Individual Test Item Specifications

Physical Science

2013

NOTE: The contents of this document were developed under a grant from the U.S. Department of Education. However, the content does not necessarily represent the policy of the U.S. Department of Education, and you should not assume endorsement by the Federal Government.
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I. Guide to the Individual Benchmark Specifications

Content specific guidelines are given in the *Individual Benchmark Specifications* for each course. The *Specifications* contains specific information about the alignment of items with the NGSSS and CCSS. It identifies the manner in which each benchmark is assessed, provides content limits and stimulus attributes for each benchmark, and gives specific information about content, item types, and response attributes.

**Benchmark Classification System**

Each NGSSS benchmark is labeled with a system of letters and numbers.

- The two letters in the first position of the code identify the Subject Area.
- The number(s) in the second position represent the Grade Level to which the benchmark belongs.
- The letter in the third position represents the Body of Knowledge to which the benchmark belongs.
- The number in the fourth position represents the Standard.
- The number in the last position identifies the specific Benchmark under the Standard.
Definitions of Benchmark Specifications

The Individual Benchmark Specifications provides standard-specific guidance for assessment item development for CFAC item banks. For each benchmark assessed, the following information is provided:

**Reporting Category**
is a grouping of related benchmarks that can be used to summarize and report achievement.

**Standard**
refers to the standard statement presented in the NGSSS or domain in the CCSS.

**Benchmark**
refers to the benchmark statement presented in the NGSSS or standard statement in the CCSS. In some cases, two or more related benchmarks are grouped together because the assessment of one benchmark addresses another benchmark. Such groupings are indicated in the Also Assesses statement.

**Item Types**
are used to assess the benchmark or group of benchmark.

**Benchmark Clarifications**
explain how achievement of the benchmark will be demonstrated by students. In other words, the clarification statements explain what the student will do when responding to questions.

**Content Limits**
define the range of content knowledge and that should be assessed in the items for the benchmark.

**Stimulus Attributes**
define the types of stimulus materials that should be used in the items, including the appropriate use of graphic materials and item context or content.

**Response Attributes**
define the characteristics of the answers that a student must choose or provide.

**Sample Items**
are provided for each type of question assessed. The correct answer for all sample items is provided.
## II. Individual Benchmark Specifications

<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter &amp; Energy Transformation</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.L.18.12</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to identify that water is a unique molecule and necessary for life because of its specific and unique properties. The student is able to relate how the cohesive behavior of water gives it unique and special properties that contribute to its usefulness in plant life and animal life. The student can relate how the density change in freezing is essential to life on this planet. The student is able to explain how water is able to dissolve many substances making it an essential molecule for life. Students understand the polar nature of a water molecule and how it relates to its special properties.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not address hydrogen bonding, the freezing point of water, or other specific conceptual or numerical values of water.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text, chart, diagram</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
Some climates have temperatures that drop below the freezing point of water for several months. Which of the following is a unique property of water that allows life on earth to exist in aquatic environments in these types of climates?

A) The density of water changes when it freezes so solid water is less dense than liquid water.
B) Water has adhesive properties that lower its freezing point allowing it to stay in liquid form longer.
C) Water has a high boiling point allowing it to evaporate and condense into clouds providing more liquid precipitation.
D) The melting and freezing points of water shift based on latitude, allowing it to stay in liquid form longer in higher latitudes.

Correct Answer: A
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Nature of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Practice of Science</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.1.2:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Describe and explain what characterizes science and its methods.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>SC.912.N.1.1</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to define <em>science</em> as a systematic process of investigation of observable phenomena using the scientific method. The student is able to relate what methods are used in scientific research</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require the students to recite the steps of the scientific method. The item does not require the knowledge of specific research methods or types of experiments. The item requires analyses of procedures that involve systematic study of observable phenomena.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>

Sample Item

A student notices that her local swimming hole has been getting warmer and warmer over the last two years and also notices that the water has become less clear due to algae that have appeared. She thinks the algae and the rising temperature are related. How would she go about testing this idea?

