New England Common Assessment Program

Released Items
Support Materials
2011

Grade 11
Science

NECAP 2011 RELEASED ITEMS
GRADE 11 SCIENCE

Grade 11 Science Released Item Information

Item Number	Big Idea[1]	Assessment Target	Depth of Knowledge Code	Item Type[2]	Answer Key	Total Possible Points
1	FAF	PS 1-4	1	MC	B	1
2	SAE	PS 2-7	2	MC	C	1
3	POC	PS 3-8	2	MC	D	1
4	INQ	ESS 1-4	2	MC	C	1
5	NOS	ESS 3-5	1	MC	D	1
6	SAE	ESS 3-7	1	MC	A	1
7	POC	ESS 3-8	2	CR		4
8	FAF	LS 1-1	2	MC	C	1
9	INQ	LS 3-7	2	MC	C	1
10	POC	LS 3-8	2	MC	B	1

Grade 11 Science Released Inquiry Task Information

Item Number	Big Idea[1]	Inquiry Construct	Depth of Knowledge Code	Item Type[2]	Total Possible Points
1	INQ	1	2	SA	2
2	INQ	6	2	SA	2
3	INQ	8	2	CR	3
4	INQ	10	2	SA	2
5	INQ	9	2	SA	2
6	INQ	12	3	SA	2
7	INQ	13	3	SA	2
8	INQ	12	3	CR	3

[1]Big Idea: NOS = Nature of Science, SAE = Systems and Energy, MAS = Models and Scale, POC = Patterns of Change, FAF = Form and Function, INQ = Scientific Inquiry

[2]Item Type: MC = Multiple Choice, CR = Constructed Response, SA = Short Answer

PS1 (9–11) FAF-4	Students will model and explain the structure of an atom or explain how an atom's electron configuration, particularly the outermost electron(s), determines how that atom can interact with other atoms.

1 Oxygen (O) atoms combine to form diatomic molecules (O_2). Which statement explains the process through which these molecules are formed?

A. Two oxygen atoms share some of their protons with each other.

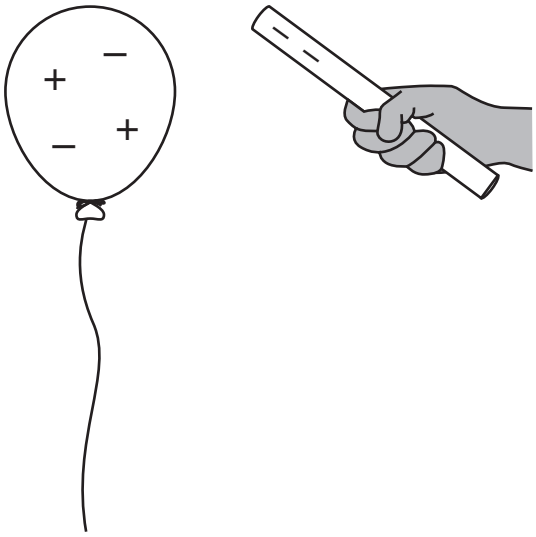
B. Two oxygen atoms share some of their electrons with each other.

C. Protons are transferred from one oxygen atom to the other oxygen atom.

D. Electrons are transferred from one oxygen atom to the other oxygen atom.

PS2 (9–11) SAE-7	Students will explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles.

2 The diagram below shows the electrical charges on a balloon and a rod. The balloon has a balanced charge and the rod has a negative charge.



The rod is placed close to the balloon but does not touch the balloon. How does this affect the charge on the balloon?

A. Electrons are transferred to the balloon.

B. Electrons are transferred to the rod.

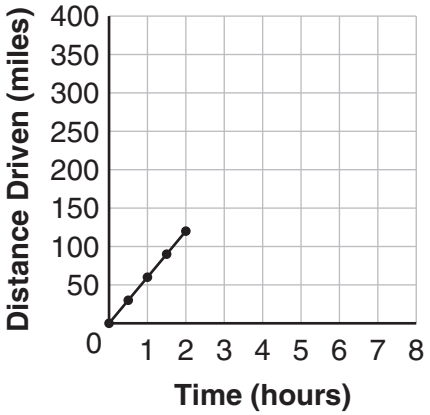
C. Electrons on the balloon move away from the rod.

D. Electrons on the balloon move toward positive charges.

PS3 (9–11) POC-8	Students will, given information (e.g., graphs, data diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects.

3 A student is driving 300 miles from Burlington, Vermont, to Newport, Rhode Island. She records the distance driven every half hour on the graph shown below.

Trip from Burlington to Newport



If the student continues driving at the same speed, what will be her total driving time from Burlington to Newport?

A. 2 hours

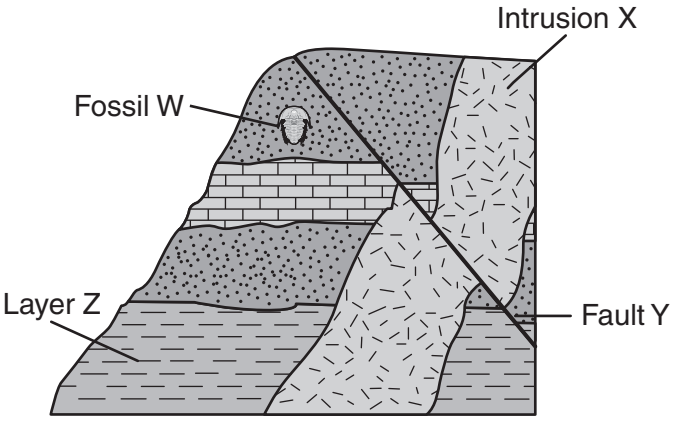
B. 3 hours

C. 4 hours

D. 5 hours

ESS1 (9–11) INQ-4	Students will relate how geologic time is determined using various dating methods (e.g., radioactive decay, rock sequences, fossil records).

4 The diagram below shows the positions of Fossil W, Intrusion X, Fault Y, and Layer Z.



Which feature in the diagram is the youngest?

A. Fossil W
B. Intrusion X
C. Fault Y
D. Layer Z

ESS3 (9–11) NOS-5 Students will explain how scientific theories about the structure of the universe have been advanced through the use of sophisticated technology (e.g., space probes; visual, radio, and X-ray telescopes).

5 The structure of the universe is described using data from technologies such as the Hubble Space Telescope, the Chandra X-ray Observatory, and the Spitzer Infrared Space Telescope.

Why are these technologies located in space?

A. to be close to celestial objects
B. to keep track of satellites orbiting Earth
C. to obtain samples of celestial objects
D. to avoid atmospheric disturbance

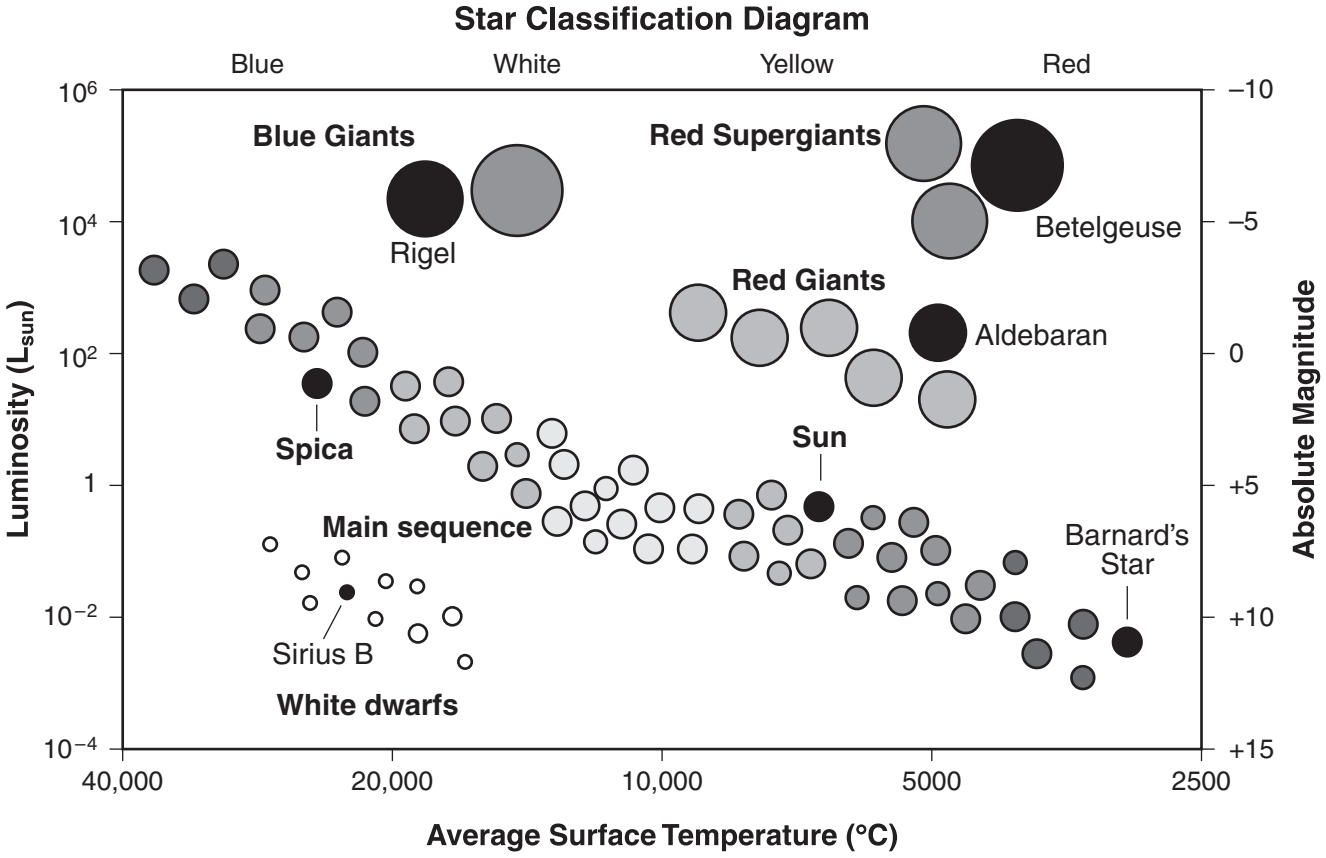
ESS3 (9–11) SAE-7 Students will, based on the nature of electromagnetic waves, explain the movement and location of objects in the universe or their composition (e.g., red shift, blue shift, line spectra).

6 Which information about a star is provided by its spectra?

A. composition
B. galaxy
C. mass
D. shape

ESS3 (9–11) POC-8 Students will explain the relationships between or among the energy produced from nuclear reactions, the origin of elements, and the life cycles of stars.

7 A star classification diagram is shown below.



a. Use specific information from the diagram to compare the surface temperatures, absolute brightnesses, and colors of the Sun and Betelgeuse.

A star's position in the diagram shows its classification and where it is in its life cycle.

b. Compare the life cycles of the Sun and Betelgeuse. Identify a difference between the Sun and Betelgeuse that causes these two stars to have different life cycles.

Scoring Guide

Score	Description
4	The response demonstrates a thorough understanding of the life cycles of stars. The response uses specific information from the diagram to compare the Sun and Betelgeuse in terms of surface temperature, absolute brightness, and color. The response also identifies a difference between the Sun and Betelgeuse that causes these two stars to have different life cycles and compares the life cycles of the Sun and Betelgeuse.
3	The response demonstrates a general understanding of the life cycles of stars. The overall response is general.
2	The response demonstrates a limited understanding of the life cycles of stars. The overall response is limited.
1	The response demonstrates a minimal understanding of the life cycles of stars. The overall response is minimal.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

A thorough understanding can be exemplified by the sample response below.

