other correct explanations.
Incorrect Response	
70	Jim's. <i>Examples: There is no reflector. It is not covered.</i>
71	Jim's but with an explanation that belongs to Sandy's.
72	Jim's with another explanation.
73	Jim's or Sandy's, with no explanation.
76	Merely repeats information in stem. <i>Example: Sandy's, because of the reflector.</i>
79	Other incorrect.
Nonresponse	
90	Crossed out/erased, illegible, or impossible to interpret.
99	BLANK

Why light-colored clothes are cooler					F02
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Physics	Understanding Complex Information	A	1	65	Y

.

On a warm sunny day, you will feel cooler wearing light-colored clothes because they

A. reflect more radiation

B. prevent sweating

C. are not as heavy as dark clothes

D. let more air in

Amount of light on wall and ceiling					P02
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Physics	Theorizing, Analyzing and Solving Problems	Rubric	1	24	N

James turns on a flashlight in his bedroom and shines it on his wall one meter away to produce a small circle of light. He then shines the flashlight on his ceiling two meters away to produce a larger circle of light.

a) Does more light reach the ceiling than the wall?
(Check one)

☐ Yes

☐ No

b) Explain your answer.

Note: A correct response is based on the same amount of light reaching both the ceiling and the wall but being more spread out (less bright) on the ceiling. Correct responses must identify **NO** and include an explanation that states that the light is the **same** (Code 10) or that indicates that the light is just more spread out (less bright) on the ceiling **without** explicitly stating **same** (Code 11). If the explanation merely repeats information that is in the stem, it is scored as incorrect (Code 71) even if **NO** is checked. If a response indicates that there is **less** light on the ceiling, the explanation must include a correct reason based on more air absorption/scattering at a greater distance to receive the correct Code 12. Responses that indicate **less** light at a greater distance **without** further explanation should receive Code 70.

Code	Response	Item: S022043
Correct Response		
10	No. Explains that the same amount of light reaches the wall and ceiling. (May also refer to light being more spread out on the ceiling or less concentrated/focused/bright). <i>Examples: No. It is going to be the same amount of light because James is using the same flashlight. No. The light might be bigger but will not be as bright. They are equal. No. The same amount of light hits the ceiling but is more spread out.</i>	
11	No. Explains (or shows in a diagram) that light is (only) more spread out (less bright) at a greater distance. (Does not explicitly state that the light is the same.) <i>Example: No. It only looks bigger because it spreads out more as it gets farther away.</i>	
12	No. Explains that less light reaches the ceiling because of more air absorption/scattering at a greater distance. <i>Example: No. The ceiling is further away, and a little bit more of the light is soaked up by the air.</i>	
19	No. Other correct explanation.	
Incorrect Response		
70	No. States that less light reaches the ceiling with inadequate explanation related to distance from source. (Does not include explanation of less light due to air absorption or scattering as in Code 12). <i>Examples: No. Because the flashlight is closer to the wall, the wall will receive more light. No. The ceiling is further than the wall is so there is less light.</i>	
71	No. Other incorrect/inadequate or no explanation. (Includes explanations that merely paraphrase the stem). <i>Example: No. When it is close its a smaller circle.</i>	
72	Yes. Explanation based on light being bigger or more spread out. <i>Examples: Yes. Because the light makes a bigger circle. Yes. Because if you move back it makes a large circle on the wall and if you move close it makes a small circle. Yes. The further it goes, the bigger it gets.</i>	
73	Yes. Other incorrect/inadequate or no explanation.	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task).	
Nonresponse		
99	BLANK	

TIMSS 2003

Content Domain

Environmental Science

Main Topic

**Use and conservation of
natural resources**

Cognitive Domain

Conceptual Understanding

Key

See scoring guide

Write down one renewable energy source and describe one way that people make use of it.

Energy Source: _____

Use:

S032242

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Note: For credit, responses must name a renewable energy source or device and a use that indicates how the energy from the source/device is applied. Credit is NOT given for responses that name a renewable source/device with no or inadequate description of its use.

