Grade 9 Released 2017 Alberta Provincial Achievement Test

Science

Alberta Provincial Achievement Testing

Alberta

This document contains a full release of the 2017 Grade 9 Science Provincial Achievement Test.

A test blueprint and an answer key that includes the difficulty, reporting category, unit, and item description for each question are also included. These materials, along with the program of studies and subject bulletin for Grade 9 Science, provide information that can be used to inform instructional practice.

The Assessment Highlights document provides information about the overall test, the test blueprints, and student performance on the Grade 9 Science Provincial Achievement Test. Commentary on student performance at the acceptable standard and the standard of excellence on the provincial achievement test is also provided. This information is intended for teachers and is best used in conjunction with the multi-year and detailed school reports that are available to schools via the Stakeholder File Exchange (SFX). **Assessment highlights reports** for all provincial achievement test subjects and grades are **posted on the Alberta Education website every year** in the fall.

For further information, contact Kelty Findlay, Exam Manager, Grades 6 and 9 Science at Kelty.Findlay@gov.ab.ca; Kristine Gagnon, Examiner, Grades 6 and 9 Science at Kristine.Gagnon@gov.ab.ca; or Nicole Lamarre, Director, Student Learning Assessment and Provincial Achievement Testing, at Nicole.Lamarre@gov.ab.ca at the Provincial Assessment Sector; or call 780-427-0010. To call toll-free from outside Edmonton, dial 780-310-0000.

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Contents

2017 Test Blueprint and Item Descriptions

The following blueprint shows the reporting categories and units by which questions were classified on the 2017 Grade 9 Science Provincial Achievement Test.

Unit	Question Distribution by Reporting Category		Number of Questions (Percentage of Total Test)
	Knowledge	**Skills**	
Biological Diversity	**5** (1, 5, 6, 7, 8)	**6** (2, 3, 4, 9, 10, NR1)	**11 Questions** (20%)
Matter and Chemical Change	**5** (11, 14, 15, 18, NR2)	**6** (12, 13, 16, 17, 19, 20)	**11 Questions** (20%)
Environmental Chemistry	**4** (22, 23, 25, 29)	**7** (21, 24, 26, 27, 28, 30, NR3)	**11 Questions** (20%)
Electrical Principles and Technologies	**3** (38, 39, 40)	**8** (31, 32, 33, 34, 35, 36, 37, NR4)	**11 Questions** (20%)
Space Exploration	**6** (41, 42, 45, 47, 48, 50)	**5** (43, 44, 46, 49, NR5)	**11 Questions** (20%)
Number of Questions (Percentage of Total Test)	**23 Questions** (42%)	**32 Questions** (58%)	**Total Test 55 Questions** (100%)

Additional Information

The table below provides information about each question: the keyed response, the difficulty of the item (the percentage of students who answered the question correctly on the English form of the test), the reporting category, the unit, and the item description.

Question	Key	Correct Response	Reporting Category	Unit	Item Description
1	A	64.3%	Knowledge	Biological Diversity	Identify the ecological niche of a specified organism. (1.2)
2	A	69.5%	Skills	Biological Diversity	Analyze an insect resistance scenario and determine a graph that represents the information provided. (1.4/AI.2)
NR1	2211	67.7%	Skills	Biological Diversity	Distinguish between variation between species and variation within a species. (1.1)
3	C	89.0%	Skills	Biological Diversity	Identify the type of reproduction shown in a diagram and determine the genetic content of the offspring. (2.1a/3.3)
4	A	69.5%	Skills	Biological Diversity	Identify a heritable trait based on information in a chart. (2.2)
5	C	42.4%	Knowledge	Biological Diversity	Identify the processes involved through each stage of sexual reproduction. (3.2)
6	C	77.2%	Knowledge	Biological Diversity	Determine a method of reproduction used based on a source. (3.4)
7	B	70.1%	Knowledge	Biological Diversity	Classify the status of a species based on a specified scenario. (4.2)
8	D	54.0%	Knowledge	Biological Diversity	Identify the relationship between the abundance of species on Earth and the regions of the planet. (4.1)
9	B	74.5%	Skills	Biological Diversity	Determine the manipulated variable in a given experiment. (AI.2)

Question	Key	Correct Response	Reporting Category	Unit	Item Description
10	C	44.3%	Skills	Biological Diversity	Draw a conclusion from provided graphs. (SO)
11	D	73.6%	Knowledge	Matter and Chemical Change	Identify a chemical property of an unknown solid from a given list of properties. (1.1/2.4a)
NR2	3412	61.6%	Knowledge	Matter and Chemical Change	Classify substances based on type of matter. (1.2a)
12	D	47.4%	Skills	Matter and Chemical Change	Identify a type of reaction from a graph. (2.2a/2.4a/ AI.4)
13	B	77.8%	Skills	Matter and Chemical Change	Calculate the mass of a reactant based on information provided about the mass of products and other reactants. (2.4c)
14	B	70.2%	Knowledge	Matter and Chemical Change	Identify an element based on shared chemical properties and position on the periodic table. (3.1/3.3)
15	D	60.0%	Knowledge	Matter and Chemical Change	Identify the location on the periodic table of the least reactive elements. (3.1)
16	C	83.1%	Skills	Matter and Chemical Change	Interpret a chemical formula and identify the elements present. (4.1)
17	D	62.9%	Skills	Matter and Chemical Change	Identify a model that represents a specified commonly found chemical. (4.4/4.2)
18	C	56.6%	Knowledge	Matter and Chemical Change	Identify ionic compounds from molecular compounds. (3.4)
19	D	47.4%	Skills	Matter and Chemical Change	Determine the word equation for a reaction described in a scenario. (4.5)
20	A	81.9%	Skills	Matter and Chemical Change	Identify a precaution that needs to be taken given a WHMIS symbol. (PR.3)

Question	Key	Correct Response	Reporting Category	Unit	Item Description
21	D	78.2%	Skills	Environmental Chemistry	Analyze a graph and interpret patterns in air-pollutant levels. (PR.1/ MCC AI.1/MCC AI.4)
22	B	52.1%	Knowledge	Environmental Chemistry	Analyze a list of substances and identify which one is organic. (1.1)
23	C	52.9%	Knowledge	Environmental Chemistry	Identify the primary roles of macromolecules in the human body. (1.2/EC 1.1)
24	C	76.4%	Skills	Environmental Chemistry	Determine if a chemical substance was released in an area when given a graph of a population. (3.3a)
25	A	71.5%	Knowledge	Environmental Chemistry	Identify an environmental condition that results in excess algal growth in the pond. (2.3)
NR3	2314	47.7%	Skills	Environmental Chemistry	Compare and order toxin concentrations given using different units. (2.4)
26	C	72.2%	Skills	Environmental Chemistry	Determine the responding variable in an experiment based on information given. (IP)
27	A	63.0%	Skills	Environmental Chemistry	Determine an incorrect statement regarding acids and bases using data from a graph. (2.5)
28	C	72.0%	Skills	Environmental Chemistry	Analyze a graph in order to determine how much acid must be added to neutralize a solution. (AI/2.5)
29	A	67.7%	Knowledge	Environmental Chemistry	Identify a question that would be posed regarding human impacts on an ecosystem. (1.5)
30	B	79.5%	Skills	Environmental Chemistry	Identify a research question reflected in a flow chart. (SO/3.5)