- The Sun has a surface temperature of about 6000°C and Betelgeuse has a lower temperature of about 3100°C. The absolute brightness of the Sun is less than that of Betelguese. The Sun is yellow in color and Betelgeuse is red in color.
- Mass is the difference between the Sun and Betelgeuse that causes the two stars to have different life cycles. The Sun has a smaller mass than Betelgeuse. Stars with smaller masses have a longer main sequence than stars with larger masses (billions of years compared with millions of years). Stars with smaller masses become giant stars after the main sequence and then become white dwarfs (dead core). Stars with larger masses become supergiants after the main sequence and then undergo an explosion (supernova) and become either neutron stars or black holes.

For a score of 4, response needs to mention something about the differences in mass (or size if explained by energy use due to size) of the two stars. Response can refer to luminosity or magnitude for absolute brightness.

SCORE POINT 4

7

a) Sun

Temperature: Approximately 6,500°C
Absolute Magnitude: Approximatey + 5.5
Color: Yellow

Betelgeuse

Temperature: Approximately 4,000°C
Absolute Magnitude. Approximately -7
Color: Red

The temperature of Earth's sun is about 1,500°C hotter then the temperature of Betelgeuse. According to the diagram however, Betelgeuse is by far much brighter than our sun. The colors of the two stars also help to indicate which is hotter in temperature. Since the sun is yellow and Betelgeuse is red, it could appear that the sun is hotter.

b) The sun is currently in the stage of living its life until it runs out of hydrogen and helium. Betelgruse has already used up all of its hydrogen and has erected a helium core, thus turning it into a red supergiant. This means that Betelgeuse is farther along in its life cycle then Earth's sun is.

When the sun attains a helium core, it will only become a red giant, instead of a red supergiant the Betelgeuse because Betelgeuse much more mass than our sun.

Response demonstrates a thorough understanding of the life cycles of stars. The response uses specific information from the diagram to compare the Sun and Betelgeuse in terms of surface temperature, absolute brightness, and color (Sun: "approximately 6,500°C, +5.5, yellow" and Betelgeuse: "approximately 4,000°C, –7, red"). The response also identifies a difference between the Sun and Betelgeuse that causes these two stars to have different life cycles ("Betelgeuse (has) much more mass") and compares the life cycles of the Sun and Betelgeuse. (Explanation includes, "Sun . . . will become . . . giant" and "Betelgeuse. . . supergiant.")

SCORE POINT 3

7

a. Betelgeuse has a land surface temperature of around 3500°C where the sun has a higher surface temperature around 7500 °C. Betelgerse is red, where the sun is yellow. Also Betelgeuse has a greater luminosity of 10^4 where the sun has a lower luminosity of around 1.

b. Betelgeuse will have a shorter life cycle then the sun because it is a red super giant and has a more negative absolute magnitude. It also has a greater luminosity meaning it is getting brighter before it becomes a supernova and dies.

Response demonstrates a general understanding of the life cycles of stars. Part (a) is correct (approximate temperature of Sun "around 7500°C" and Betelgeuse "around 3500°C"). Colors and luminosity are correct. Part (b) has a comparison, but response fails to identify a difference.

SCORE POINT 2

7

a) The sun compared to Betelgeuse is hotter due to its yellow color compared to Betelgeuses red color. The sun however is less luminesint at a little less than 1 on the Luminosity scale compared to Betelgeuse, which is 10^4 on the scale, and finally the suns surface temperature is 6,000, where Betelgeuses is 4,000.

b) The suns life cycle is normal, with an average temp, where it will eventually become hotter, and explode. Betelgeuse however isn't average it is much larger and might explode in the far future. With the size difference their life cycles would be different.

Response demonstrates a limited understanding of the life cycles of stars. Part (a) gives correct color, luminosity, and surface temperature. Part (b) is too vague to receive credit.

Score Point 1

7

A.) The sun and Betelgeuse are among the hottest in the diagram the absolute magnitude is rather low for Betelgeuse and high for the sun. Betelgeuse is Red and the sun is yellow.

B.) The sun and Betelgeuse have different life cycles because they are at different levels of absolute magnitude and luminosity.

Response demonstrates a minimal understanding of the life cycles of stars. The response receives credit for color only—"Betelgeuse is Red and the sun is yellow."

Score Point 0

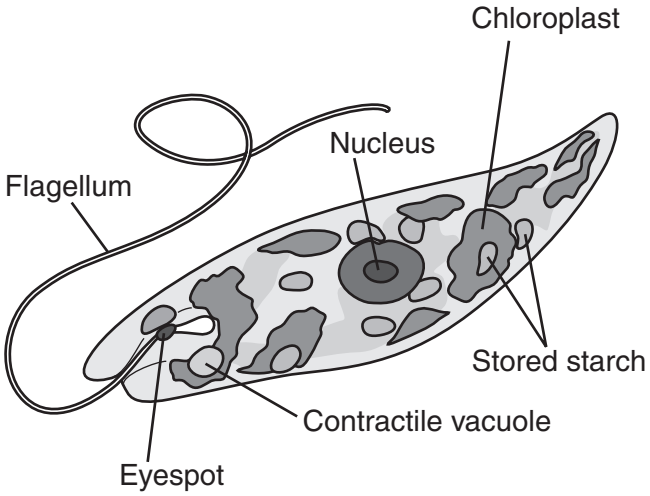
7

The Sun is right at an average temp of: 6000

Response is incorrect; no comparison is made.

LS1 (9–11) FAF-1	Students will use data and observation to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multicellular organism needs for survival (e.g., protein synthesis, DNA replication, nerve cells).

8 The diagram below shows a Euglena.



Which two characteristics of a Euglena also apply to an oak tree?

A. unicellular and contractile vacuole
B. eyespot and heterotrophic
C. eukaryotic and autotrophic
D. forms cysts and moves with a flagellum

LS3 (9–11) INQ-7	Students will, given a scenario, provide evidence that demonstrates how sexual reproduction results in a great variety of possible gene combinations and contributes to natural selection (e.g., Darwin's finches, isolation of a species, Tay Sach's disease).

9 A gardener cross-pollinates pure red rose plants with pure white rose plants. None of the offspring have red or white flowers. All of the offspring have pink flowers.

Which statement **best** explains the gardener's observations?

A. Only the red parent plant's genes were passed on to the offspring.

B. Only the white parent plant's genes were passed on to the offspring.

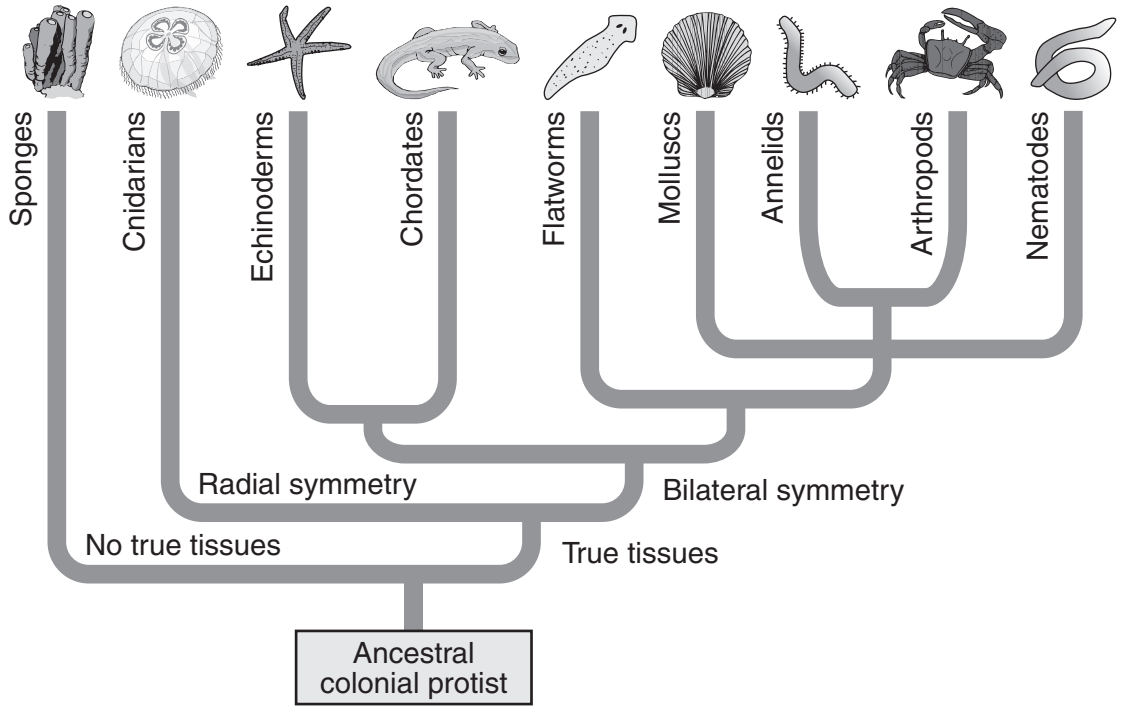
C. The offspring received red and white alleles from the parent plants.

D. The offspring received no color alleles from either parent plant.

LS3 (9–11) POC-8	Students will, given information about living or extinct organisms, cite evidence to explain the frequency of inherited characteristics of organisms in a population OR explain the evolution of varied structures (with defined functions) that affected the organisms' survival in a specific environment (e.g., giraffe, wind pollination of flowers).

10 The diagram below shows the evolutionary relationships among animal phyla.

Evolutionary Relationships



Which two phyla have the **most** in common?

A. sponges and cnidarians
B. echinoderms and chordates
C. chordates and annelids
D. flatworms and annelids

Broad Area of Inquiry:	**Formulating Questions and Hypothesizing**
Inquiry Construct 1:	Analyze information from observations, research, or experimental data for the purpose of formulating a question, hypothesis, or prediction.

❶ Form a hypothesis about the relationship between the concentration of antifreeze in a solution and its freezing point. Use information from the story to explain how you formed your hypothesis.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to make a hypothesis using available evidence. The response includes a reasonable hypothesis relating the concentration of antifreeze and the freezing point of a solution and explains the hypothesis by using information presented in the story.
1	The response demonstrates a limited understanding of how to make a prediction using available evidence.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

The response contains a relevant hypothesis and reasonable explanation.

While the expected response is "increasing antifreeze concentration lowers freezing point," other hypotheses are also acceptable. (The hypothesis does not have to be "correct" since the students have not observed experimental data at this point.) However, the hypothesis should be reasonable, related to topic, and use information presented in the story.

SCORE POINT 2

1

My hypothesis is: The more antifreeze added in the solution, the better-protected the engine is from cold temperatures.

I formed this hypothesis by reading and understanding the antifreeze label. It said that a solution with 60% antifreeze in it could protect from freezing at -55°C, whereas a solution with 50% antifreeze in it could protect from freezing at -35°C. Therefore, the more antifreeze added in the solution, the better-protected the engine is from colder temperatures.

Response demonstrates a general understanding of how to make a prediction using available evidence. Response includes a reasonable hypothesis with data to support it.

Score Point 1

❶

If there is a higher concentration of antifreez in the solution than the freezing point will be lower.