Code	Response	Item: S032242
	Correct Response	
10	Sun or sunlight (solar energy) with a correct description of its use. <i>Examples: Sun. It is used to heat water by solar panels.</i> <i>Sunlight. It keeps us warm.</i> Note: Must name “sun”, “sunlight” or “solar energy” for full credit. If just “light” is named, then use Code 11.	
11	Wind (windmills) with a correct description of its use. <i>Examples: Windmills. Are for grinding corns or for pumping water.</i> <i>Wind turbines to generate electricity.</i>	
12	Water (waves, tides, water wheels, etc.) with a correct description of its use. <i>Examples: Tidal barrage. To generate electricity.</i> <i>Water. To generate electricity.</i>	
19	Other correct <i>Examples: Food. To give the body energy.</i> <i>Wood. It is used in wood stoves for cooking.</i>	
	Incorrect Response	
70	Names any fossil fuel (e.g., coal, oil, gasoline). <i>Examples: Gas. You can use it for heating.</i>	
71	Names a renewable energy source/device with no or inadequate description of use. <i>Examples: Water. You can heat, freeze and melt it.</i> <i>Sunlight.</i> <i>Windmill.</i>	
72	Names “light” (without connection to the Sun) with or without a correct description of use. <i>Examples: Light energy. It help us to see.</i> <i>Light.</i>	
79	Other incorrect (including crossed out/erased, stray marks, illegible or off task) <i>Examples: Electricity. Used for cooking.</i> <i>Batteries. To power a torch.</i>	
	Nonresponse	
99	Blank	

* : Revised following data collection.

TIMSS 2003

Content Domain

Environmental Science

Main Topic

**Use and conservation of
natural resources**

Cognitive Domain

Conceptual Understanding

Key

C

S032422

Which group of energy sources are ALL renewable?

- (A) coal, oil, and natural gas
- (B) solar, oil, and geothermal
- (C) wind, solar, and tidal
- (D) natural gas, solar, and tidal

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Result of global warming					R06
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly	Used in 1995
Environmental and Resource Issues	Understanding Simple Information	A	1	33	N

What is predicted to be a result of global warming?

A. Rising ocean level

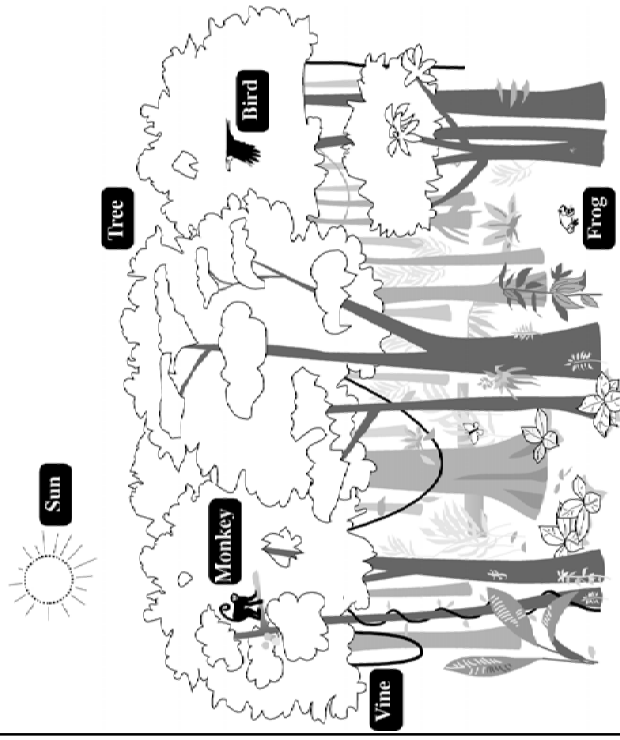
B. More severe earthquakes

C. Larger volcanic eruptions

D. Thinning ozone layer

Importance of trees/sun in rain forest				X02A
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly
Life Science	Theorizing, Analyzing and Solving Problems	Rubric	1	72
				Used in 1995
				N

In the picture of a rainforest, six objects have been labeled.



Explain why each of the following is important in maintaining the ecosystem in the rainforest.