Question	Key	Correct Response	Reporting Category	Unit	Item Description
31	D	78.9%	Skills	Electrical Principals and Technologies	Determine a modification to a wet cell design that would result in a greater voltage reading. (1.3)
32	A	72.6%	Skills	Electrical Principals and Technologies	Identify the energy transformation that occurs in a diagram of a circuit. (1.2)
33	D	50.8%	Skills	Electrical Principals and Technologies	Create a circuit that meets specific criteria by choosing the correct location for four devices in a given circuit diagram. (2.7)
34	B	71.9%	Skills	Electrical Principals and Technologies	Identify a circuit design based on a given description. (2.8)
35	B	72.8%	Skills	Electrical Principals and Technologies	Extrapolate information based on a graph. (IP.4/EC AI.3)
36	B	70.1%	Skills	Electrical Principals and Technologies	Analyze experimental data and identify a substance that is an insulator. (2.3)
37	D	73.5%	Skills	Electrical Principals and Technologies	Calculate power in a given system. (3.2a)
NR4	80	69.9%	Skills	Electrical Principals and Technologies	Measure and evaluate the efficiency of different systems using given information. (3.4)
38	D	49.3%	Knowledge	Electrical Principals and Technologies	Identify an action that affects energy efficiency in a home. (3.5)
39	A	63.0%	Knowledge	Electrical Principals and Technologies	Identify which methods of generating electricity are most inconsistent. (4.1)
40	D	65.9%	Knowledge	Electrical Principals and Technologies	Identify an unknown energy source based on a table of pros and cons for that unknown energy source. (4.2/4.1)

Question	Key	Correct Response	Reporting Category	Unit	Item Description
41	D	73.8%	Knowledge	Space Exploration	Identify characteristics of planets. (1.4)
42	D	55.9%	Knowledge	Space Exploration	Identify the purpose of spectral analysis. (1.2)
43	B	50.2%	Skills	Space Exploration	Describe the position of a celestial object using altitude and azimuth coordinates. (1.5c)
44	A	78.7%	Skills	Space Exploration	Identify the primary reason why astronauts experience changes in muscle mass and bone density while in space. (2.1)
NR5	2413	63.9%	Skills	Space Exploration	Match labelled spacesuit parts to the condition in space they are designed to protect an astronaut from. (2.2/4.1)
45	B	77.8%	Knowledge	Space Exploration	Compare space-based telescopes to Earth-based telescopes. (3.1)
46	A	68.0%	Skills	Space Exploration	Analyze a table to determine the time necessary for radio waves to travel from the Sun to a planet other than Earth. (IP.3)
47	C	85.5%	Knowledge	Space Exploration	Identify a use for triangulation. (1.5b/3.3)
48	D	56.8%	Knowledge	Space Exploration	Identify differences in motion between stars and planets. (1.6)
49	C	50.4%	Skills	Space Exploration	Determine an advantage of a satellite's geosynchronous orbit based upon a source. (2.5)
50	B	76.1%	Knowledge	Space Exploration	Identify the research for space exploration that would be the least helpful to an astronaut. (4.3)

2017 Provincial Achievement Test Questions

The questions presented in this document are from the previously secured 2017 Grade 9 Science Provincial Achievement Test and are representative of the questions that form provincial achievement tests. These questions are released by Alberta Education for teacher and student use.

Use the following information to answer question 1.

Some Facts About Giant Canada Geese

W Play an important role in seed dispersal

X Fly in V-formation to conserve energy

Y Have well-developed vocal cords for communication

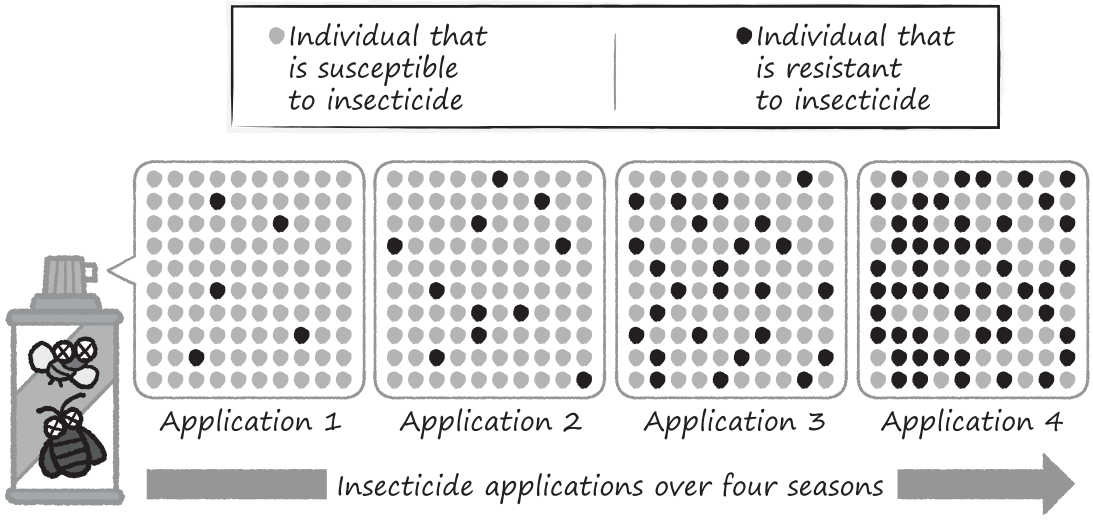
Z Were believed to be extinct in the 1950s

1. Which fact listed above describes part of the ecological niche of giant Canada geese?

A. Fact W
B. Fact X
C. Fact Y
D. Fact Z

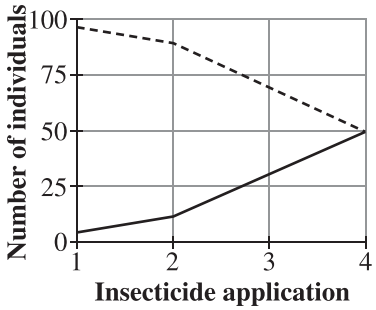
Use the following information to answer question 2.

The number of insects affected by the applications of an insecticide was observed in a plot over time.



2. Which of the following graphs **best** represents the information shown above?

A.



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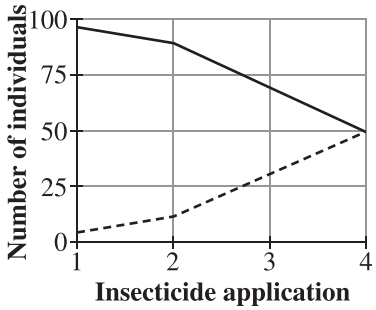
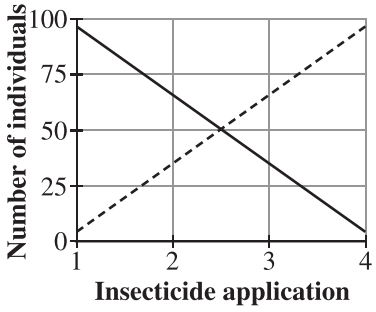
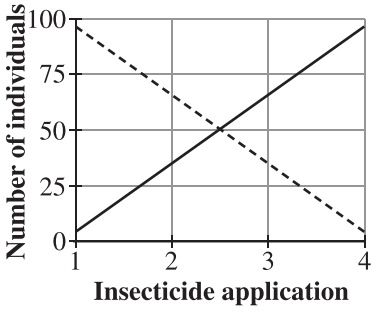


C.



D.



Resistant individuals ------ Susceptible individuals

Use the following information to answer numerical-response question 1.

Statements Related to Variation Within and Between Species

Statement W	Sharks exchange gases using gills, while whales exchange gases using lungs.
Statement X	Some houseplants, such as ferns, use spores to reproduce, while other houseplants, like ivy, use runners.
Statement Y	Black bears have fur colours ranging from blonde to brown to black.
Statement Z	The black veins on a male monarch butterfly's wings are thicker than the black veins on a female monarch butterfly's wings.

Numerical Response

1. Use the following code to identify whether the statements above describe examples of variation **within** a species or variation **between** species.

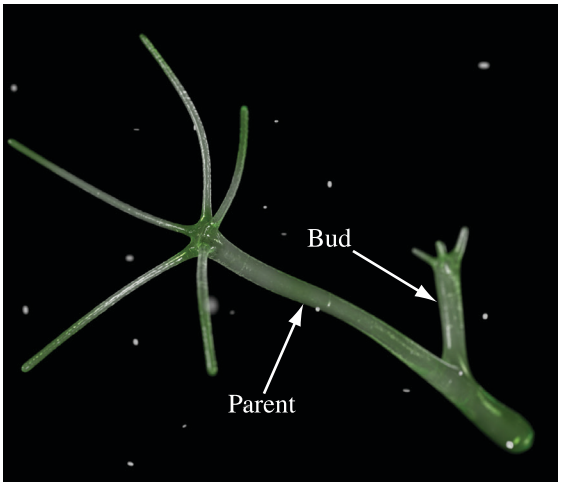
1 = Variation within a species
2 = Variation between species

_____	_____	_____	_____
Statement W	**Statement X**	**Statement Y**	**Statement Z**

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 3.