Response demonstrates a limited understanding of how to make a prediction using available evidence. Response is a basic hypothesis without data to support it.

Score Point 0

❶

I think the freezing point of the antifreeze Solution will be far to low to freeze in a New England winter.

Response demonstrates a minimal understanding of how to make a prediction using available evidence. Response is a very general prediction that offers no connection to the prompt request or the data—no comparison.

Broad Area of Inquiry:	**Planning and Critiquing of Investigations**
Inquiry Construct 6:	Provide reasoning for appropriateness of materials, tools, procedures, and scale used in the investigation.

❷ Identify one possible source of error in the procedure of the investigation. Explain why this could be a source of error and how this potential error could affect the results of the investigation.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of whether procedures for a task are appropriate or inappropriate for the investigation. The response identifies a potential procedural error, explains why it could be a source of error, and describes how the error could affect the results of the investigation.
1	The response demonstrates a limited understanding of whether procedures for a task are appropriate or inappropriate for the investigation.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

The response identifies a source of error, explains why it is a source of error, and describes how the error could affect the results of the investigation.

Potential errors include

- Not testing a solution of pure water as a way to calibrate procedure and thermometer/not making sure measurements are accurate by measuring the freezing temp of 30 mL of pure water: Improper calibration will produce flawed results. Actual temperatures may be higher or lower than measured.
- Not specifying a reproducible standard way to stir the solution: Using a mechanical stirring device would homogenize all solutions in the same way. Pockets of pure water or pure antifreeze will freeze at temperatures different from a homogenized mixture.
- Not specifying whether concentrations were by volume or by weight: Select whether concentrations are by volume or weight and be consistent. This could cause an inconsistency in freezing points when someone tries to reproduce the experiment.
- Each concentration was only tested once so error would be undetected: Multiple trials of each solution reduce the effect of chance error.

Score Point 2

❷

when prepaning the test solutions, it states to fill each with "between 10 and 100 percent antifreeze". this could be a possible source of error because they should know exactly how much percent antifreeze is in each solution or else their data could be inaccurate. A planned amount should be thought out for each of the 10 test solutions.

Response demonstrates a general understanding by identifying a potential procedural error (between 10 and 100 does not define accurate intervals between 10 and 100) and explains a way the error can be corrected ("A planned amount should be thought out").

Score Point 1

❷

One possible source of error is the fact that she stirred the mixture which forses the solution not to freeze.

Response demonstrates a limited understanding by identifying a potential procedural error. That the energy added to the solution due to stirring may reduce some ice crystal formation is considered a reasonable point, but response does not offer a sufficient explanation.

Score Point 0 (Example A)

❷

The error is Having That steper in The Beaker That will caz Problems.

Response is incorrect. (Response includes having a stirrer in the beaker, but it does not explain why it is a source or error or how the stirrer in the beaker affects the investigation.)

Score Point 0 (Example B)

❷

An error in their proceedure is that they did not test the antifreeze that was in the car so they don't Know what its freezing temperature IS and it could freeze if its not the Right Ratio in their Antifreeze Solution

Response is irrelevant. Response offers another experiment.

Broad Area of Inquiry:	**Conducting Investigations**
Inquiry Construct 8:	Use accepted methods for organizing, representing, and manipulating data.

❸ Use the data in Data Table 1 to construct a graph. Be sure to include all the required elements of a graph.

Scoring Guide

Score	Description
3	The response demonstrates a thorough understanding of how to represent data in an appropriate graph. The response includes a graph with an appropriate title, labels, keys or symbols, scale, terminology, and relationships among variables based upon the data table.
2	The response demonstrates a general understanding of how to represent data in an appropriate graph.
1	The response demonstrates a limited understanding of how to represent data in an appropriate graph.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

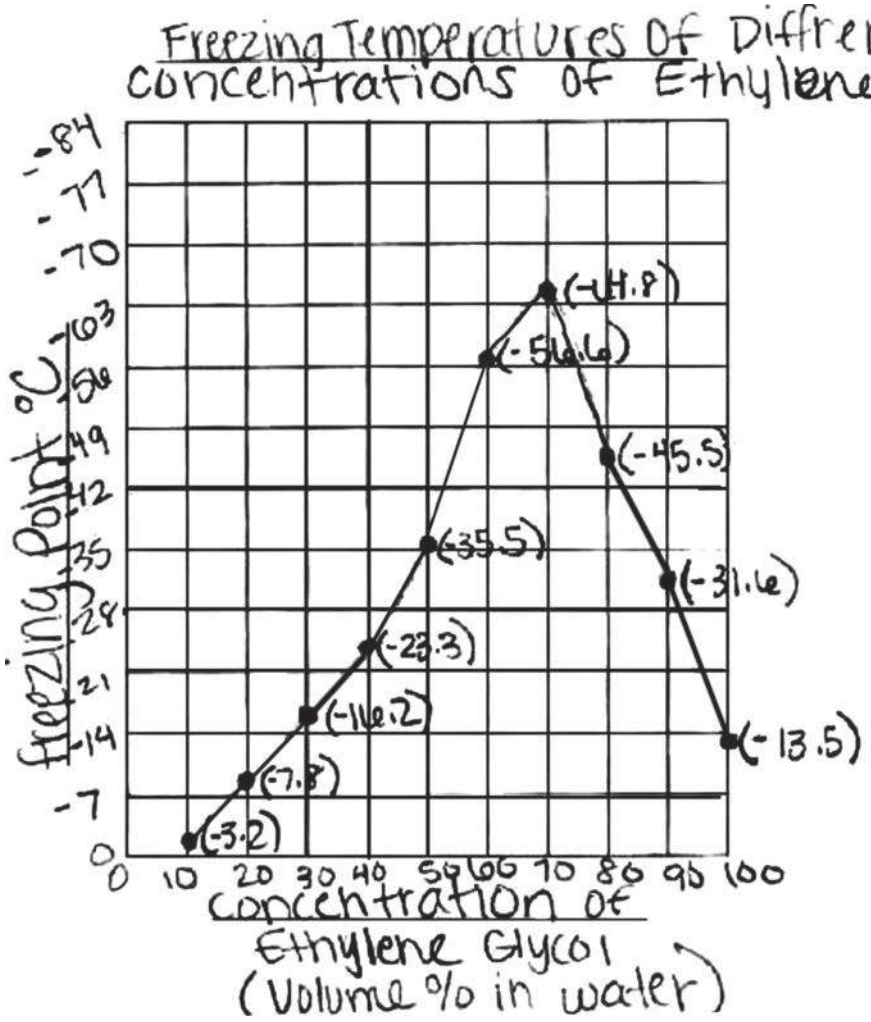
Scoring notes:

A line graph or scatter plot is the expected presentation; however, a bar graph is acceptable. The independent variable (concentration) should be plotted on the *x*-axis and the dependent variable (temperature) on the *y*-axis.

Notes: Switched axes with everything else correct receives a score of 1.

SCORE POINT 3 (EXAMPLE A)

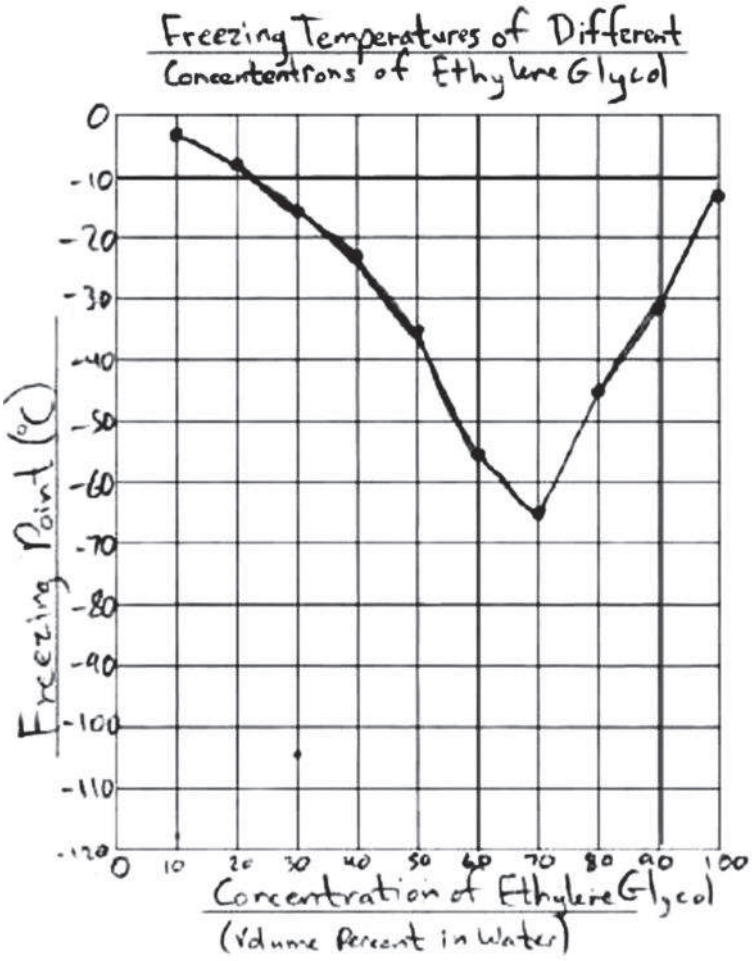
3



Response demonstrates a thorough understanding of how to represent data in an appropriate graph. Response includes a graph with an appropriate title, labels, and scale, and is based upon the data table. The independent variable (concentration) is plotted on the *x*-axis, and the dependent variable (temperature) is plotted on the *y*-axis.

SCORE POINT 3 (EXAMPLE B)

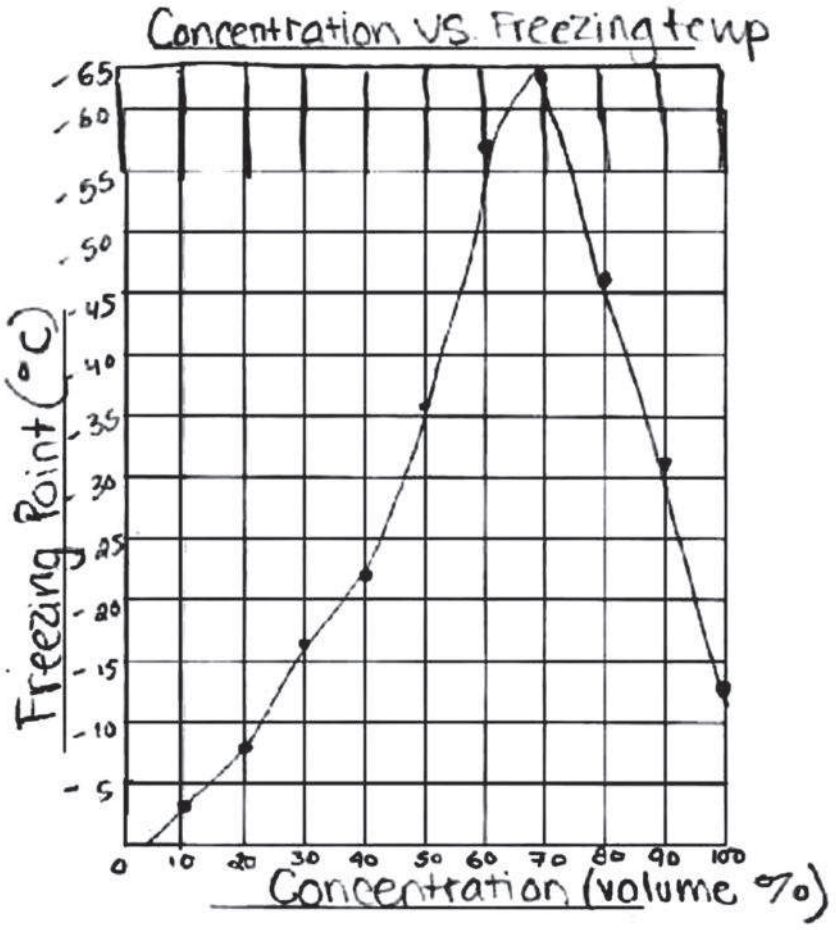
3



Response demonstrates a thorough understanding of how to represent data in an appropriate graph. Response includes a graph with an appropriate title, labels, and scale, and is based upon the data table. (Extra units in the scale do not cause the response to lose credit if all elements are correct.) The independent variable (concentration) is plotted on the *x*-axis, and the dependent variable (temperature) is plotted on the *y*-axis.