A. The Tree

B. The Sun

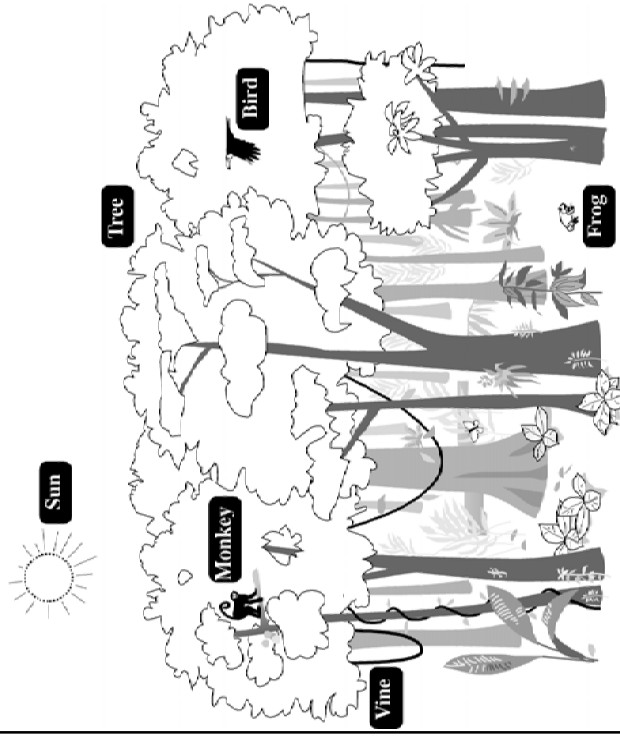
A: Codes for Trees

Note: If student response refers to oxygen/carbon dioxide cycle, use Code 10 even if other reasons are given. If more than one reason is given, assign the code corresponding to the first correct reason, giving priority to Code 10.

Code	Response	Item: S022172a
Correct Response		
10	Trees produce oxygen and/or use carbon dioxide. <i>Examples:</i> Trees provide oxygen. Trees are important because the ecosystem needs the oxygen they give off. The trees take in carbon dioxide and give off oxygen which animals need. The trees help the rainforest by turning the carbon dioxide into oxygen. The trees recycle carbon dioxide which animals give out.	
11	Trees provide food or energy. <i>Examples:</i> Food energy for Earth. Trees provide fruit for the animals. Animals eat leaves on trees. Trees provide energy for the ecosystem.	
12	Trees provide a place to hide/shelter. <i>Examples:</i> Trees are important because they give a home for the animals. The trees provide a habitat (for animals). Trees are where the monkeys and birds live.	
13	Trees provide shade or protection from the Sun. <i>Examples:</i> Trees block sunlight to protect animals. It would get too hot in the forest without shade from trees.	
19	Other correct.	
Incorrect Response		
70	Response too vague. <i>Examples:</i> You need trees for the animals. They are part of the whole ecosystem.	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task).	
Nonresponse		
99	BLANK	

Importance of trees/sun in rain forest				X02B
Content Category	Performance Expectation	Item Key	Score Points	International Average Percentage of 8th Grade Students Responding Correctly
Life Science	Theorizing, Analyzing and Solving Problems	Rubric	1	68
				Used in 1995
				N

In the picture of a rainforest, six objects have been labeled.



Explain why each of the following is important in maintaining the ecosystem in the rainforest.

A. The Tree

B. The Sun

B: Codes for Sun

Note: If response refers explicitly to **photosynthesis**, use Code 10 even if other reasons are given. If more than one reason is given, assign the code corresponding to the first correct reason, giving priority to Code 10 and then Code 11.

Code	Response	Item: S022172b
	Correct Response	
10	Sun is needed for photosynthesis (by plants). <i>Examples:</i> The Sun provides light energy for plants so they can grow using photosynthesis. The Sun gives energy to chlorophyll in plants to make photosynthesis.	
11	Sun is needed in order for chlorophyll in plants to produce food. (Does not explicitly mention photosynthesis). <i>Examples:</i> The trees use chlorophyll and make their food from the Sun. Sun gives food to the trees through chlorophyll.	
12	Sun provides energy and/or is needed for plant growth. (No mention of photosynthesis or chlorophyll). <i>Examples:</i> The Sun helps trees stay healthy and strong. The Sun helps things grow and it gives nutrients to the trees. The Sun keeps the trees and all plants living which give us oxygen. The Sun gives energy.	
13	Sun provides heat (warmth) or maintains the temperature. (No mention of photosynthesis or chlorophyll). <i>Examples:</i> The Sun heats the Earth so the plants and animals will not freeze to death. The Sun creates heat that helps animals to grow and the trees to make their food.	
14	Sun provides light and/or enables animals to see. <i>Examples:</i> The Sun is the source of light for plants and animals. The animals need the light from the Sun in order to see.	
19	Other correct.	
	Incorrect Response	
70	Response too vague. <i>Examples:</i> Sun is needed by plants and animals. Everything needs the sun to survive. The Sun is probably the most important part of the ecosystem. It nourishes everything.	
79	Other incorrect (including crossed out/erased, stray marks, illegible, or off task).	
	Nonresponse	
99	BLANK	