A Budding Hydra



3. *The type of reproduction shown in the diagram is* ___***i***___ *and the hydra's offspring is genetically* ___***ii***___ *the parents.*

The statement above is completed by the information in row

Row	***i***	***ii***
A.	sexual	identical to
B.	sexual	different from
C.	asexual	identical to
D.	asexual	different from

Use the following information to answer question 4.

Characteristics of Four Students

Student	Height (cm)	Scarring	Widow's Peak	Straight Thumb
I	158	Yes	Yes	No
II	185	Yes	No	Yes
III	176	No	Yes	Yes
IV	168	Yes	No	No

4. Which of the following characteristics is a heritable trait that exhibits continuous variation?

A. Height
B. Scarring
C. Widow's peak
D. Straight thumb

Use the following information to answer question 5.

Stages of Reproduction

5. Which of the following rows identifies the processes above?

Row	Process 1	Process 2	Process 3
A.	Mitosis	Meiosis	Fertilization
B.	Mitosis	Fertilization	Meiosis
C.	Meiosis	Fertilization	Mitosis
D.	Meiosis	Mitosis	Fertilization

Use the following information to answer question 6.

Sam would like to increase the volume of milk produced by the cows at her farm. The 10 highest milk-producing cows from her herd are chosen to produce the next generation of calves.

6. Which of the following processes is described above?

A. Asexual reproduction
B. Genetic engineering
C. Artificial selection
D. Natural selection

Use the following information to answer question 7.

In 1995 wolves that were captured in Canada were reintroduced to Yellowstone National Park, United States, in an attempt to re-establish the predator–prey balance in the ecosystem. Before 1995, wolves had been absent from the park for almost 70 years.

7. Before 1995, prior to their reintroduction, wolves in Yellowstone National Park would have been classified as being

A. extinct
B. extirpated
C. threatened
D. endangered

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8. Which of the following statements describes the abundance of species in different regions on Earth?

A. The greatest abundance of species on Earth is found near the equator, but the greatest diversity among species is found in regions furthest from the equator.

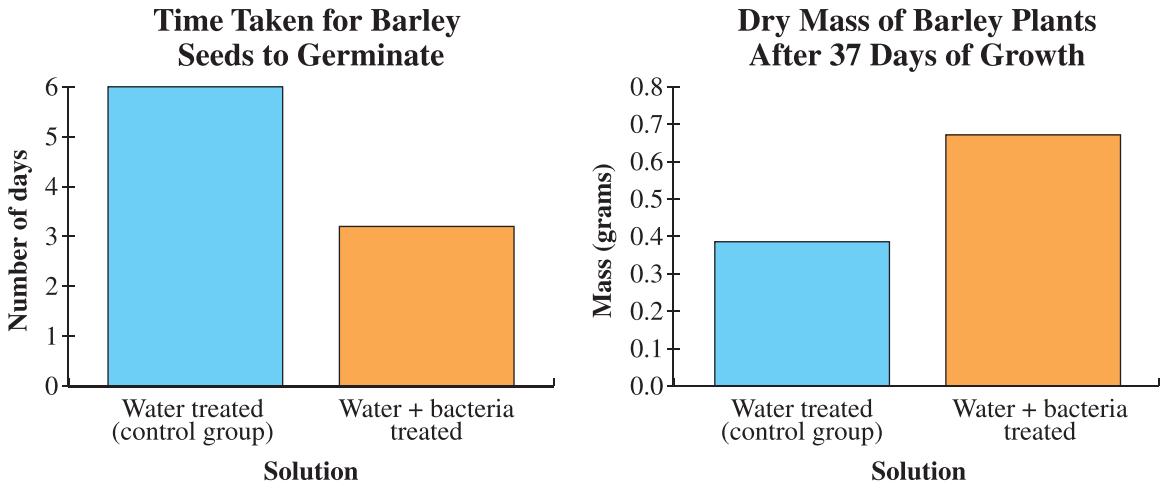
B. The greatest diversity among species on Earth is found near the equator, but the greatest abundance of species is found in regions furthest from the equator.

C. The greatest abundance of species and the greatest diversity among species on Earth are found in regions furthest from the equator.

D. The greatest abundance of species and the greatest diversity among species on Earth are found near the equator.

Use the following information to answer questions 9 and 10.

Three 16-year-old girls won the top prize at the 2014 Google Science Fair. The girls studied the effects of treating barley seeds in different solutions before planting them. Some of their findings are summarized below.



9. According to the information given, the manipulated variable in the experiment described above is the

A. time taken for the plants to germinate
B. different solution treatments for the seeds
C. type of potting soil used to plant the seeds
D. dry mass of the plants after 37 days of growth

10. Compared to control group seeds, the water + bacteria treated seeds produce

A. slower-germinating and more massive crops
B. slower-germinating and less massive crops
C. faster-germinating and more massive crops
D. faster-germinating and less massive crops

Use the following information to answer question 11.

A teacher challenged a group of students to identify an unknown white solid. The students recorded the following results in their investigation.

	Test	Results
A	Density	2.13 g/cm^3
B	Melting point	140 °C
C	Microscope	Crystalline structure observed
D	Mixed with $HClO_4(aq)$	Heat generated

11. Which of the tests listed above provides evidence of a chemical property of the unknown solid?

A. Test A
B. Test B
C. Test C
D. Test D

Use the following information to answer numerical-response question 2.

Classifications of Matter

1 Element
2 Compound
3 Solution
4 Mechanical mixture

Numerical Response

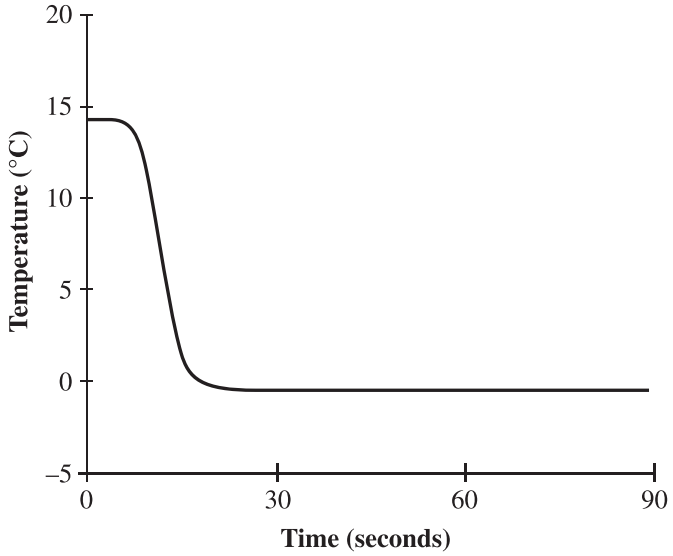
2. Match each classification of matter listed above with the example of that classification of matter given below.

Acid rain _____ (Record in the **first** column)
Chocolate chip cookies _____ (Record in the **second** column)
Helium gas _____ (Record in the **third** column)
Table salt _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 12.

Change in Temperature in a Solution During a Chemical Reaction Over Time



12. A type of reaction that produces a change like the one shown in the graph above is

A. corrosion
B. exothermic
C. combustion
D. endothermic

Use the following information to answer question 13.

In an experiment, 12.0 g of solid carbon, C(s), reacted with oxygen gas, $O_2(g)$, to form 44.0 g of carbon dioxide gas, $CO_2(g)$.