A) conduct a video survey of the type and number of algae in the swimming hole over two weeks  
B) culture the algae and subject it to different temperatures of water to see impact on colony size  
C) measure the water temperature over two weeks  
D) pole local swimmers to determine what most believe

Correct Answer: B
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Standard</td>
<td>Practice of Science</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.1.3</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>SC.912.N.2.4</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student will be able to identify and explain the value of continuous testing of theories to determine validity and value of challenges to advance scientific understanding. The student recognizes and understands that data is not conclusive, comprehensive, and is interpreted. The student will assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Student will not be required to provide an example of advancement from previous interpretation.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Possible question contexts: Heliocentric/geocentric.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item         | A researcher states that there is a link between cell phone radiation and cancer. Another researcher contends another factor is responsible. What is the best method for resolving the issue?  

A) accept both as scientifically correct  
B) accept the original findings because they were first  
C) collaborate and gather additional data to find a factual conclusion  
D) decide based on which researcher has the best credentials  

Correct Answer: C |
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<tr>
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</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.1.4</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Identify sources of information and assess their reliability according to the strict standards of scientific investigation.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Given multiple sources, students will distinguish between authentic/reliable sources and opinion or conjecture. Students will identify sound scientific process within a given experiment.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Students will not be required to name specific sources of information (current journals, organizations, etc.).</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Possible question contexts: From a list of resources have students identify the most reliable source for a given experiment. Students could be provided with short scientific procedures for similar experiments and ask students to identify the one with the most supportable conclusion based on the results.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Which of the following methods would provide the most accurate information for students collecting data about local attitudes concerning the use of alternative fuels for automobiles?</td>
</tr>
<tr>
<td></td>
<td>A) listen to local politicians</td>
</tr>
<tr>
<td></td>
<td>B) opinion polls of local drivers study newspaper articles</td>
</tr>
<tr>
<td></td>
<td>C) listen to local politicians</td>
</tr>
<tr>
<td></td>
<td>D) track prices at local gas stations</td>
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<td></td>
<td>Correct Answer: B</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Nature of Science</td>
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<tr>
<td>Standard</td>
<td>Practice of Science</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.1.6</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will identify the most appropriate inference based on a given set of observations. Students will collect data/evidence, use tables and graphs to draw conclusions and make inferences based on patterns or trends in the data.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Content should be limited to material covered within the scope of a physical science course.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>This could be an open-ended question asking students to make an appropriate inference based on a set of observations. This could also be a MC question that lists &quot;possible&quot; inferences resulting from a set of observations with only one being valid.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
In her school lab, Jane heated an air filled balloon to see what would happen. At 20°C the balloon's volume was 10L. At 40°C the balloon's volume was 20L. At 60°C the balloon's volume was 30L. What can Jane infer from the results of her experiment?

A) increasing temperature decreases air volume  
B) increasing temperature increases air volume  
C) temperature and volume are not related  
D) temperature changes the mass of air

Correct Answer: B

Short Answer using same concept:
In her school lab, Jane heated an air filled balloon to see what would happen. At 20°C the balloon's volume was 10L. At 40°C the balloon's volume was 20L. At 60°C the balloon's volume was 30L. What can Jane infer from the results of her experiment? What would be the balloon’s volume at 100°C?

2 points: Student correctly infers results of the experiment and identifies the volume of the balloon at 100°C.  
1 point: Student correctly infers the results of the experiment or identifies the volume of the balloon at 100°C.  
0 points: Student incorrectly infers the results of the experiment and identifies the volume of the balloon at 100°C,
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Standard</td>
<td>Characteristics of Scientific Knowledge</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.2.1</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Identify what is science, what clearly is not science, and what superficially resembles science (but fails to meet the criteria for science).</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>SC.912.N.2.2, SC.912.N.2.3</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will be able to identify a scientific claim versus one that is not scientific. The student will be able to identify why a seemingly scientific study fails to qualify as a scientific statement.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not address biological content but should instead focus on science as it relates to what is covered in a physical science class.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text. Student is given several claims and is either able to identify which one is not science, or is able to identify why a particular claim fails to meet the criteria for science given a list of choices.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Sample Item</th>
<th>Which of the following claims would be considered a valid scientific conclusion?</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>A) Bees like red flowers because they are prettier.</td>
</tr>
<tr>
<td></td>
<td>B) Elephants gain very little mass after they reach maturity.</td>
</tr>
<tr>
<td></td>
<td>C) Two out of 100 people can communicate telepathically with each other.</td>
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<tr>
<td></td>
<td>D) A monkey is happier when given bananas because they smile more than</td>
</tr>
<tr>
<td></td>
<td>monkeys that do not get bananas.</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: B</td>
</tr>
</tbody>
</table>