TIMSS 2003

Content Domain

Environmental Science

Main Topic

Changes in environment

Cognitive Domain

Factual Knowledge

Key

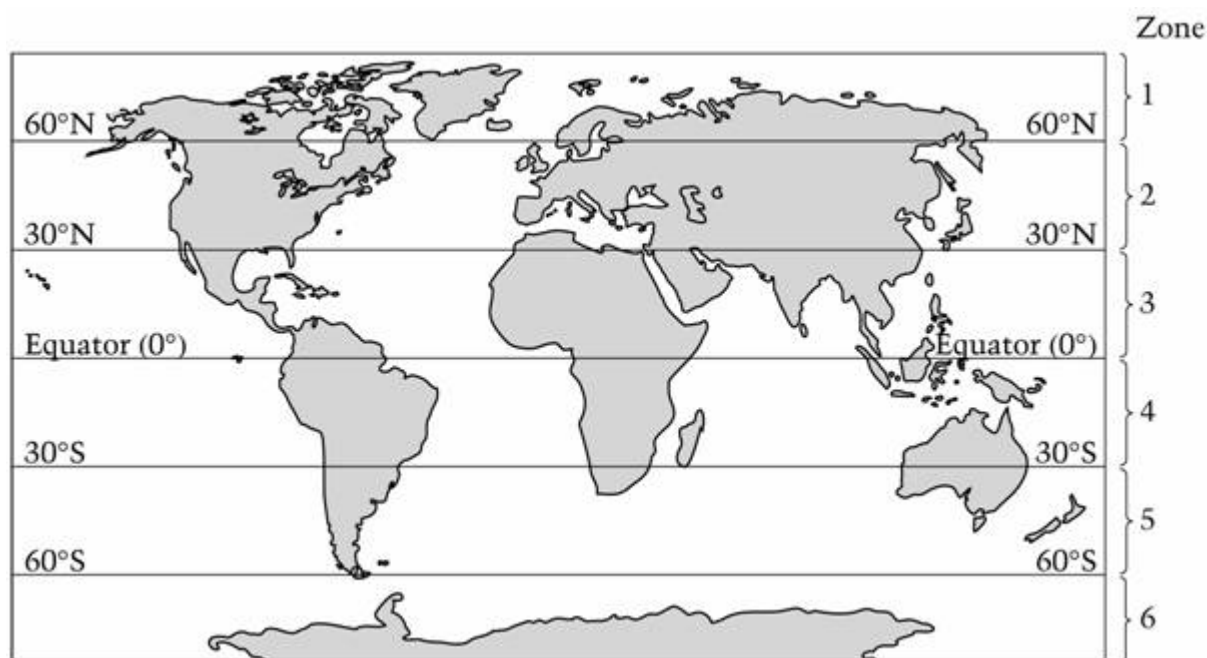
A

The burning of fossil fuels has increased the carbon dioxide content of the atmosphere. What is a possible effect that the increased amount of carbon dioxide is likely to have on our planet?

- Ⓐ A warmer climate
- Ⓑ A cooler climate
- Ⓒ Lower relative humidity
- Ⓓ More ozone in the atmosphere

S012017

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1. Which zones in the map above are most likely to have a temperate climate (warm summers and cold winters) ?

- A) 1 and 6
- B) 2 and 5
- C) 3 and 4
- D) 1, 2, and 3

2. When you exercise strenuously, your body produces excess heat. Describe what your body does to help prevent your temperature from rising excessively, and explain why the body's response is effective.

Some scientists think that the Earth's climate is getting warmer.

3. If these scientists are correct and the Earth keeps getting warmer for the next 50 years, what will happen to the oceans? Explain why this would happen.

If these scientists are correct, what things about the Earth's weather will change? Explain why this would happen.

If these scientists are correct, what will happen to plants? Explain why this would happen.

4. The Earth's climate may be getting warmer because of some things that people do. List two human activities that may contribute to warming of the Earth's climate.

5. Air in the atmosphere continuously moves by convection. At the equator, air rises; at the poles, it sinks. This occurs because

- A) the Earth's ozone layer is thinner at the equator than at the poles
- B) the Earth's magnetic field is stronger at the poles than at the equator
- C) warm air can hold less water vapor than can cold air
- D) warm air is less dense than cold air

Question 1**Key**

1. Which zones in the map above are most likely to have a temperate climate (warm summers and cold winters) ?

-  A) 1 and 6
B) 2 and 5
C) 3 and 4
D) 1, 2, and 3

Question 2**Scoring Guide**

Score & Description
Complete Student indicates that the body keeps its temperature from rising through sweating or by blood vessels dilating and states how these are effective.
Partial Student indicates that the body keeps its temperature from rising through sweating or by blood vessels dilating but does not explain fully how the mechanism works.
Unsatisfactory/Incorrect Student provides little or no evidence of knowledge of any mechanism for losing heat during exercise.