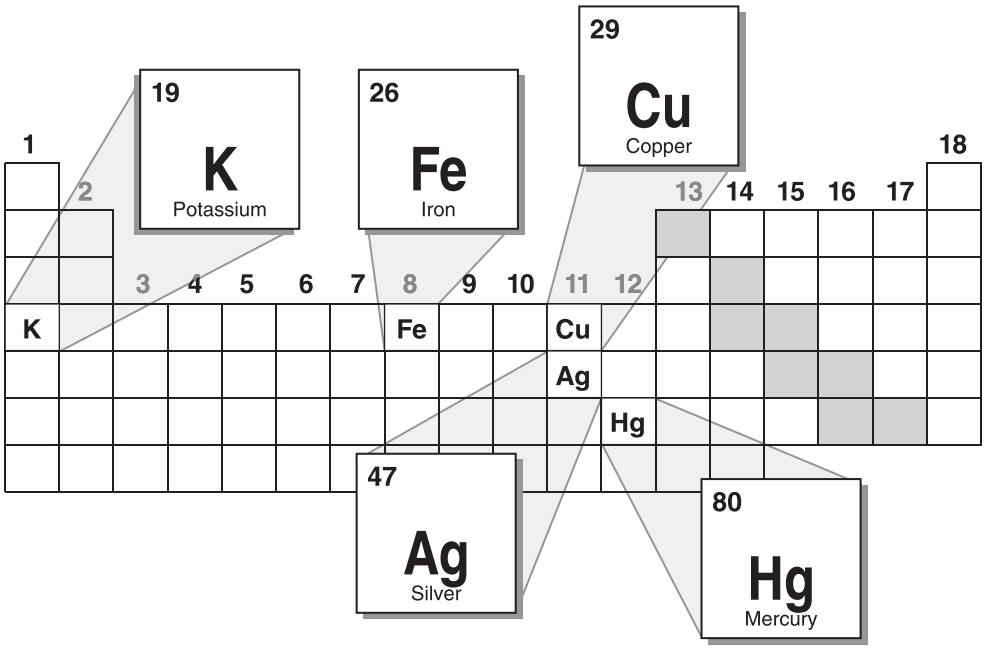
13. If all 12.0 g of carbon reacted, how many grams of oxygen reacted with the carbon?

A. 12.0 g
B. 32.0 g
C. 44.0 g
D. 56.0 g

Use the following information to answer questions 14 and 15.

Copper has been used to produce metal coins because it is

- non-reactive with most acids
- not readily reactive with oxygen
- malleable



14. Which of the elements on the periodic table above would be another appropriate metal to use for producing metal coins based on its similar properties to copper?

A. Iron
B. Silver
C. Mercury
D. Potassium

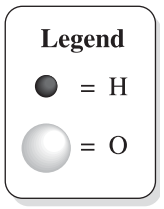
15. Which group of elements on the periodic table has the **least** reactive elements?

A. Group 1
B. Group 2
C. Group 17
D. Group 18

16. Which of the following rows identifies the three elements present in washing soda, $Na_2CO_3(s)$?

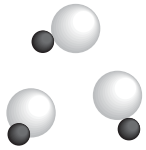
Row	Element #1	Element #2	Element #3
A.	Nitrogen	Carbon	Oxygen
B.	Nitrogen	Calcium	Oxygen
C.	Sodium	Carbon	Oxygen
D.	Sodium	Calcium	Oxygen

Use the following information to answer question 17.

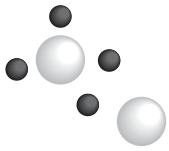


17. Which of the following diagrams **best** represents molecules of water?

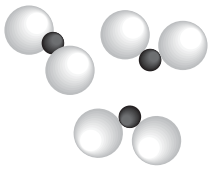
A.



B.



C.



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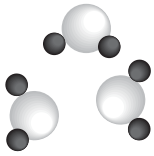


Use the data sheet to answer question 18.

18. Which pair of compounds below can be classified as ionic compounds?

A. $C_6H_6(l)$ and $BeF_2(s)$
B. $C_6H_6(l)$ and $NO_2(g)$
C. $LiCl(s)$ and $BeF_2(s)$
D. $LiCl(s)$ and $NO_2(g)$

Use the following information to answer question 19.

In a science class, students saw a copper precipitate, Cu(s), appear in a solution of copper(II) sulfate, $CuSO_4(aq)$, after a piece of zinc, Zn(s), was added to the solution.

19. Which of the following chemical equations represents the reaction described above?

A. $CuSO_4(aq) + ZnSO_4(aq) \rightarrow Cu(s) + Zn(s)$
B. $Cu(s) + ZnSO_4(aq) \rightarrow Zn(s) + CuSO_4(aq)$
C. $Zn(s) + ZnSO_4(aq) \rightarrow Cu(s) + CuSO_4(aq)$
D. $Zn(s) + CuSO_4(aq) \rightarrow Cu(s) + ZnSO_4(aq)$

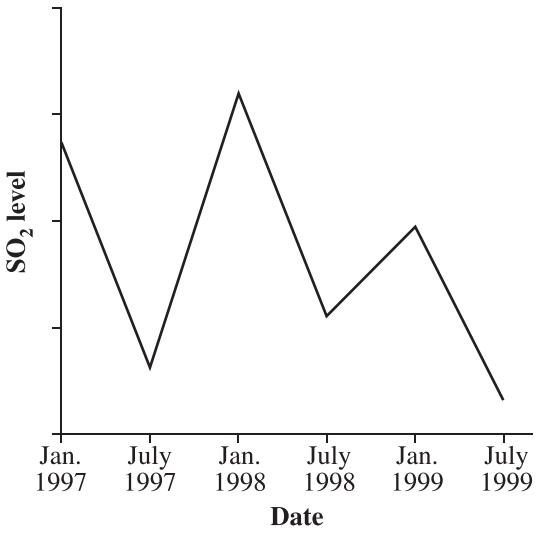
Use the following information to answer question 20.

WHMIS Symbol

20. Which of the following actions best describes how to safely deal with a material with the above WHMIS symbol after working with it?

A. Place it in a biohazardous-waste bin for collection.
B. Dilute it with water before pouring it down the drain.
C. Combine it with a sand–gravel mixture before disposing of it.
D. Place it in a lead-lined container for radioactive-waste collection.

Use the following information to answer question 21.



21. The information in the graph above indicates that sulfur dioxide levels

A. increased in the summers
B. decreased throughout 1997
C. consistently increased from 1997 to 1999
D. were at their highest in the winter of 1998

Use the following information to answer question 22.

Some Common Substances

Chemical Name	Chemical Formula	Common Name
Iron	Fe(s)	Iron
Sucrose	$C_{12}H_{22}O_{11}(s)$	Table sugar
Sodium chloride	NaCl(s)	Table salt
Magnesium hydroxide	$Mg(OH)_2(s)$	Milk of magnesia

22. Which of the substances listed above is classified as an organic substance?

A. Iron
B. Sucrose
C. Sodium chloride
D. Magnesium hydroxide

Use the following information to answer question 23.

Macromolecules and the Human Body

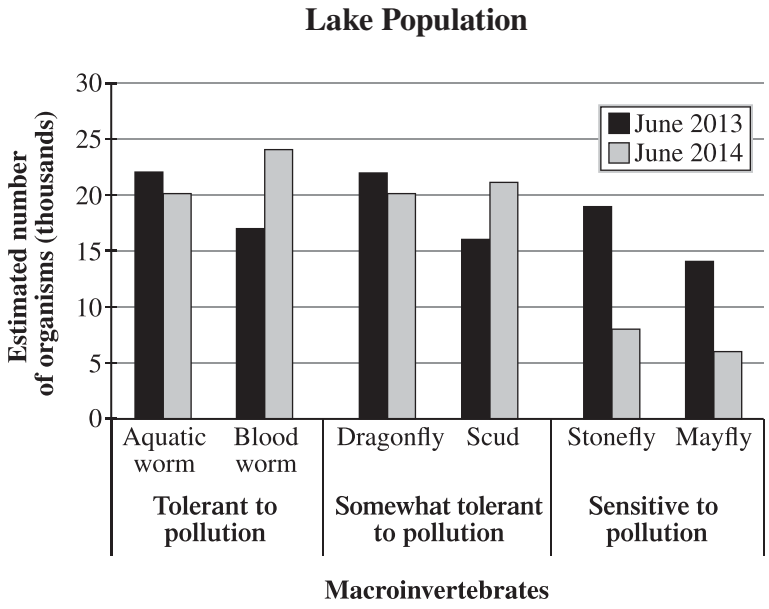
Macromolecule	Primary Role in the Human Body	Possible Source
W	Immediate source of energy	Apple
Lipid	**X**	Corn oil

23. Which of the following rows completes the table above?

Row	W	X
A.	Protein	Energy storage
B.	Protein	Structural support
C.	Carbohydrate	Energy storage
D.	Carbohydrate	Structural support

Use the following information to answer question 24.