**Short Answer using same concept:**
Describe a claim that would be considered a valid scientific conclusion and why? (Answers may vary)

2 points: Student correctly identifies a valid scientific conclusion and explains why.
1 point: Student correctly identifies a valid scientific conclusion but does not explain why.
0 points: Student incorrectly identifies a valid scientific conclusion.
<table>
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<tr>
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<tbody>
<tr>
<td>Standard</td>
<td>Characteristics of Scientific Knowledge</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.2.4</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explain that scientific knowledge is both durable and robust and open to change. Scientific knowledge can change because it is often examined and re-examined by new investigations and scientific argumentation. Because of these frequent examinations, scientific knowledge becomes stronger, leading to its durability.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>SC.912.N.1.3:</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to explain that no matter how well one theory fits observations, a new theory might fit them as well or better, or might fit a wider range of observations. The student will be able to demonstrate understanding through the use of examples that the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not to absolute truth.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Students should be able to identify the history of relevant theories from the course including the Atomic Theory and Newton's Laws. Specific understanding of theory development will not be required from content outside the course (i.e. solar system model, evolutionary theory, etc.)</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Textual content, timeline, or chart documenting changes in the theories regarding a particular natural phenomenon such as the atom, or formation of stars.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
Rutherford radically changed the idea of what an atom looks like through his 'gold foil experiment.' His observations led him to change the model of the atom to include a positive nucleus and a region of negative electrons outside of that. Shortly after this, Bohr discovered that the electrons did not seem to just 'hang out' in empty space, but they seemed to be in orbits around the nucleus. What is the most likely outcome of this controversy?

A) Throw out Rutherford's theory and go with Bohr's theory.  
B) Disregard Bohr's theory because Rutherford's theory was first, and therefore probably more correct.  
C) Take what seems correct about Rutherford's theory and add what seems correct about Bohr's theory to come up with an even better theory.  
D) If neither one of them seem to agree, then a totally new theory needs to be developed.

Correct Answer: C

Short Answer using same concept:
Rutherford radically changed the idea of what an atom looks like through his 'gold foil experiment.' His observations led him to change the model of the atom to include a positive nucleus and a region of negative electrons outside of that. Shortly after this, Bohr discovered that the electrons did not seem to just 'hang out' in empty space, but they seemed to be in orbits around the nucleus. Compare and contrast the two experiments.