Score Point 2

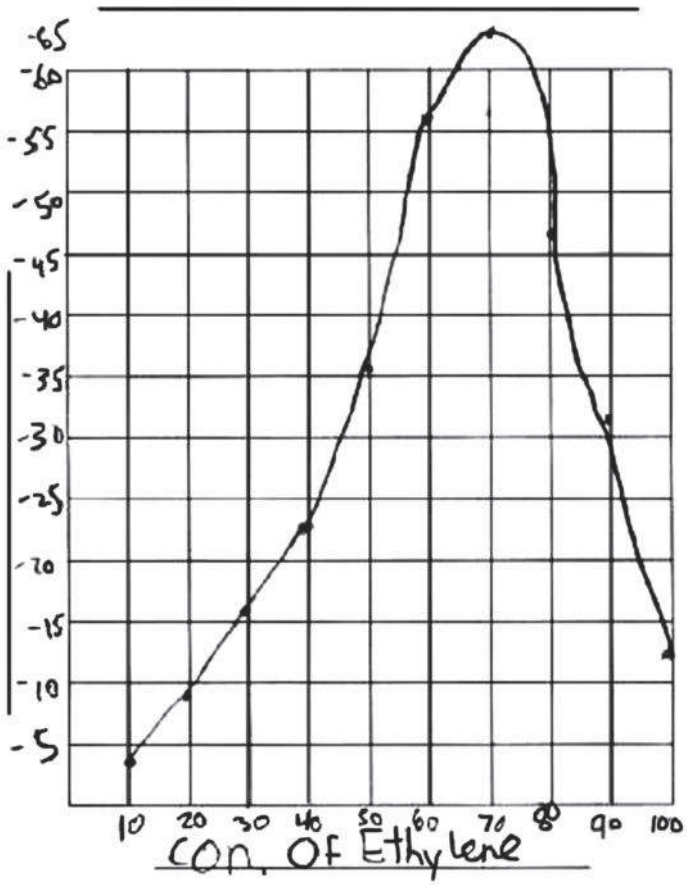
❸



Response demonstrates a general understanding of how to represent data in an appropriate graph. Response includes a graph with an appropriate title, labels, and scale, and is based upon the data table. (Extending the graph does not cause the response to lose credit if the graph provides correct elements.) The independent variable (concentration) is plotted on the *x*-axis, and the dependent variable (temperature) is plotted on the *y*-axis. However, ethylene glycol is not included anywhere on the graph, so it cannot be considered an example of thorough understanding.

Score Point 1

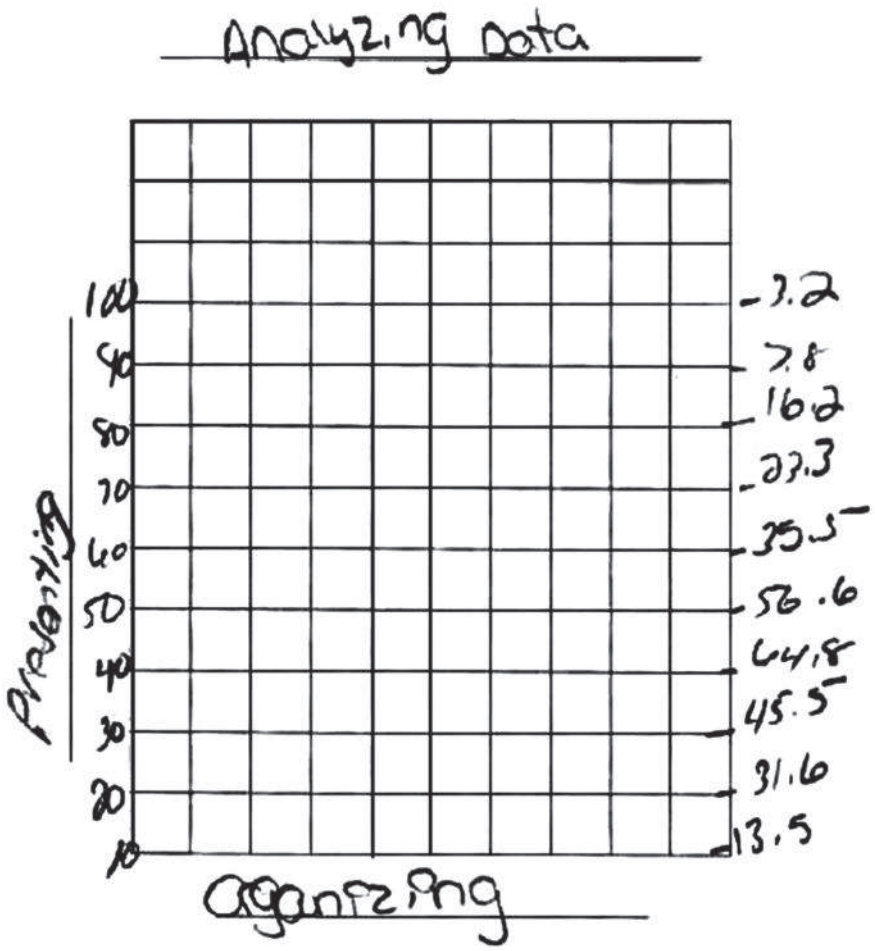
❸



Response demonstrates a limited understanding of how to represent data in an appropriate graph. Response includes a graph with a scale and data points that are based upon the data table. The independent variable (concentration) is plotted on the *x*-axis, and the dependent variable (temperature) is plotted on the *y*-axis.

SCORE POINT 0

❸



The response is incorrect.

Broad Area of Inquiry:	**Conducting Investigations**
Inquiry Construct 10:	Summarize results based on data.

❹ Use evidence from Data Table 1 or your graph to describe the relationship between the ethylene glycol antifreeze concentration and the freezing point of the solution.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to summarize data. The response correctly describes the relationship between the freezing point and the concentration of antifreeze in solution.
1	The response demonstrates a limited understanding of how to summarize data.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

The response states that the freezing point decreases as the concentration of antifreeze increases in the range of 10% to 70%. When the antifreeze concentration is greater than 70%, the freezing point temperature increases.

SCORE POINT 2

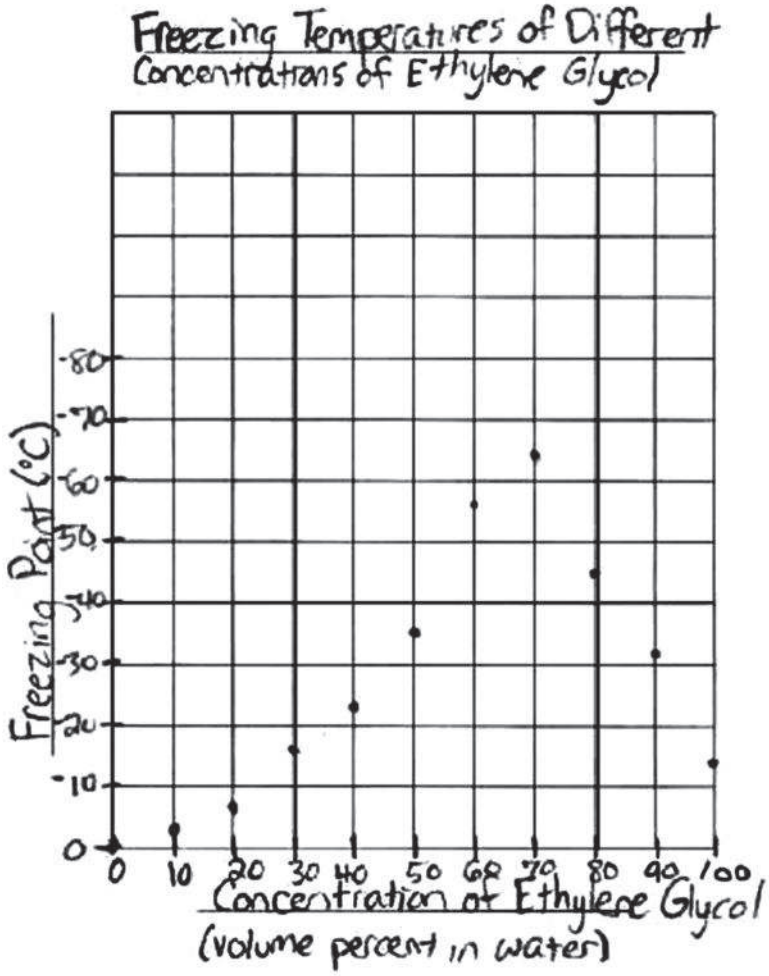
4

From 10% to 70% of Ethylene Glycol added to the solution, the freezing point of the solution decreases. However, from 80% to 100% of Ethylere Glycol added, the freezing point of the solution increases. So, up to a certain point the antifreeze solution decreases the freezing point until the concentration levels of the antifreeze are too high in which the freezing point actually increases.

Response demonstrates a general understanding of the relationship between the freezing point and the concentration of antifreeze in water.