Question 3**Scoring Guide**

Score & Description
Complete Student predicts the effects on oceans, weather, and plants and explains why each predicted event might occur. Response consists of six correct parts: a prediction and an explanation for each of oceans, weather, and plants.
Essential Student response consists of three to five correct parts.
Partial Student response consists of one or two correct parts.
Unsatisfactory/Incorrect Student response does not include any predictions of the effects of global warming.

Question 4**Scoring Guide**

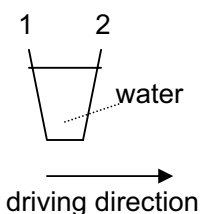
Score & Description
Complete Student lists two human activities that are thought to contribute to global warming.
Partial Student lists one activity that may contribute to global warming.
Unsatisfactory/Incorrect Student response does not indicate an understanding of the relationship of humans to global warming.

S127: Buses

Question 1: BUSES

S127Q01

A bus is driving along a straight stretch of road. The bus driver, named Ray, has a cup of water resting on the dashboard:



Suddenly Ray has to slam on the brakes.

What is most likely to happen to the water in the cup?

- A The water will stay horizontal.
- B The water will spill over side 1.
- C The water will spill over side 2.
- D The water will spill but you cannot tell if it will spill at side 1 or side 2.

BUSES SCORING 1

QUESTION INTENT: Process: Demonstrating knowledge and understanding
Theme: Forces and movement
Area: Science in technologies

Full credit

Code 1: C. The water will spill over side 2.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 4: BUSES

S127Q04- 0 1 8 9

Ray's bus is, like most buses, powered by a petrol engine. These buses contribute to environmental pollution.

Some cities have trolley buses: they are powered by an electric engine. The voltage needed for such an electric engine is provided by overhead lines (like electric trains).

The electricity is supplied by a power station using fossil fuels.

Supporters for the use of trolley buses in a city say that these buses don't contribute to environmental pollution.

Are these supporters right? Explain your answer.

.....

.....

.....

BUSES SCORING 4

QUESTION INTENT: Process: Demonstrating knowledge and understanding

Theme: Energy transformations

Area: Science in Earth and environment

Full credit

Code1: Gives an answer in which it is stated that the power station also contributes to environmental pollution:

- No, because the power station causes environmental pollution as well.
- Yes, but this is only true for the city itself; the power station however causes environmental pollution.

No credit

Code 0: No or yes, without a correct explanation.

Code 8: Off task.

Code 9: Missing.

Example responses

Code 1:

- Yes and No. The buses don't pollute the city which is good, but the power station does pollute and that's not very good.
- The buses do contribute to the environmental pollution by using fossil fuels but they're not as harmful as normal buses with all their gases. *[Note: This answer can be given the benefit of the doubt.]*

Code 0:

- Well they have no outlet so no harmful smoke goes into the air which can damage the O-zone layer, and having electricity created by fossil fuels is also more environmental friendly.
- Yes, they are. Because electricity isn't harmful for the environment we only use up our Earth's gas.

S210: Climate Change

Climate Change Text 1

Read the following information and answer the questions which follow.

WHAT HUMAN ACTIVITIES CONTRIBUTE TO CLIMATE CHANGE?

The burning of coal, oil and natural gas, as well as deforestation and various agricultural and industrial practices, are altering the composition of the atmosphere and contributing to climate change. These human activities have led to increased concentrations of particles and greenhouse gases in the atmosphere. The relative importance of the main contributors to temperature change is shown in Figure 1. Increased concentrations of carbon dioxide and methane have a heating effect. Increased concentrations of particles have a cooling effect in two ways, labelled 'Particles' and 'Particle effects on clouds'.