2 points: Students correctly compare and contrast both experiments.  
1 point: Students correctly compare or contract both experiments.  
0 points: Student incorrectly compare and contrast both experiments.
<table>
<thead>
<tr>
<th>Reporting Category</th>
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</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Role of Theories, Laws, Hypotheses &amp; Models</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.3.1</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explain that a scientific theory is the culmination of many scientific investigations drawing together all the current evidence concerning a substantial range of phenomena; thus, a scientific theory represents the most powerful explanation scientists have to offer.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>SC.912.N.3.2</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to explain that scientific theories are based on the results of many investigations over a period of time. The student is able to relate that theories change over time and the current theory is the best explanation so far, but is subject to change in the future.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require the student to recite a specific example of this benchmark. The scientific theories discussed in the item should refer to content covered in a physical science course.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text. Selected scientific theories are examined to prompt students to identify how the theory is supported by different scientific investigations by different scientists.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Many scientists over time have contributed to what we know about the atom. Based on all these investigations and their conclusions about the structure of the atom, what is the most correct statement about the theory of the atom?</td>
</tr>
<tr>
<td></td>
<td>A) It is not very reliable since all previous theories had errors in them.</td>
</tr>
<tr>
<td></td>
<td>B) It will probably change again as the previous models contained errors.</td>
</tr>
<tr>
<td></td>
<td>C) In relative terms, little is known about the atom and will likely stay that way.</td>
</tr>
<tr>
<td></td>
<td>D) The theory of the atom is well documented, has been thoroughly tested, and represents our best explanation on what the atom looks like, but it could change in the future.</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: D</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Nature of Science</td>
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<td>------------------</td>
</tr>
<tr>
<td>Standard</td>
<td>Role of Theories, Laws, Hypotheses &amp; Models</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.3.3</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explain that scientific laws are descriptions of specific relationships under given conditions in nature, but do not offer explanations for those relationships.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to explain that a law describes a relationship but does not explain why the relationship exists.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not address laws or relationships in biology.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>The student is given a law and the relationships that exist, then the student is prompted to address its limitations in explaining why a relationship exists.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>The law of gravity describes a relationship between two masses. The more massive an object is or the closer it is to another body, the more the gravitational attraction between the two objects. However, the law is limited because it cannot explain which of the following?</td>
</tr>
<tr>
<td></td>
<td>A) what gives the larger object more mass</td>
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<tr>
<td></td>
<td>B) why does the smaller object also attract the larger object</td>
</tr>
<tr>
<td></td>
<td>C) why there is a gravitational attraction in the first place</td>
</tr>
<tr>
<td></td>
<td>D) why we experience gravity on earth and not in space</td>
</tr>
<tr>
<td>Correct Answer</td>
<td>C</td>
</tr>
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<td>--------------------</td>
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<tr>
<td>Standard</td>
<td>Role of Theories, Laws, Hypotheses &amp; Models</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.3.4</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Recognize that theories do not become laws, nor do laws become theories; theories are well supported explanations and laws are well supported descriptions.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students must differentiate between the criteria that define a theory versus the criteria that define a law.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The test item should pertain to laws and models covered within the physical science course.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Students are given examples of current laws and/or theories and asked to identify differences between them, or be asked to identify why theories and models are used in science.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>The Law of Conservation of Mass states that the total amount of mass in an isolated system will remain constant over time. The law implies that mass can neither be created nor destroyed, although it may be rearranged in space and changed into different types of particles; and that for any chemical process in an isolated system, the mass of the reactants must equal the mass of the products. The Law of Conservation of Mass is considered to be a scientific law. What makes it a law rather than a theory? A) it can be expressed mathematically B) it has taken many years to prove C) many experimental results support the law D) the results of repeated experimentation have never refuted it Correct Answer: D</td>
</tr>
<tr>
<td>Reporting Category</td>
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<tr>
<td>Standard</td>
<td>Role of Theories, Laws, Hypotheses &amp; Models</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.N.3.5</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Describe the function of models in science, and identify the wide range of models used in science.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to define the term, <em>model</em>. The student is able to relate how models are used in science. The student is able to explain why models are necessary in science.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should address models associated with concepts in physical science.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Students should be given a current model as a prompt and identify how or why it is used.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>At the National Oceanic &amp; Atmospheric Administration Tropical Weather Lab, Susan has a computer simulation of various impacts due to a variety of hurricane situations. The computer shows all the possible outcomes based on different hurricane parameters. Why is it more appropriate to use a computer simulation in these types of settings?</td>
</tr>
</tbody>
</table>

A) A model of a hurricane is easier to see than the real thing.  
B) Modeling a hurricane's impact is a much safer way to learn.  
C) The simulated scenarios do not allow Susan to make mistakes.  
D) The speed of the computer helps determine the exact outcome faster.  