SCORE POINT 2 (CONTINUED)

❸



SCORE POINT 1 (EXAMPLE A)

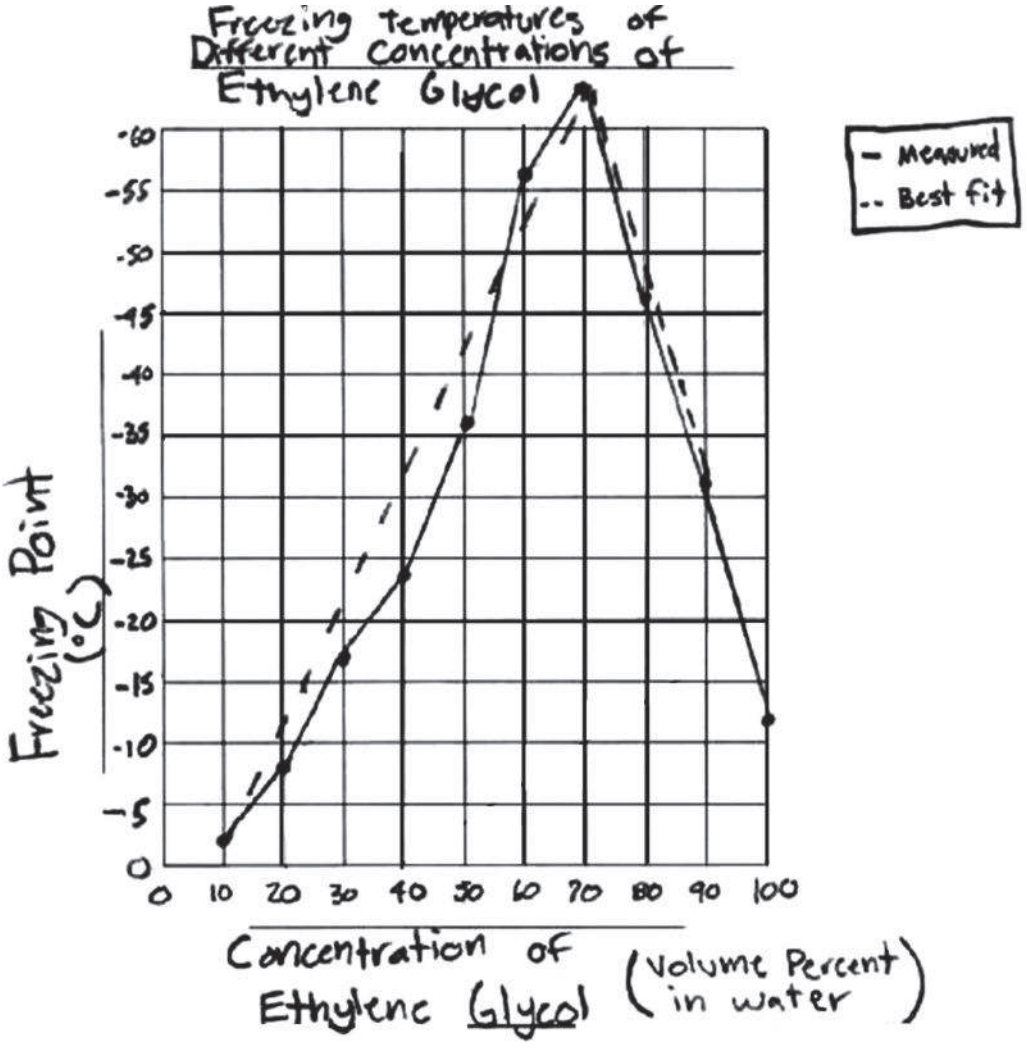
4

As the amount of antifreeze concentrate increased the freezing point increased as well. the ethylene glycol peaks at a temperature of -64.8°c freeze protection with 70% concentrate but following that drops significantly with increasing concentrate.

Response demonstrates a limited understanding of how to explain data. Response includes an example of trend by identifying the increase and decrease shown on the graph, with the minimum temperature identified as the "peak."

SCORE POINT 1 (EXAMPLE A CONTINUED)

❸



SCORE POINT 1 (EXAMPLE B)

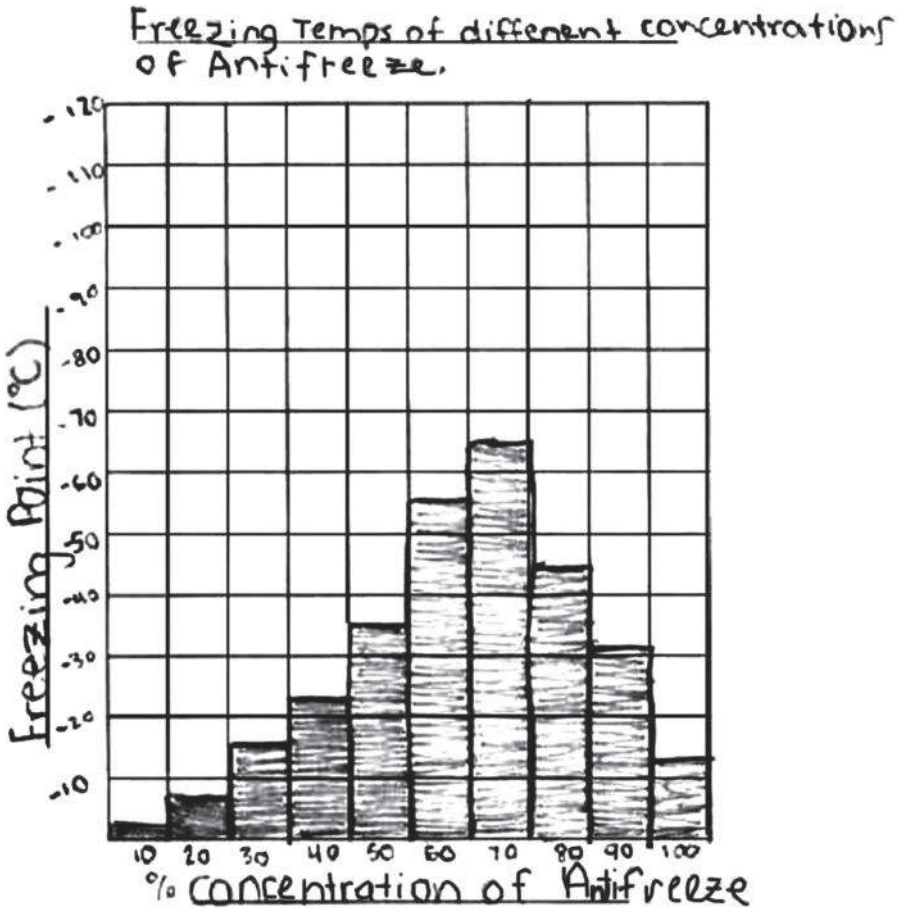
❹

when working with an antifreeze solution and the antifreeze concentration is 70%, The mixture will not freeze up to -64.8 °C. But when you cross the threshhold of 70%, then the Antifreeze begins to not work anymore, and the freezing temperature gets warmer.

Response demonstrates a limited understanding of how to explain data. Response includes an explanation of the upper range and the maximum protection.

SCORE POINT 1 (EXAMPLE B CONTINUED)

❸



SCORE POINT 0

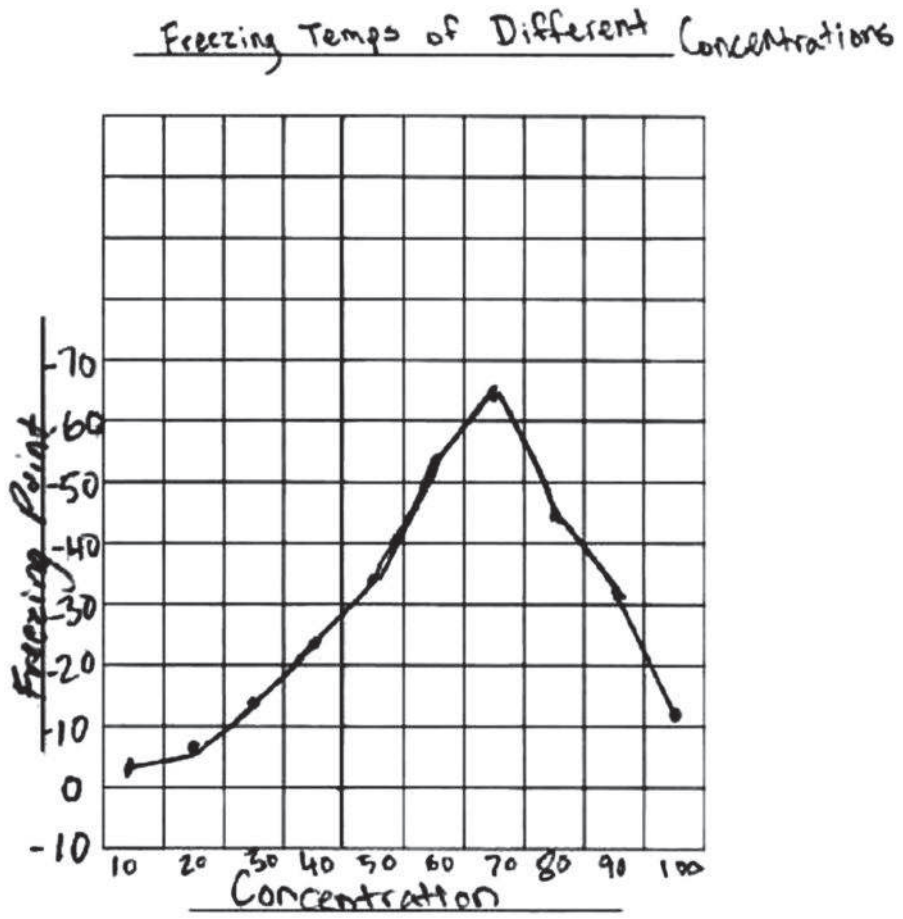
4

The relationship of Anti freeze to water is the higher the anti freeze, the lower the freezing temperature, but There needs to be water in the solution for anti freeze to work to the desired way.

Response is irrelevant. Response does not use evidence to describe the relationship demonstrated by the data and may be derived from a general understanding of the word antifreeze.

SCORE POINT 0 (CONTINUED)

3



Broad Area of Inquiry:	**Conducting Investigations**
Inquiry Construct 9:	Collect sufficient data to study a question, a hypothesis, or relationships.

5 Explain why the test results for solution concentrations ranging from 10 to 100 percent gave a better understanding of the relationship between the ethylene glycol antifreeze concentration and the freezing point of the solution than the test results for concentrations ranging only from 10 to 50 percent. Use specific evidence to support your explanation.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to determine if the quantity of data is sufficient to study a relationship. The response identifies the importance of the full data set/graph to form an accurate conclusion.
1	The response demonstrates a limited understanding of how to determine if the quantity of data is sufficient to study a relationship.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

The response describes the relationship (freezing point decreases as concentration of antifreeze increases) and uses data to show how this is not accurate at all concentration levels because the relationship changes after a 70% concentration for ethylene glycol antifreeze. If the students had only tested antifreeze concentrations ranging from 10–50 percent, they could have concluded the freezing point will continue to decrease as the antifreeze concentration increases.

SCORE POINT 2

5

If Cathy and Anthony only tested from 10% to 50% concentration they would have missed the fact that above 70% concentration the temperature the solution froze at actually increased. By actually testing 10-100% they were able to see that happen, and therefore find the actual relationship between the amount of antifreeze and the temperature the mix will freeze at

Response demonstrates a general understanding by identifying the importance of the full data set to form an accurate conclusion ("If . . . only tested from 10% to 50% concentration they would have missed the fact that above 70% concentration the temperature [at which] the solution froze . . . actually increased").

Score Point 1

❺ The test results for solution concentrations ranging from 10 to 100 percent gave a better understanding because it shows at what percentage the antifreeze stops being helpful.

Response demonstrates a limited understanding of identifying the importance of the full data set to form an accurate conclusion, but it does not include data.

Score Point 0

❺ because 1-100 gives you a better and more accurate understanding that 1-50

The response is irrelevant. "More accurate understanding" is not enough.

Broad Area of Inquiry:	**Developing and Evaluating Explanations**
Inquiry Construct 12:	Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.

6 Use evidence from Data Table 1 or your graph and the freezing point of the sample of radiator fluid (–18.2°C) to estimate the ethylene glycol antifreeze concentration of the radiator fluid in the donated car. Explain your reasoning and use specific evidence to support your explanation.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to use data to justify a conclusion. The response suggests an antifreeze concentration based on the data table/graph and explains how the value was determined.
1	The response demonstrates a limited understanding of how to use data to justify a conclusion.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

The response correctly determines that the radiator fluid has between 30% and 40% antifreeze (or between 90% and 100%) AND explains how that estimate was obtained. Response must identify the concentration range and explain how the graph was used to interpolate that value.