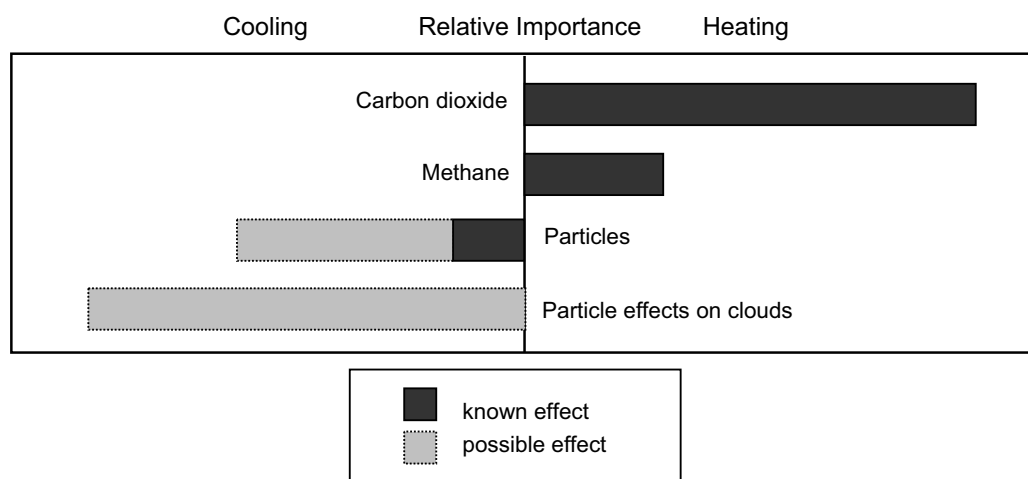


Figure 1: Relative importance of the main contributors to change in temperature of the atmosphere.

Bars extending to the right of the centre line indicate a heating effect. Bars extending to the left of the centre line indicate a cooling effect. The relative effect of 'Particles' and 'Particle effects on clouds' are quite uncertain: in each case the possible effect is somewhere in the range shown by the light grey bar.

Source: adapted from <http://www.gcric.org/ipcc/qa/04.html>

S307: Corn

Consider the following newspaper report.

DUTCHMAN USES CORN AS FUEL

Auke Ferwerda's stove contains a few logs burning quietly with low flames. From a paper bag next to the stove he takes a handful of corn and puts it onto the flames. Immediately the fire flares up brightly. "Look here," Ferwerda says, "The window of the stove stays clean and transparent. Combustion is complete." Ferwerda talks about the fact that corn can be used as fuel as well as cattle food. As far as he is concerned, this is the future.

Ferwerda points out that corn, in the form of cattle food, is in fact a type of fuel too. Cows eat corn to get energy out of it. But, Ferwerda explains, the sale of corn for fuel instead of for cattle food might be much more profitable for farmers.

Ferwerda has become convinced that, in the long run, corn will be widely used as fuel. He imagines what it will be like harvesting, storing, drying and packing the grains in bags for sale.

Ferwerda is currently investigating whether the whole corn plant could be used as fuel, but this research has not been completed yet.

What Ferwerda also needs to consider is the amount of attention being focused on carbon dioxide. Carbon

dioxide is regarded as the main cause of the increase of the Greenhouse effect. The increase of the Greenhouse effect is said to be the cause of the increasing average temperature of the Earth's atmosphere.

In Ferwerda's view, however, there is nothing wrong with carbon dioxide. On the contrary, he argues, plants absorb it and convert it into oxygen for human beings.

However, Ferwerda's plans may clash with those of the government, which is actually trying to reduce the emission of carbon dioxide. Ferwerda says, "There are many scientists who say that carbon dioxide is not the main cause of the Greenhouse effect."

Question 2: CORN

S307Q02

Ferwerda compares corn used as fuel to corn used as food.

The first column of the table below contains a list of things that happen when corn burns.

Do these things also happen when corn works as a fuel in an animal body?

Circle Yes or No for each.

When corn burns:	Does this also happen when corn works as a fuel in an animal body?
Oxygen is consumed.	Yes / No
Carbon dioxide is produced.	Yes / No
Energy is produced.	Yes / No

CORN SCORING 2**Full credit**

Code 1: Yes, Yes, Yes.

No credit

Code 0: Other responses.

Code 9: Missing.

Question 5: CORN

S307Q05 - 0 1 9

In the article a conversion of carbon dioxide is described: "...plants absorb it and convert it into oxygen ...".

There are more substances involved in this conversion than carbon dioxide and oxygen only. The conversion can be represented in the following way:

carbon dioxide + water → oxygen +

Write in the box the name of the missing substance.

CORN SCORING 5**Full credit**

Code 1: One of the following names:

- glucose

- sugar(s)
- carbohydrate(s)
- saccharide(s)
- starch

No credit

Code 0: Other responses.

Code 9: Missing.

Question 7: CORN

S307Q07

At the end of the article Ferwerda refers to scientists who say that carbon dioxide is not the main cause of the Greenhouse effect.

Karin finds the following table showing the relative Greenhouse effect caused by four gases:

Relative Greenhouse effect per molecule of gas			
Carbon dioxide	Methane	Nitrous oxide	Chlorofluorocarbons
1	30	160	17 000

From this table Karin cannot conclude which gas is the main cause of the increase of the Greenhouse effect. The data in the table need to be combined with other data for Karin to conclude which gas is the main cause of the increase of the Greenhouse effect.

Which other data does Karin need to collect?

- A Data about the origin of the four gases.
- B Data about the absorption of the four gases by plants.
- C Data about the size of each of the four types of molecules.
- D Data about the amounts of each of the four gases in the atmosphere.