In 2009, citizens of Havenfield were worried that local industry might be polluting the lake water used by the town. A one-year water study was commissioned to determine if pollution was being discharged into the lake. The results of the study are summarized in the graph below.



24. Which of the following statements is **best** supported by the information presented in the graph above?

A. The pollution discharged in the water by industries was beneficial to species survival.

B. The increase in the scud population indicates that the lake ecosystem was not affected by pollution.

C. The decrease in the stonefly population supports the conclusion that the water became more polluted.

D. The decrease in the aquatic worm population supports the conclusion that the water became more polluted.

25. Which of the following factors would contribute the **most** to excess algal growth in a pond?

A. Fertilizer use
B. Drought conditions
C. Reduced air temperatures
D. Exhaust from farm equipment

Use the following information to answer numerical-response question 3.

Several organisms from a specific region have been tested to determine the concentration of a biomagnifying toxin in their body tissues.

Average Toxin Concentrations in Four Organisms

Organism	Average Toxin Concentration
1	50 parts per million
2	50 parts per trillion
3	50 parts per billion
4	50 parts per thousand

Numerical Response

3. Place the organisms from the table above in order from **lowest** average toxin concentration to **highest** average toxin concentration.

_____	_____	_____	_____
Lowest average toxin concentration			**Highest average toxin concentration**

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer question 26.

Details of a study to test the effectiveness of different antacids are shown below.

Procedure:

Step 1 Combine 60 mL of vinegar with 30 mL of antacid.

Step 2 After 10 min, measure the pH of the solution.

Step 3 Repeat steps 1 and 2 for each antacid.

Observations:

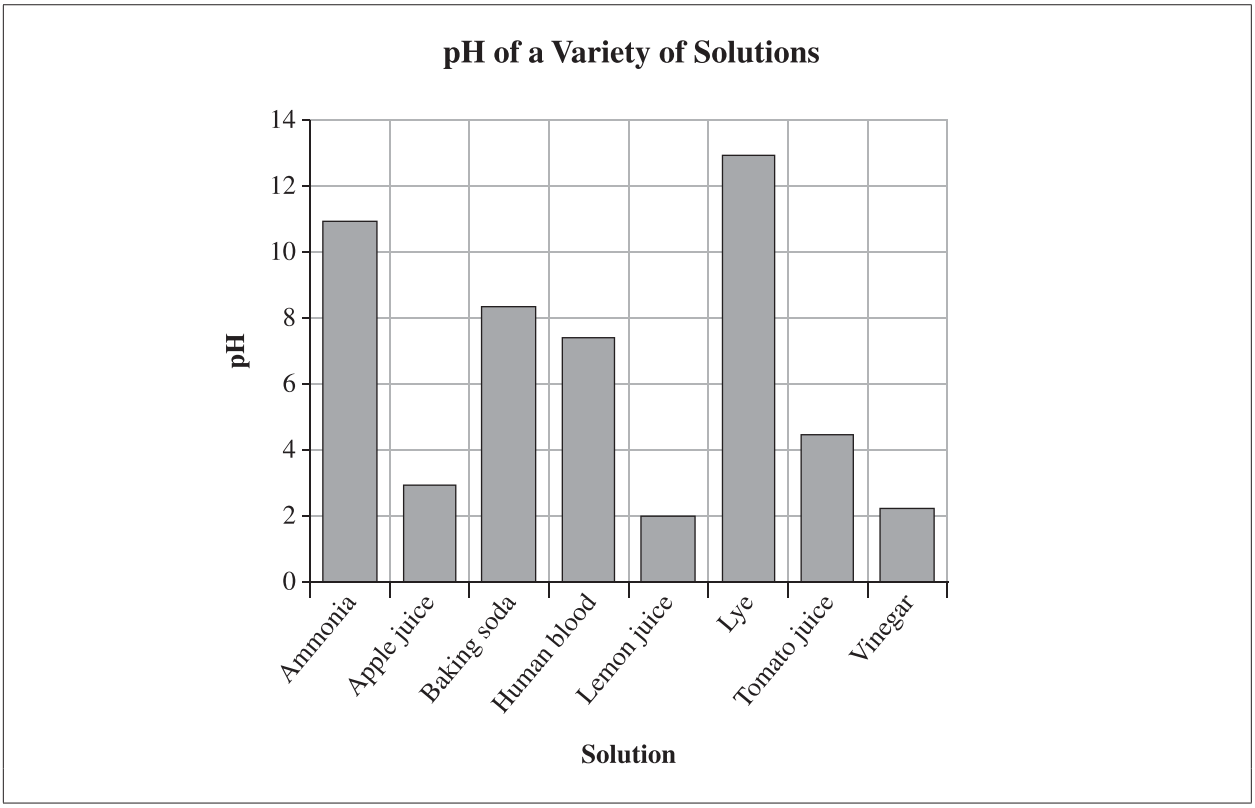
pH of Vinegar and Antacid Solution After 10 Min

	Vinegar and Antacid Solution (pH)			
Trial	**Antacid M**	**Antacid N**	**Antacid O**	**Antacid P**
I	6.5	4.7	5.0	2.6
II	6.4	4.7	4.4	2.7
III	6.4	4.7	5.6	2.6

26. The responding variable in the experiment described above is the

A. type of antacid
B. volume of vinegar in the solution
C. pH of the vinegar and antacid solution
D. length of time waited before measurements are taken

Use the following information to answer question 27.

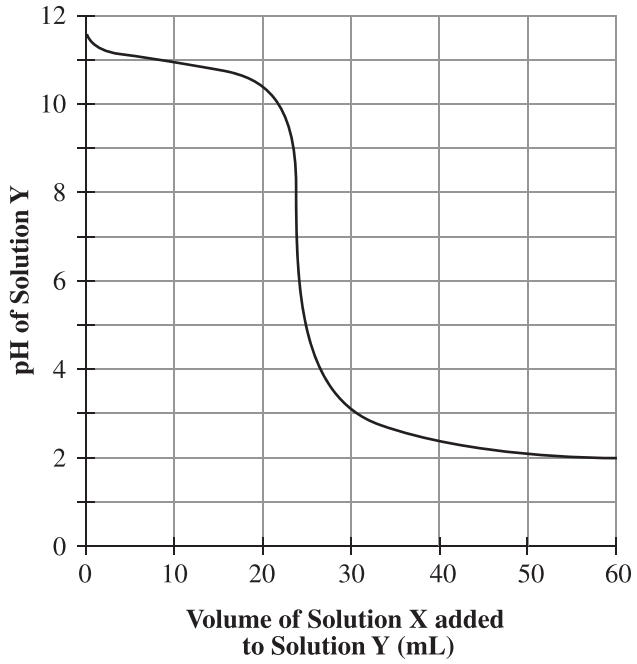


27. Using the information above, which of the following statements is **incorrect**?

A. Tomato juice is less basic than vinegar.
B. Lye is the most basic of all the solutions.
C. Apple juice is less acidic than lemon juice.
D. Human blood is more acidic than ammonia.

Use the following information to answer question 28.