Based on the graph, the freezing point of the radiator fluid could easily be both 30%–40% and/or 90%–100%. Both answers are acceptable.

SCORE POINT 2

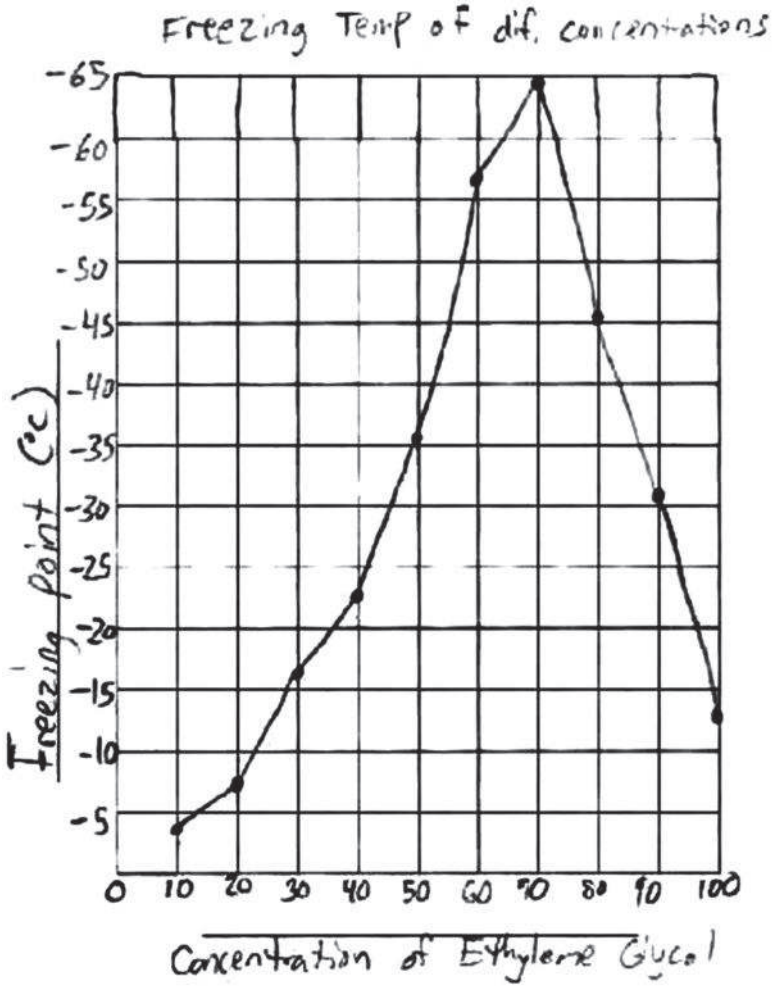
6

Due to the fact that the freezing temp is -18.2°C, I believe that the concentration level was around 33%, based on the graph. I believe this because at 30% the freezing temp is -16.2°C and the freezing point of 40% concentration is -23.3°C, therefore the answer is closer to 30% but is much less than 40% concentration.

Response demonstrates a general understanding by suggesting an antifreeze concentration ("around 33%") based on the graph and gives a clear explanation how the value was determined.

SCORE POINT 2 (CONTINUED)

❸



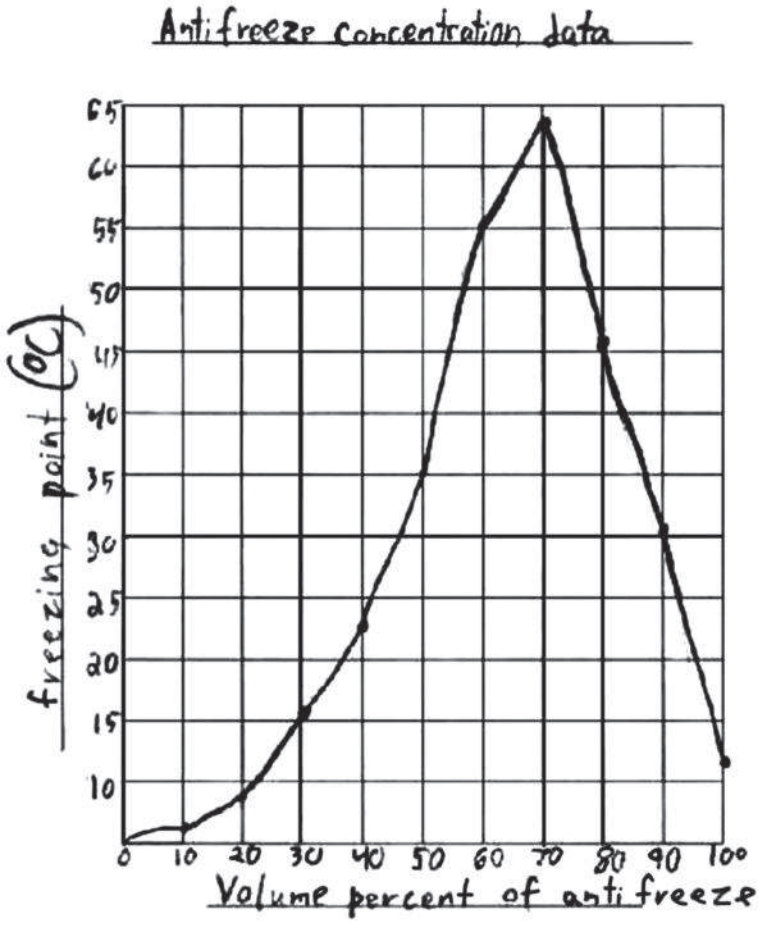
SCORE POINT 1 (EXAMPLE A)

6

The solution in the radiator when the car was recived was probubly in the range of 31 to 35% anti freeze.

Response demonstrates a limited understanding by suggesting a correct range ("31–35% antifreeze") with no explanation.

3



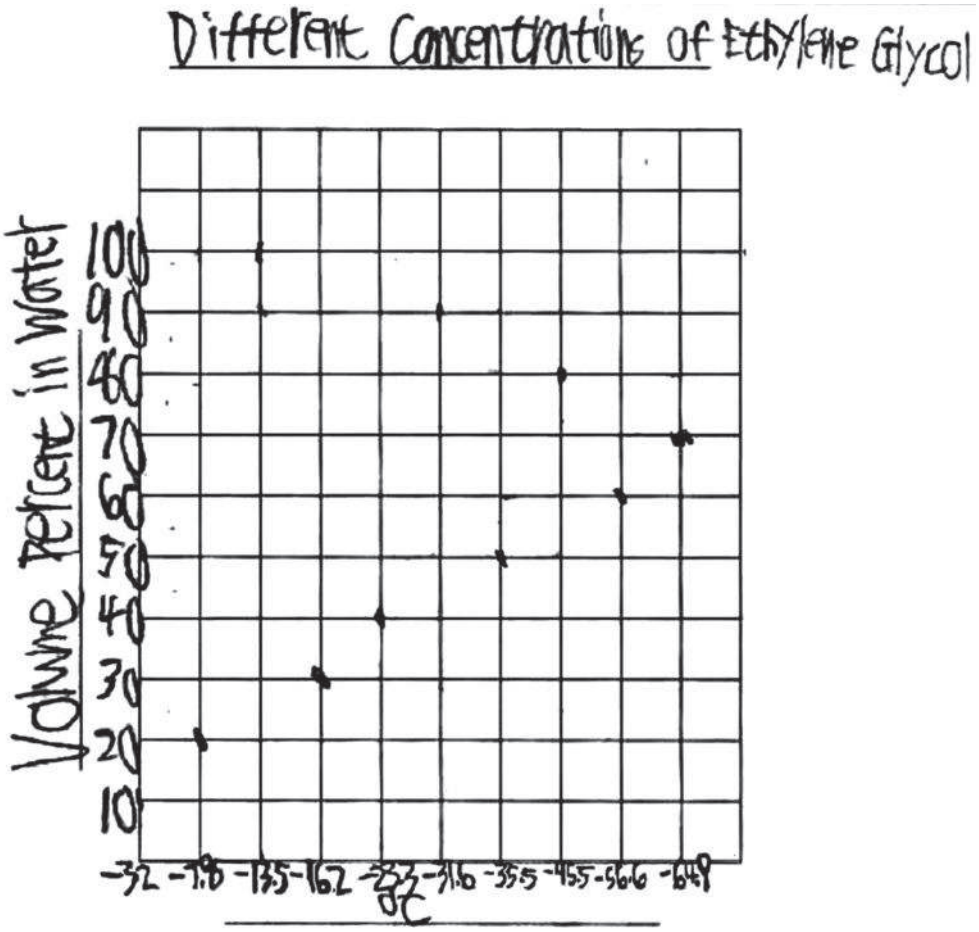
SCORE POINT 1 (EXAMPLE B)

6

The Volume Percene in water of (−16.2°C) would be 30 because it is the closest to (−16.2°C)

Response demonstrates a limited understanding by suggesting an accurate estimate with far too little explanation.

3



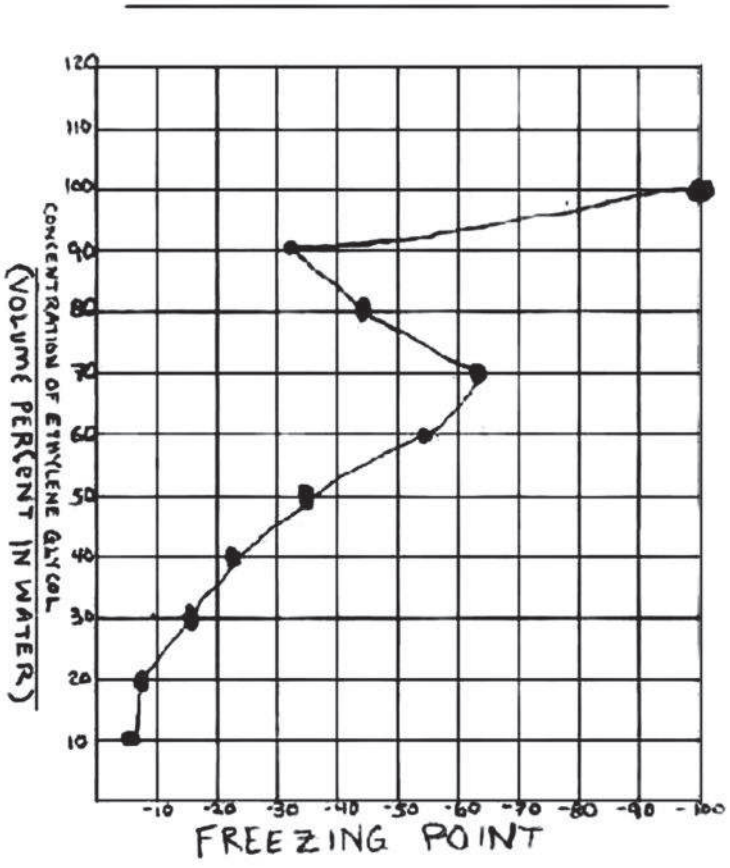
SCORE POINT 0

6

10% concentration.

The response is incorrect.

3



Broad Area of Inquiry:	**Developing and Evaluating Explanations**
Inquiry Construct 13:	Communicate how scientific knowledge applies to explain results, propose further investigations, or construct and analyze alternative explanations.