CORN SCORING 7

Full credit

Score 1: D. Data about the amounts of each of the four gases in the atmosphere.

No credit

Score 0: Other responses.

Code 9: Missing.

S420: Hot Work

Question 1: HOT WORK

S420Q01

Peter is working on repairs to an old house. He has left a bottle of water, some metal nails, and a piece of timber inside the boot of his car. After the car has been out in the sun for three hours, the temperature inside the car reaches about 40 °C.

What happens to the objects in the car? Circle “Yes” or “No” for each statement.

Does this happen to the object(s)?	Yes or No?
They all have the same temperature.	Yes / No
After some time the water begins to boil.	Yes / No
After some time the metal nails begin to glow red.	Yes / No

HOT WORK SCORING 1

Full credit

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

No credit

Code 0: Other responses.

Code 9: Missing.

Question 3: HOT WORK

S420Q03

For drinks during the day, Peter has a cup of hot coffee, at a temperature of about 90 °C, and a cup of cold mineral water, with a temperature of about 5 °C. The cups are of identical type and size and the volume of each drink is the same. Peter leaves the cups sitting in a room where the temperature is about 20 °C.

What are the temperatures of the **coffee** and the **mineral water** likely to be after 10 minutes?

- A 70 °C and 10 °C
- B 90 °C and 5 °C
- C 70 °C and 25 °C
- D 20 °C and 20 °C

HOT WORK SCORING 3

Full credit

Code 1: A. 70 °C and 10 °C

No credit

Code 0: Other responses.

Code 9: Missing.

Question 10N: HOT WORK

S420Q10N

How much interest do you have in the following information?

Tick only one box in each row.

	<i>High Interest</i>	<i>Medium Interest</i>	<i>Low Interest</i>	<i>No Interest</i>
a) Understanding how the shape of the cup influences the speed at which coffee cools	☐ ₁	☐ ₂	☐ ₃	☐ ₄
b) Learning about the different arrangements of atoms in wood, water and steel	☐ ₁	☐ ₂	☐ ₃	☐ ₄
c) Knowing why different solids conduct heat differently	☐ ₁	☐ ₂	☐ ₃	☐ ₄

S529: Wind Farms

Many people believe that wind should replace oil and coal as a source of energy for producing electricity. The structures in the picture are windmills with blades that are rotated by the wind. These rotations cause electricity to be produced by generators that are turned by the windmills.

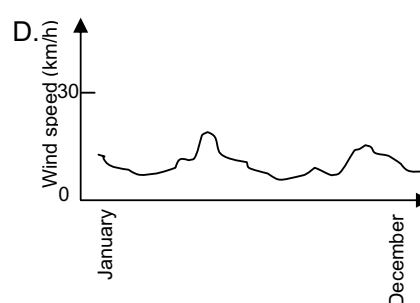
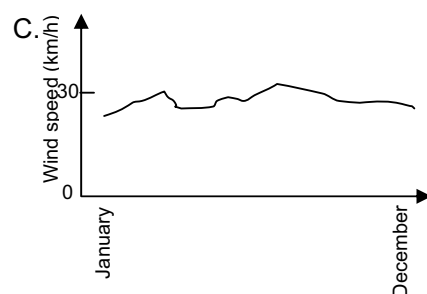
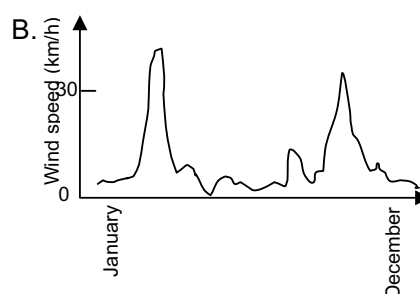
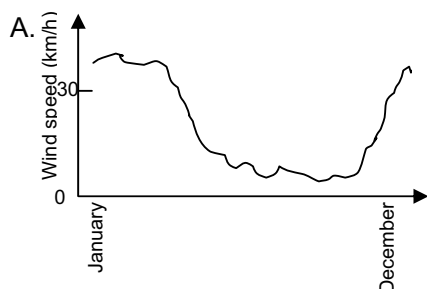


A wind farm

Question 1: WIND FARMS

S529Q01

The graphs below show the average wind speeds in four different places throughout a year. Which one of the graphs indicates the most appropriate place to establish a wind farm for generating electricity?



WIND FARMS SCORING 1

Full credit

Code 1: C

No credit

Code 0: Other responses.

Code 9: Missing.