Correct Answer: B
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.1</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Differentiate among the various forms of energy and recognize that they can be transformed from one form to others.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will identify and/or name various forms of energy. Students will recognize that one form of energy is transformed into another form of energy within the same system. Students will differentiate between kinetic and potential energy. Students will recognize that energy cannot be created or destroyed, only transformed.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Items assessing this benchmark should be limited to concepts of heat, electricity, electromagnetic and mechanical energy.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>This could use a graphic depicting both energy forms and their respective changes over time based on the position of the ball.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>What happens to the kinetic energy and gravitational potential energy of a ball during free fall?</td>
</tr>
<tr>
<td></td>
<td>A) gravitational potential energy and kinetic energy both decrease</td>
</tr>
<tr>
<td></td>
<td>B) gravitational potential energy and kinetic energy both increase</td>
</tr>
<tr>
<td></td>
<td>C) gravitational potential energy decreases, and kinetic energy increases</td>
</tr>
<tr>
<td></td>
<td>D) gravitational potential energy increases, and kinetic energy decreases</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: C</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Physics</td>
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<tr>
<td>--------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.2 (Physical Science Honors only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explore the Law of Conservation of Energy by differentiating among open, closed, and isolated systems and explain that the total energy in an isolated system is a conserved quantity.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will identify and/or relate the difference between an open, closed, and isolated system. The student will be able to explain that the total energy in an isolated system is conserved and its amount never changes</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Items should assess only those systems related to chemical or mechanical processes.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Scenarios should be limited to those that would typically be discussed in the physical science classroom.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Which of the following violates the law of conservation of energy?</td>
</tr>
<tr>
<td></td>
<td>A) a ball dropped from the top of a building increases speed as it falls</td>
</tr>
<tr>
<td></td>
<td>B) a block sliding freely on level ice increases speed until it hits a wall</td>
</tr>
<tr>
<td></td>
<td>C) a child playing on a swing moves fastest at the bottom of the swing's path</td>
</tr>
<tr>
<td></td>
<td>D) the height a ball bounces decreases with each bounce</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: B</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Physics</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.3</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Compare and contrast work and power qualitatively and quantitatively.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Fill-In Response</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will compare and contrast the concepts of work and power. Students will be able to use the formula for work and power to compare and contrast the concepts of work and power.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not address efficiency and should not use horsepower as part of the question or in the answer. The item should use SI units.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>A diagram, chart or text involving a scenario in which students are asked to compare and contrast the work done on an object and/or the power involved when moving the object.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Which of the following would have a power rating of 1kW?</td>
</tr>
<tr>
<td></td>
<td>A) 5 seconds to move a 1000 N object 1 meter</td>
</tr>
<tr>
<td></td>
<td>B) 5 seconds to move a 2500N object two (2) meters</td>
</tr>
<tr>
<td></td>
<td>C) 10 seconds to move a 250N object 10 meters</td>
</tr>
<tr>
<td></td>
<td>D) 1000 Joules of energy to move an object</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: B</td>
</tr>
<tr>
<td></td>
<td><strong>Fill-In Response using same concept:</strong></td>
</tr>
<tr>
<td></td>
<td>If it takes 5 seconds to move a 2500N object two (2) meters, what is the power rating in kW?</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: 1</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Physics</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.4:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will describe energy transference through convection, conduction, and radiation. The student will identify that heat is the energy that is responsible for changing the temperature of matter. The student will identify that the addition of heat or the release of heat from matter is what is responsible for changing its state from one form to another. Students will explain how heat is transferred (energy in motion) from a region of higher temperature to a region of lower temperature until equilibrium is established. Students will solve problems involving heat flow and temperature changes by using known values of specific heat and/or phase change constants (latent heat). Students will explain the phase transitions and temperature changes demonstrated by a heating or cooling curve.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not address the kinetic theory of matter or the relationship between kinetic energy and heat.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Scenarios should be limited to materials and situations related to physical science concepts</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
A student decides to do a science fair project on clouds. Through research he learns that energy from the sun warms the water at the surface which causes it to evaporate. This evaporated water rises with warm rising air. As it rises, cold air above it flows down to fill the space left behind by the warmer rising air generating wind. The rising air begins to cool causing the water vapor to condense and clouds are formed. This cyclical process results in both wind and cloud formation. What processes are taking place to make this happen?

A) conduction and convection
B) conduction and radiation
C) conduction and thermal expansion
D) convection and radiation