The Effect of Solution X on the pH of Solution Y



28. Based on the graph above, what volume of Solution X was needed to neutralize Solution Y?

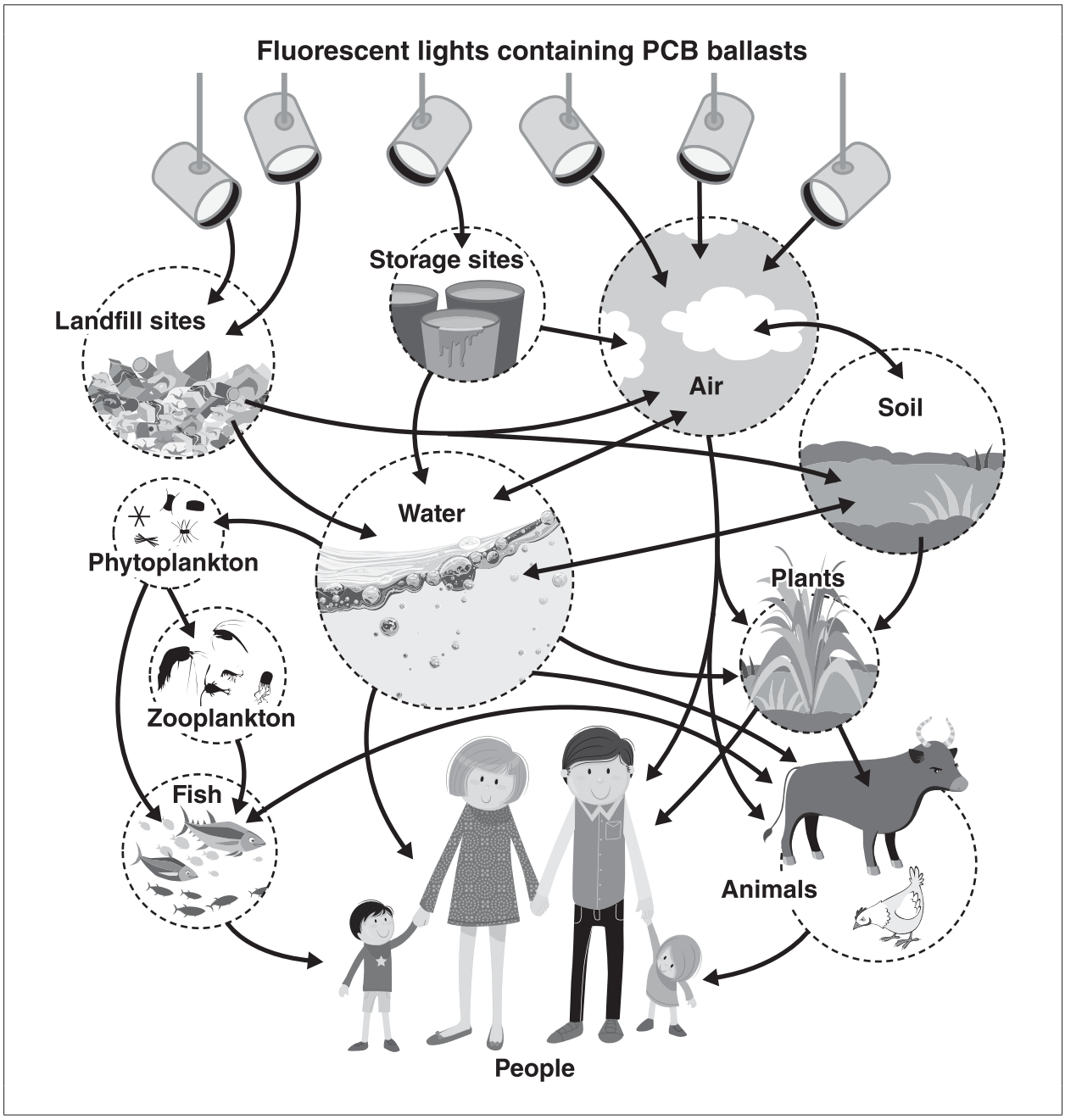
A. 10 mL
B. 20 mL
C. 24 mL
D. 44 mL

---

29. Which of the following questions would be of **greatest** significance to a waterbird ecologist in discussing the substances that can be safely released into a wetland environment?

A. What is the LD_{50} of the substance?
B. How porous is the soil in the dumping area?
C. Will the odour of the substance affect local residents?
D. Which direction will the prevailing winds carry the substance?

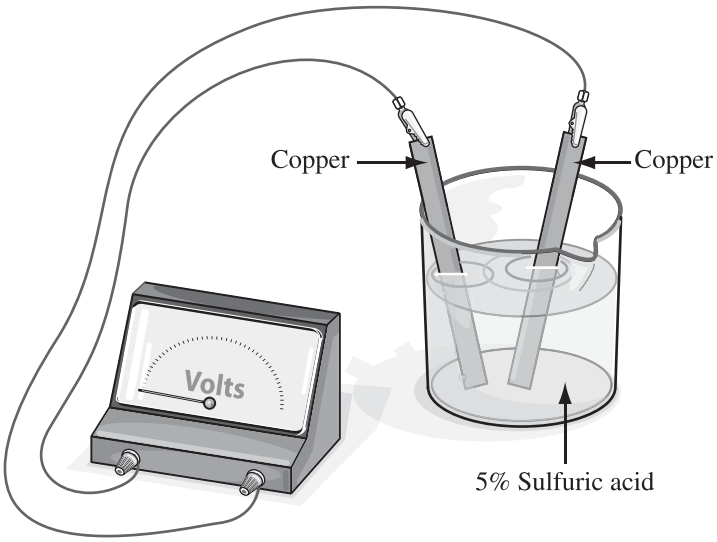
Use the following information to answer question 30.



30. Which of the following research questions **best** reflects the information shown above?

A. How do PCBs form in the environment?
B. How do PCBs move through an ecosystem?
C. What impact do PCBs have on water quality?
D. What are the various ways that PCBs are stored?

Use the following information to answer question 31.

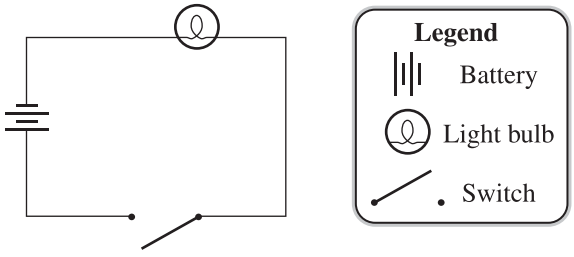


31. Which of the following changes to the cell shown above would result in voltage being produced?

A. Reversing the leads on the voltmeter
B. Using a greater volume of sulfuric acid
C. Replacing 5% sulfuric acid with 20% sulfuric acid
D. Changing one of the electrodes to a zinc electrode

Use the following information to answer question 32.

The diagram below shows a simple circuit.



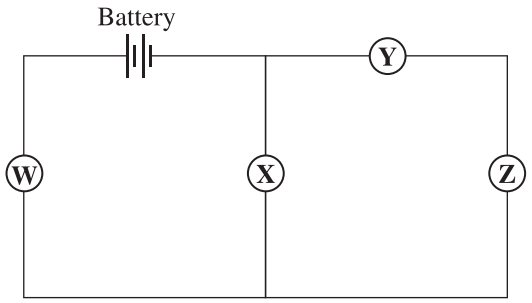
32. The energy transformation that occurs in the circuit above when the switch is closed is

A. chemical energy → electrical energy → light and thermal energy
B. light energy → electrical energy → chemical and thermal energy
C. thermal energy → chemical energy → electrical and light energy
D. chemical energy → thermal energy → electrical and light energy

Use the following information to answer question 33.

When a switch, a variable resistor, a light bulb, and a motor are connected in a circuit such as the one shown below, the circuit will operate as follows:

- The switch will control both the motor and the light bulb.
- The user will be able to control the brightness of the light bulb.



33. Which of the following rows matches the electrical components to their corresponding locations in the circuit described above?

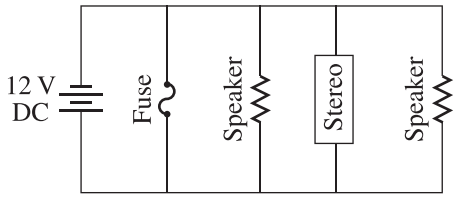
Row	W	X	Y	Z
A.	Variable resistor	Light bulb	Switch	Motor
B.	Variable resistor	Motor	Switch	Light bulb
C.	Switch	Light bulb	Variable resistor	Motor
D.	Switch	Motor	Variable resistor	Light bulb

Use the following information to answer question 34.