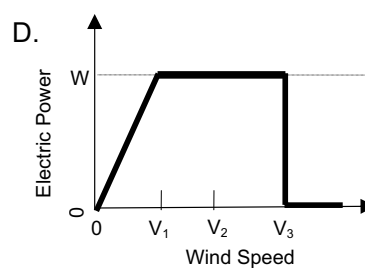
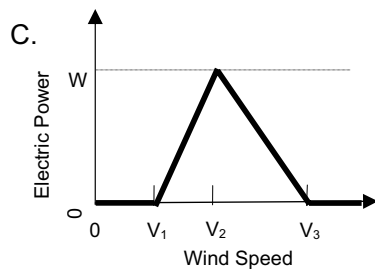
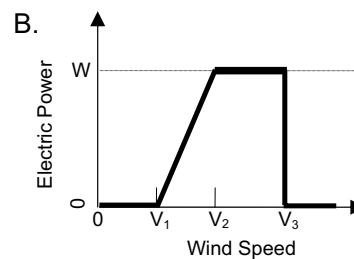
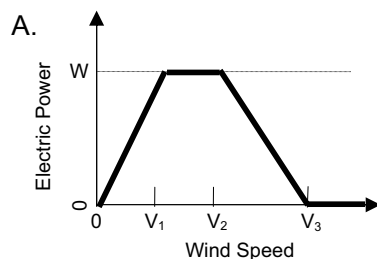
Question 2: WIND FARMS

S529Q02

The stronger the wind, the faster the windmill blades rotate and the greater the electric power output. However, there is not a direct relationship between wind speed and electric power in a real setting. Below are four working conditions of electricity generation in a real wind farm.

- The windmill blades start rotating when the wind speed reaches V_1 .
- The electric power output reaches a maximum (W) when the wind speed is V_2 .
- For safety reasons, the blades are prevented from rotating faster than they do when the wind speed is V_2 .
- The blades stop rotating when the wind speed reaches V_3 .

Which one of the following graphs best represents the relationship between wind speed and electric power output under these working conditions?



WIND FARMS SCORING 2

Full credit

Code 1: B

No credit

Code 0: Other responses

Code 9: Missing

Question 3: WIND FARMS

S529Q03

The higher the altitude the more slowly windmills rotate at the same wind speed.

Which one of the following is the best reason why the blades of windmills rotate more slowly in higher places at the same wind speed?

- A The air is less dense as altitude increases.
- B The temperature is lower as altitude increases.
- C Gravity becomes less as altitude increases.
- D It rains more often as altitude increases.

WIND FARMS SCORING 3***Full credit***

Code 1: A. The air is less dense as altitude increases.

No credit

Code 0: Other responses

Code 9: Missing

Question 4: WIND FARMS

S529Q04 – 0 1 2 9

Describe one specific advantage, and one specific disadvantage, of using wind to generate electricity compared with using fossil fuels like coal and oil.

An advantage

.....

A disadvantage

.....

WIND FARMS SCORING 4***Full credit***

Code 2: One **specific** advantage and one **specific** disadvantage are described.

Scoring Comment: It is possible for the cost of wind farms to be seen as an advantage or disadvantage depending on what aspect is considered (e.g., establishment costs or running costs). Hence, mentioning “the cost” involved, without further explanation, is not sufficient to gain credit as either an advantage or a disadvantage.

[Advantage]

- Do not discharge carbon dioxide (CO₂).
- Do not consume fossil fuels.
- The wind resource will not be used up.
- After the wind generator is established, the cost for electric generation is cheap.
- No waste and/or no toxic substance will be emitted.
- Using natural forces or clean energy.
- Environmentally friendly and will last for a very long time.

[Disadvantage]

- Generation on demand is not possible. *[Because the wind speed cannot be controlled.]*
- Good places for windmills are limited.
- The windmill could be damaged by too strong wind.
- The amount of power generated by each windmill is relatively small.
- Noise pollution occurs in some cases.
- Birds are sometimes killed when they crash into the rotors.
- Natural views are altered *[Visual pollution]*.
- Expensive to set up

Partial credit

Code 1: Either a correct advantage or a correct disadvantage is described (as shown in the full credit examples) but not both

No credit

Code 0: No correct advantage or correct disadvantage is described. Individual examples of unacceptable advantages or disadvantages are given below.

- Good for the environment or nature. *[This answer is a general value statement.]*
- Bad for the environment or nature
- It costs less to build a wind power generator than to build a fossil fuel power plant. *[This ignores the fact that a great number of wind power generators would be needed to produce the same amount of power as a fossil fuel power plant.]*
- It wouldn't cost as much.

Code 9: Missing.