❼ Use evidence from Data Table 2 to estimate the ethylene glycol concentration in the radiator fluid of the donated car. Compare data in Data Table 1 or your graph with data in Data Table 2. Identify whether Data Table 1 or Data Table 2 clearly provides the actual antifreeze concentration of the radiator fluid in the donated car. Explain your reasoning and include specific evidence to support your explanation.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how additional data would strengthen an investigation to justify interpretations and conclusions. The response includes how the data from Data Table 2 and the concentration investigation provides the antifreeze concentration in the donated car.
1	The response demonstrates a limited understanding of how additional data would strengthen an investigation to justify interpretations and conclusions.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

The response identifies Data Table 2 and explains that it shows an exact correlation between density, antifreeze concentration, and freezing point while the concentration method alone yields two possible answers for the freezing point of the radiator fluid. Therefore, knowing the density is essential to finding the exact concentration of antifreeze in the radiator.

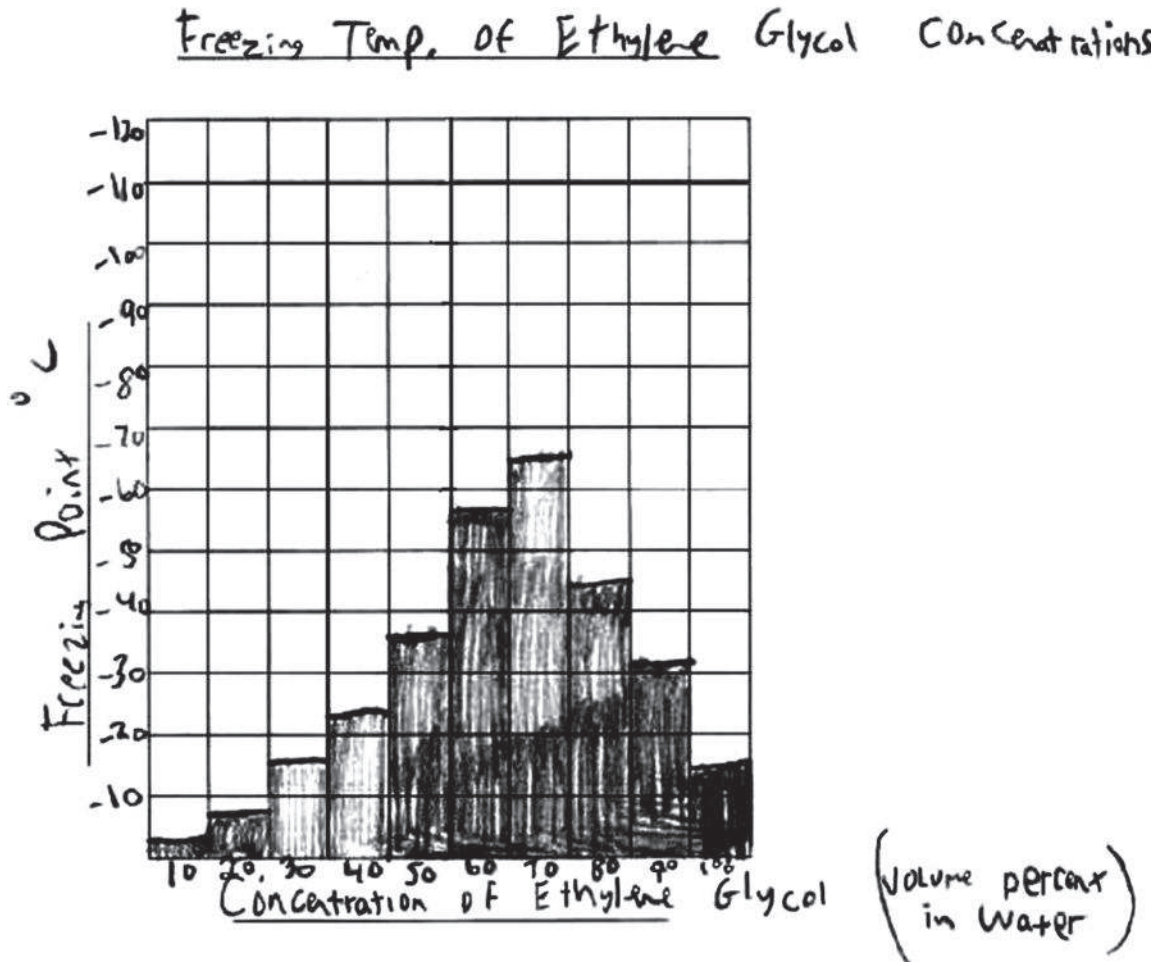
SCORE POINT 2

❼ After viewing Data table 2, it appears that the car had a antifreeze concentrate of around 38%. This is because the freezing point of 40% is -20.6°C, and -18.2°C is close to that. also, the densities are very similar 1.046 g/mL and 1.043 g/mL. Data table 2 provides a closer concentrate because it is closer in temperature and has another variable, density, that is also similar. Because both variables match up in the second table, the second table is more accurate.

Response demonstrates a general understanding by including how the data from Table 2 and the investigation confirm the antifreeze concentration in the donated car. Response includes a discussion of the added variable (density) and its significance to the estimate for the antifreeze concentration.

SCORE POINT 2 (CONTINUED)

❸



SCORE POINT 1

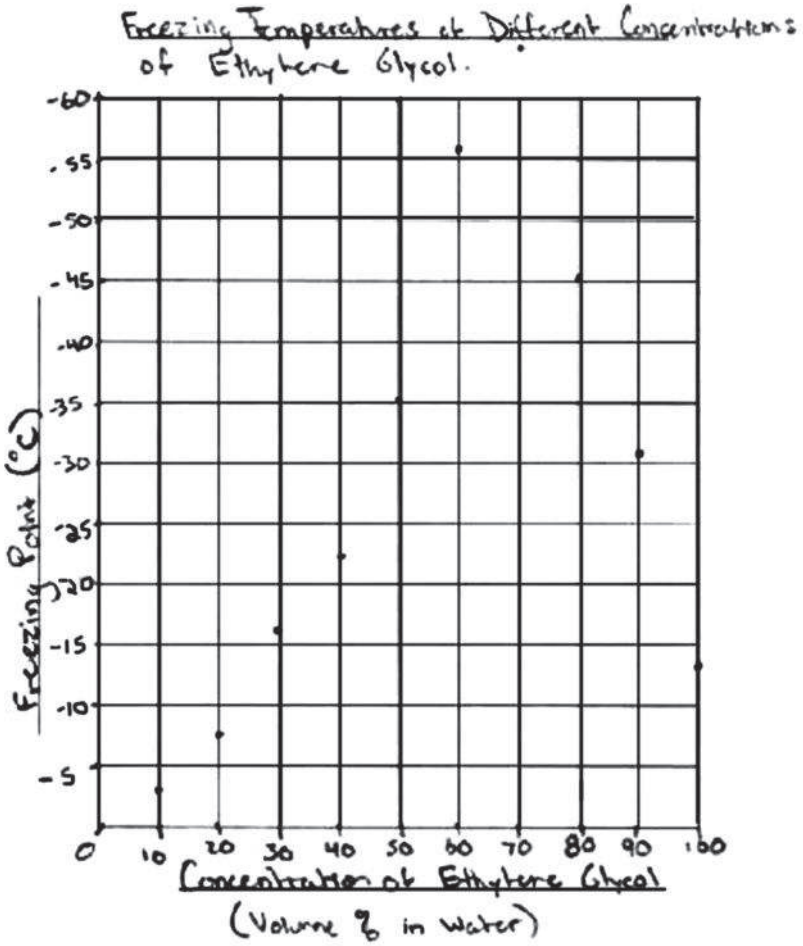
7

By analyzing Table 2, the ethylene Glycol concentration in the mixture is roughly 39%. Table 2 helps give a more accurate estimation due to the fact that it gives precise numbers for density, leading to a more accurate answer.

Response demonstrates a limited understanding by including how the data from Table 2 identifies the antifreeze concentration in the donated car. Response includes an estimated antifreeze concentration but a limited explanation.

SCORE POINT 1 (CONTINUED)

3



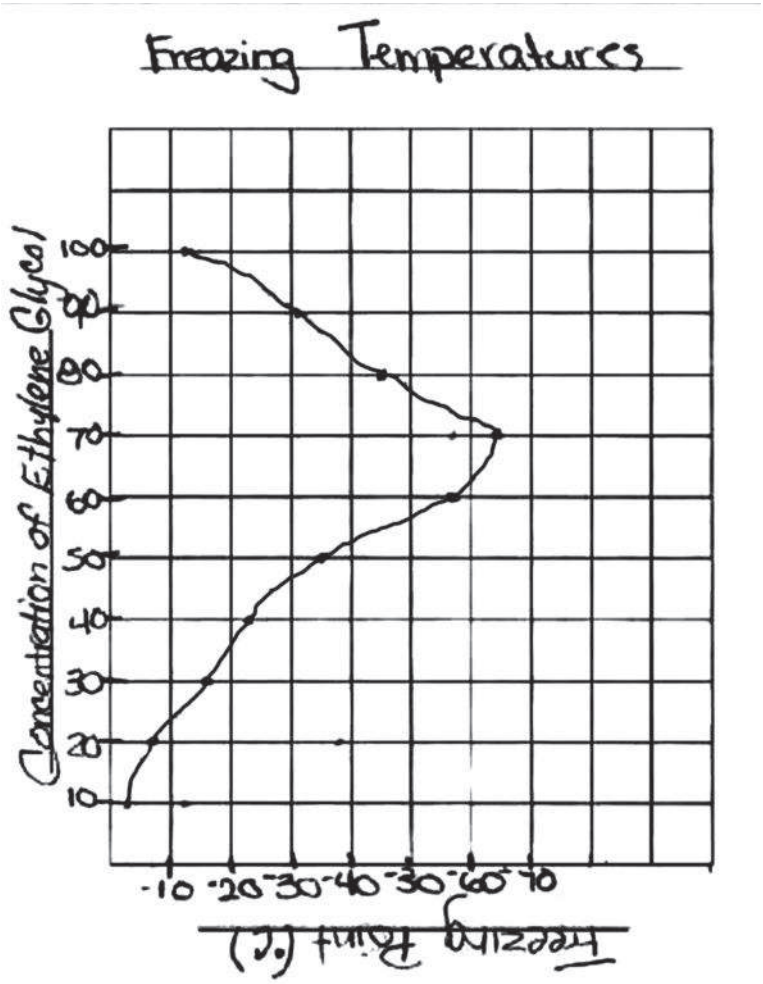
SCORE POINT 0

7 In my opinion table 2 is better because it give you more information than table 1. On table one they give you Ethylene Glycol and Freezing Point (°C), but here on table2 they give you Ethylene Glycol, Freezing Point (°C) and it also give us the Density (g/mL).

Response is irrelevant. This response presents the "more is better" argument, but does not indicate why more is better, derive a new estimate from the additional data, or explain the derivation of the new estimate.

SCORE POINT 0 (CONTINUED)

❸



Broad Area of Inquiry:	**Developing and Evaluating Explanations**
Inquiry Construct 12:	Use evidence to support and justify interpretations or conclusions or explain how the evidence refutes the hypothesis.

8 After reviewing the same information as the students reviewed, describe one advantage and one disadvantage of **both** types of antifreeze. Include specific information from the investigation in your descriptions.

Identify the antifreeze that you think the students should use. Explain your reasoning and include specific information from the investigation to support your explanation.