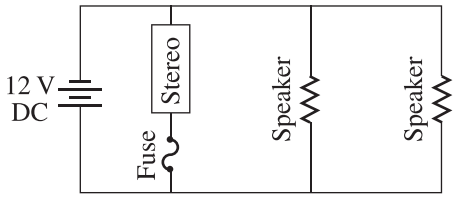
Jake needs to repair a car stereo system. The system contains a stereo and a fuse that are connected in series and two speakers that are connected in parallel.

34. Which of the following diagrams represents the car stereo system described above?

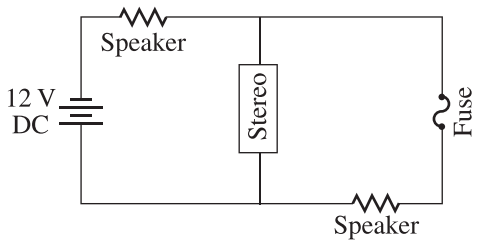
A.



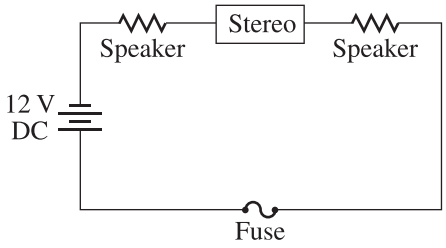
B.



C.

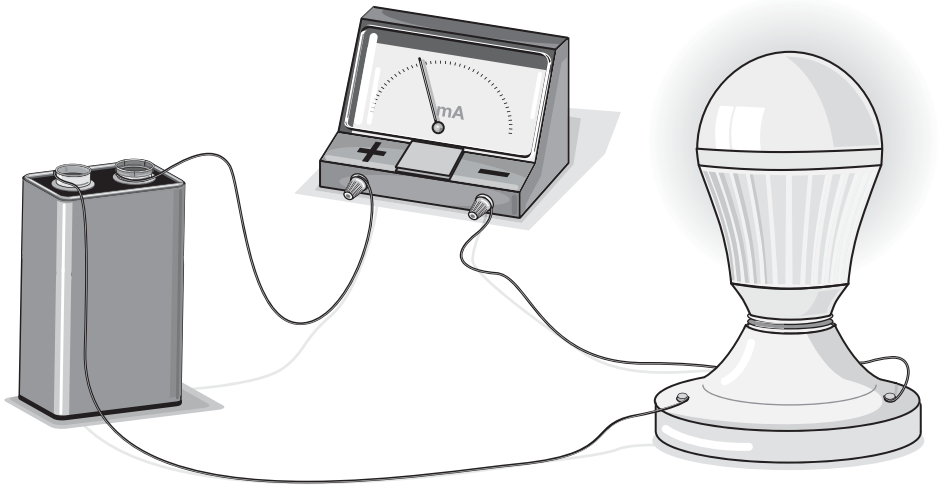


D.



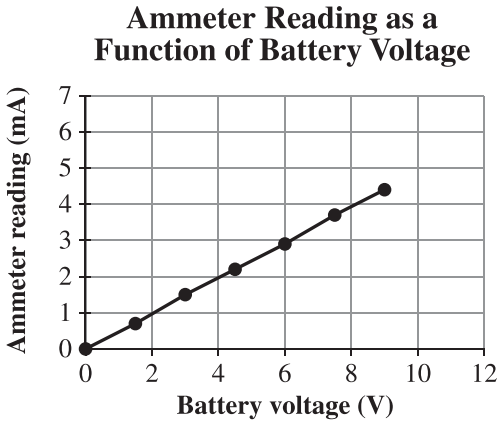
Use the following information to answer question 35.

A Grade 9 student used an ammeter to measure the current of a circuit consisting of a bulb, an ammeter, and a 1.5 volt battery. She then changed the voltage using various batteries and measured the resulting currents using the same bulb and ammeter.



She recorded all of her data in the following chart and then drew the following graph.

Battery Voltage (V)	Ammeter Reading (mA)
0	0
1.5	0.7
3.0	1.5
4.5	2.2
6.0	2.9
7.5	3.7
9.0	4.4



35. Based on information in the graph, if a 10.5 V battery were used, then the expected ammeter reading would be

A. 4.6 mA
B. 5.1 mA
C. 5.6 mA
D. 6.6 mA

Use the following information to answer question 36.

A student is testing the conductivity of 4 different substances. He uses a 2.5 V battery and records the current in the circuit in each of the 4 substances. The chart below indicates the current measured.

Substance	Current
Substance Q	37 mA
Substance R	0.01 mA
Substance S	2.50 A
Substance T	2.40 A

36. Which substance is **most likely** an insulator?

A. Substance Q
B. Substance R
C. Substance S
D. Substance T

Use the following information and the data sheet to answer question 37.

Ratings for an Electrical Device

Voltage	Current	Resistance	Power
100 V	4 A	25 Ω	**?**

37. Calculate power for the device given above.

A. 16 W
B. 25 W
C. 100 W
D. 400 W

Use the following information to answer numerical-response question 4.

Energy Measurements for Different Systems

System	Input Energy (J)	Output Energy (J)
P	520	260
Q	90	36
R	15	12

Numerical Response

4. The most efficient system described above has an efficiency of _____ %.

(Record your answer in the numerical-response section on the answer sheet.)

38. Which of the following actions will **not** reduce waste of energy in a home?

A. Replacing single-pane windows with double-pane windows
B. Installing a programmable thermostat to control a furnace
C. Wrapping an insulating blanket around a hot water tank
D. Installing an air conditioner to reduce temperatures

39. Which of the following two methods of power generation provide the **least** consistent energy?

A. Wind and solar power
B. Hydro and wind power
C. Nuclear and solar power
D. Hydro and nuclear power

Use the following information to answer question 40.

The advantages and disadvantages of a particular energy source are given in the following table.

Advantages	Disadvantages
Cost effective	Non-renewable resource
Readily available	Contributes to global warming
Reliable source of energy	Disrupts natural habitats

40. The energy source being described in the table above is **most likely**

A. solar
B. biomass
C. geothermal
D. natural gas

Use the following information to answer question 41.

The first four planets from the Sun are called the inner planets. The four planets that are furthest from the Sun are called outer planets.

41. Which of the tables below lists some of the key characteristics that distinguish outer planets from inner planets in our solar system?

A.

Inner Planets	Outer Planets
Gaseous	Terrestrial
Large	Small
Many natural satellites	Few natural satellites

B.

Inner Planets	Outer Planets
Gaseous	Terrestrial
Small	Large
Many natural satellites	Few natural satellites

C.

Inner Planets	Outer Planets
Terrestrial	Gaseous
Large	Small
Few natural satellites	Many natural satellites

D.

Inner Planets	Outer Planets
Terrestrial	Gaseous
Small	Large
Few natural satellites	Many natural satellites

Use the following information to answer question 42.

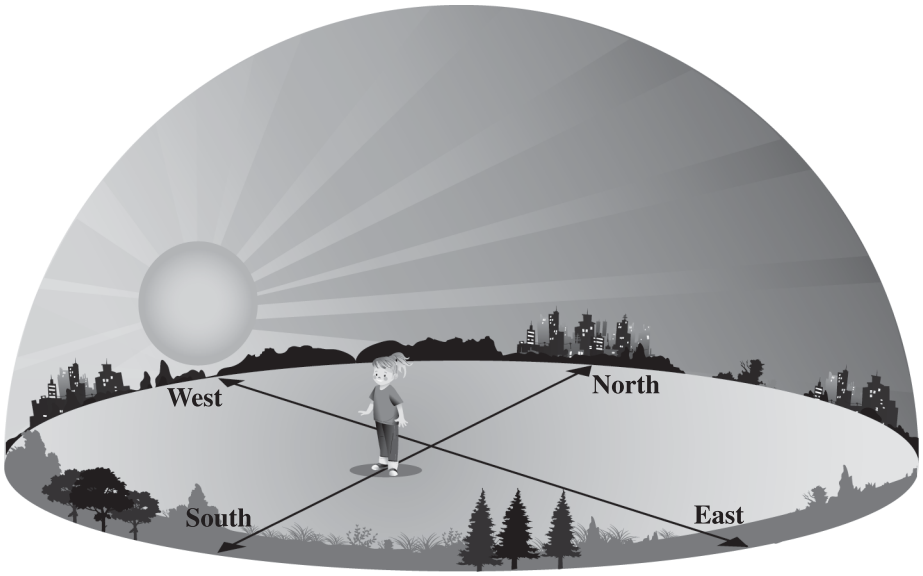
One Spectral Analysis Observation

42. Which primary property of a star does the above spectral analysis determine?

A. Age
B. Size
C. Temperature
D. Composition

Use the following information to answer question 43.