Scoring Guide

Score	Description
3	The response demonstrates a thorough understanding of how to use evidence to justify a conclusion or explanation based on experimental data. The response identifies and explains one advantage and one disadvantage of each antifreeze, chooses an antifreeze for the 1968 Mustang, and uses data to support the explanation.
2	The response demonstrates a general understanding of how to use evidence to justify a conclusion or explanation based on experimental data.
1	The response demonstrates a limited understanding of how to use evidence to justify a conclusion or explanation based on experimental data.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes

Scoring notes:

A thorough response describes an advantage and a disadvantage of each antifreeze, chooses an antifreeze for the car, and uses data (information from the story or investigation) to support the conclusion. Either antifreeze can be chosen, as long as the student is logical and consistent.

	Ethylene Glycol	**Propylene Glycol**
Advantage	Use less for same protection as propylene glycol (information in tables on pages 9 and 15); low cost, good corrosion protection, biodegradable	Nontoxic or low toxicity (information in reading), better heat transfer ability, biodegradable
Disadvantage	High toxicity to animals (information in reading)	Use more antifreeze for same protection as ethylene glycol, cost; fair corrosion protection (information in tables on pages 9 and 15)

SCORE POINT 3

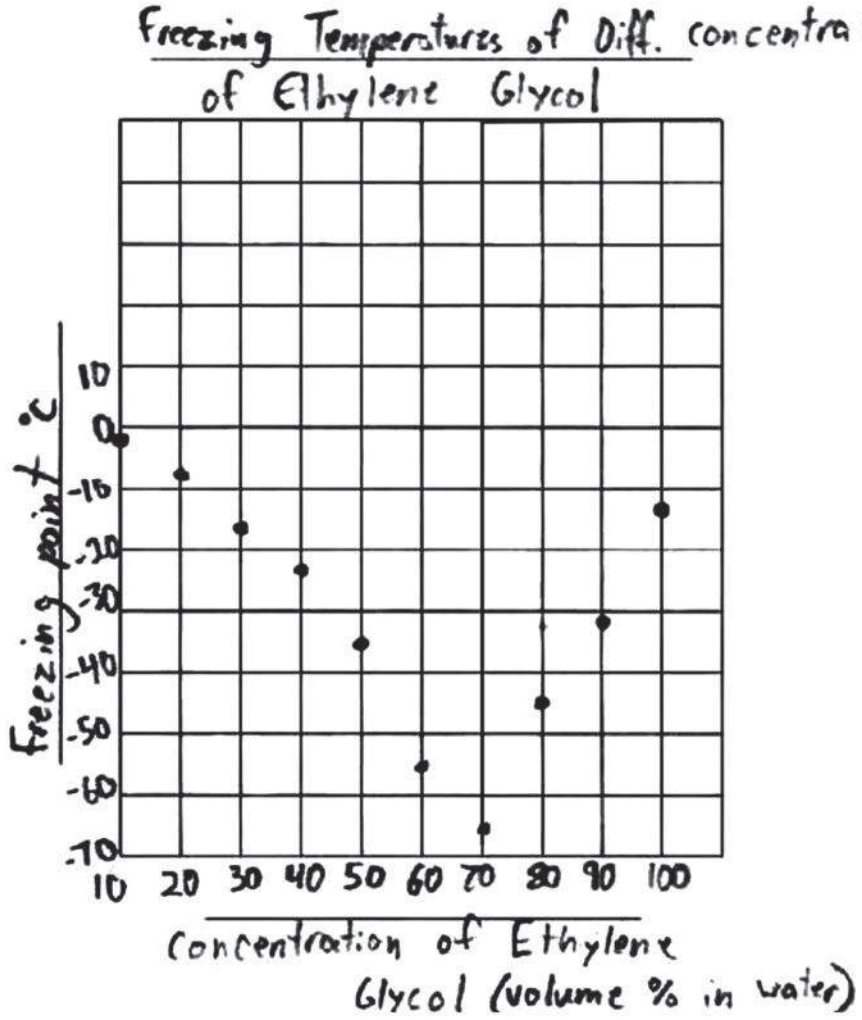
8

1 advantage to using Ethylene Glycol is that it is cheaper per gallon. A disadvantage is that it is highly toxic and may be damaging if spilled. An advantage to Propylene Glycol is that it transfers heat very efficiently. One disadvantage is that its protection against corrosion is only moderately good. I would choose Ethylene Glycol because its cheaper and also needs less concentrate to produce the same protection.

Response demonstrates a thorough understanding by identifying and explaining one advantage and one disadvantage of each antifreeze, uses data to support the explanation, and chooses antifreeze for the 1968 Mustang. This concisely worded response meets all criteria.

SCORE POINT 3 (CONTINUED)

3



SCORE POINT 2

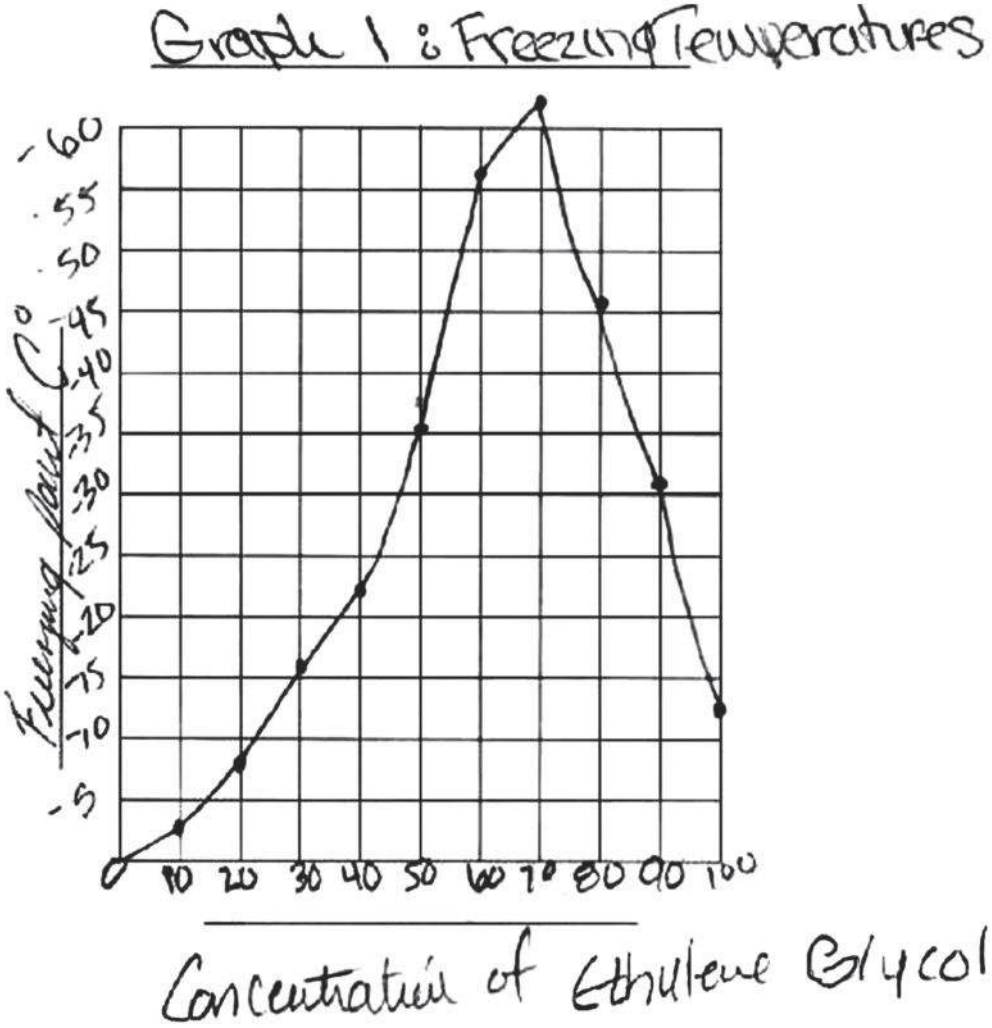
8

Propylene glycol is non toxic
Ethylene glycol is toxic
propylene glycol - more expensive
Ethylene glycol - less expensive
propylene glycol may be more expensive, but it is less harmful and more efficient.

Response demonstrates a general understanding by identifying and explaining one advantage and one disadvantage of each antifreeze (list format), uses data to support the explanation, and includes a possible choice that is stated as a repeat of the listed advantages.

SCORE POINT 2 (CONTINUED)

❸



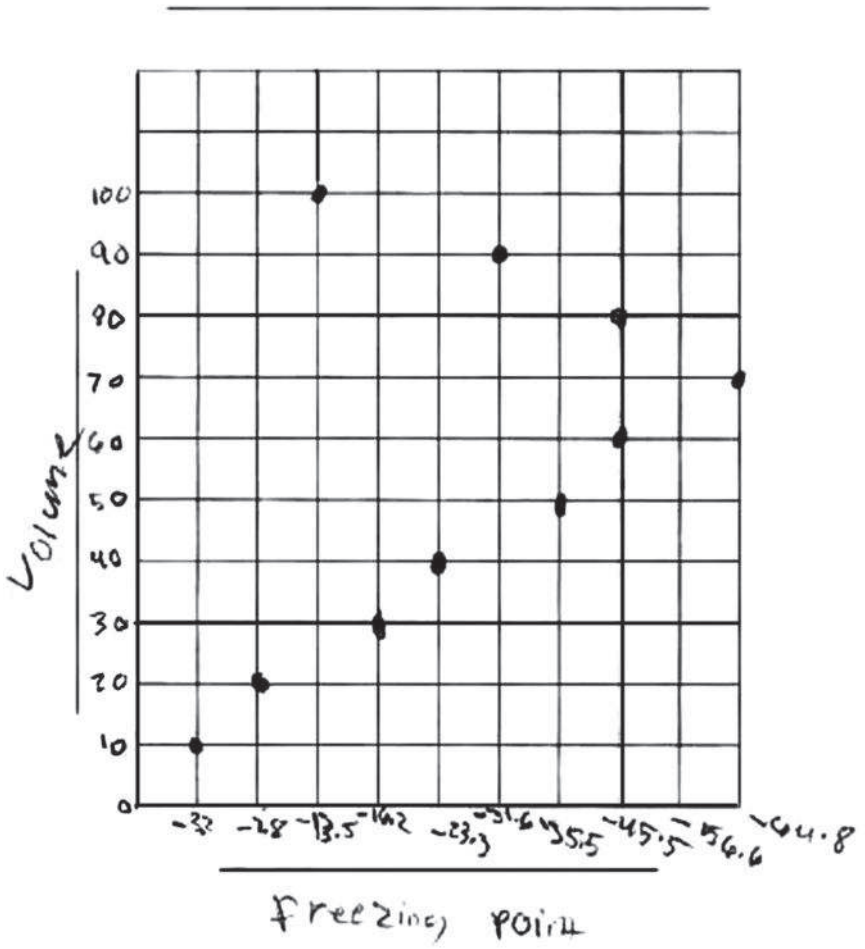
Score Point 1

❽ Ethylene base high toxicity
Propylene has very low toxicity
So I think Propylene whould be bator
to use

Response demonstrates a limited understanding by identifying and explaining one advantage of one antifreeze and one disadvantage of the other antifreeze and making a choice.

SCORE POINT 1 (CONTINUED)

3



SCORE POINT 0

8

The Kids should use propylene antifreeze because it better protects against corrosion.

The response is incorrect. One advantage is stated in error as the propylene glycol offers less corrosion protection (not "better").

3