Sally is facing south on March 21 and is trying to find the coordinates of the Sun as it sets.



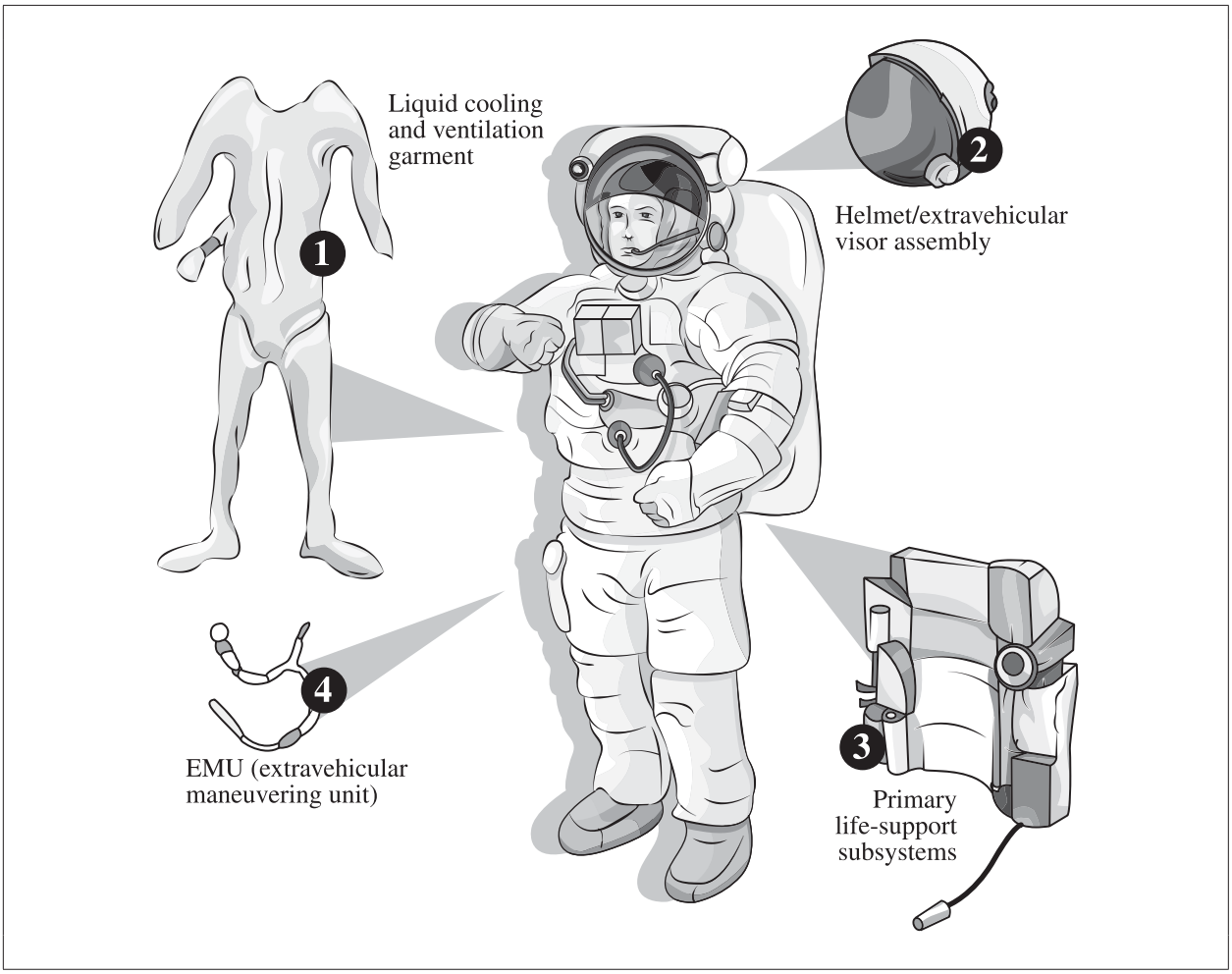
43. Which of the following coordinates **most likely** describe the location of the Sun?

A. Altitude 85° and azimuth 90°
B. Altitude 5° and azimuth 270°
C. Altitude 5° and azimuth 90°
D. Altitude 85° and azimuth 270°

44. Which of the following factors is the **main** reason an astronaut's muscle mass and bone density decrease while in space?

A. Astronauts do not need to support body weight in space.
B. Astronauts are restricted to a confined living area in space.
C. It is not possible for astronauts to exercise vigorously in space.
D. It is difficult for astronauts to consume a balanced diet in space.

Use the following information to answer numerical-response question 5.



Numerical Response

5. Match the space conditions given below with the numbered space suit components shown above that protect an astronaut while in space.

Ultraviolet radiation _____ (Record in the **first** column)

Zero gravity _____ (Record in the **second** column)

Extreme temperatures _____ (Record in the **third** column)

No atmosphere _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

45. Which of the following statements best compares telescopes based in space to telescopes based on Earth?

A. Space-based telescopes are generally larger.
B. Space-based telescopes capture clearer images.
C. Earth-based telescopes, in general, cost more to build.
D. Earth-based telescopes explore further into deep space.

Use the following information to answer question 46.

Radio telescopes receive radio waves from distant objects.

	Earth	Mars
Distance from the Sun	1 AU (astronomical unit) (150 000 000 km)	1.5 AU (astronomical unit) (225 000 000 km)
Time required for radio waves to travel from the Sun	8.3 min	?

46. If radio waves travel through space at the speed of light (300 000 km/s), then how long do radio waves emitted by the Sun take to reach Mars?

A. 12.5 min
B. 10.0 min
C. 8.3 min
D. 5.5 min

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47. Which of the following measurements could be calculated using the process of triangulation?

A. The brightness of a celestial body
B. The temperature of a celestial body
C. The distance between two celestial bodies
D. The speed at which a celestial body is travelling

Use the following information to answer question 48.

Constellations consist of patterns of stars in the sky. The constellations we recognize today were identified by many ancient civilizations.

48. Which of the following statements **best** explains why planets are never featured in constellations?

A. Planets look bigger than stars.
B. Planets are more difficult to see than stars.
C. Planets have a chemical composition different from that of stars.
D. Planets do not maintain fixed positions relative to other planets or stars.

Use the following information to answer question 49.

A geosynchronous orbit occurs when an object orbits Earth at the same rotational rate as Earth.

49. A geosynchronous orbit allows a single satellite to

A. capture information about global weather patterns
B. capture images of the planet from many perspectives
C. send signals continuously to a specified area on Earth
D. send messages to multiple receivers anywhere on Earth

Use the following information to answer question 50.

A long-stay Mars mission with astronauts has been calculated to last approximately 905 Earth days. NASA has broken down the duration of the mission as follows:

Factor	Duration (Earth days)
Travel time to Mars	180
Time on Mars surface	545
Travel time to Earth	180
Total mission time	**905**

50. Research into which of the following areas would be **least** helpful to support astronauts during a successful long-stay Mars mission?

A. Spacesuits
B. Telescopes
C. Water reclamation
D. Growing food in space

You have now completed the test.
If you have time, you may wish to check your answers.