Correct Answer: D
<table>
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<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.5</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Relate temperature to the average molecular kinetic energy.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will identify that temperature is a measure of the average kinetic energy of the particles. Students will identify that the temperature of substance increases or decreases with an increase or decrease in the average kinetic energy of the particles of the substance.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not compare and contrast states of matter and the motion of their particles. The item should not address differences in the Kelvin, Celsius, and Fahrenheit scales.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>The item may include illustrations and descriptions.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>The temperatures of two identical liquids are taken. Liquid A has a temperature of 25.5 degrees C and Liquid B has a temperature of 45.1 degrees C. What best describes the difference between the two liquids? A) There are more particles in Liquid B than there are in Liquid A. B) The particles in Liquid A are smaller than the particles in Liquid B. C) The particles in Liquid A are moving faster than the particles in Liquid B. D) The particles in Liquid A are moving slower than the particles in Liquid B. Correct Answer: D</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Chemistry</td>
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<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.7</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Distinguish between endothermic and exothermic chemical processes.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students distinguish between an endothermic and an exothermic reaction.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should only focus on the classification of a chemical reaction related to endothermic or exothermic processes. The item does not have to involve catalysts in the reaction. Items will include classifying phase changes as endothermic or exothermic.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>The item should contain a chemical formula or chemical reaction. The item can include an energy diagram.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>How is this reaction classified? ( \text{CaO} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2 + \text{Heat} )</td>
</tr>
<tr>
<td></td>
<td>A) endothermic</td>
</tr>
<tr>
<td></td>
<td>B) exothermic</td>
</tr>
<tr>
<td></td>
<td>C) decomposition</td>
</tr>
<tr>
<td></td>
<td>D) double replacement</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: B</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Chemistry</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.10:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, strong nuclear).</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students can list the four fundamental forces in order of magnitude from strongest to weakest.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not focus on the cause of the forces. The item should not address the definitions of the forces.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Test descriptions, graphs, or charts will work with this item.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>Students will choose which force is larger than the other when prompted.</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Two protons are located next to each other in the nucleus of a Carbon atom. Which of the four fundamental forces is greatest between them? A) the gravitational attraction between them. B) the repulsion of their charges C) the strong nuclear force holding them together in the nucleus D) the weak nuclear force between them</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: C</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Chemistry</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.11 (Physical Science Honors Only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explain and compare nuclear reactions (radioactive decay, fission and fusion), and the energy changes associated with them and their associated safety issues.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students are able to distinguish between a fission reaction and a fusion reaction. Students are able to explain the process of radioactive decay. The student can describe the energy changes that take place with any nuclear reaction. The student can list safety concerns that must be applied when working with nuclear reactions.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should only focus on basic nuclear reactions such as uranium decay or the fusion reaction of the sun.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>The item can contain a text description or reaction equation.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item        | A particular reaction is studied and it is found that two small atoms reacted to release energy and form a single larger atom. This type of reaction would be classified as  
A) fission  
B) fusion  
C) radioactive decay  
D) synthesis  
Correct Answer: B |
<table>
<thead>
<tr>
<th>Reporting Category</th>
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</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.12</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Differentiate between chemical and nuclear reactions.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will describe how chemical reactions involve the rearranging of atoms to form new substances, while nuclear reactions involve the change of atomic nuclei into entirely new atoms. Students will identify real-world examples where chemical and nuclear reactions occur every day.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not require the students to balance or complete a reaction.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Reactions equations are required.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item        | A lab conducts two separate experiments that both release energy. In the first experiment, they only allow the neutrons of atoms to react. In the second, they only let the electrons of atoms to react. What, if any, is the relationship between the two reactions?  
A) they are chemical reactions  
B) they are nuclear reactions  
C) experiment 1 is a chemical reaction while 2 is a nuclear reaction  
D) experiment 1 is a nuclear reaction while 2 is a chemical reaction  
Correct Answer: D |
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.14</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Differentiate among conductors, semiconductors, and insulators.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will identify the differences between materials that are conductors, semiconductors, and insulators.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should focus on materials and motion of electrons. The item should not focus on the transmission of heat energy.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>Students chose the correct term to apply to a prompt.</td>
</tr>
<tr>
<td>Sample Item</td>
<td>A student notices that when a certain material is used as a wire in a circuit and the circuit will work when the voltage is 10V. However, if the voltage is less than that, the circuit will not work. The material used in the circuit is most likely a(n)</td>
</tr>
</tbody>
</table>

A) conductor  
B) insulator  
C) resistor  
D) semiconductor  

Correct Answer: D
## Reporting Category
Chemistry

## Standard
Motion

## Benchmark Number
SC.912.P.12.10

## Benchmark
Interpret the behavior of ideal gases in terms of kinetic molecular theory.

## Also Assesses
Not Applicable

## Item Types
Multiple Choice

## Benchmark Clarification
Students will be able to explain why gases exhibit unique behaviors using the kinetic theory of matter in their explanation. Using the kinetic molecular theory, students will explain the behavior of gases and the relationship between pressure and volume (Boyle’s law), volume and temperature (Charles’s law), pressure and temperature (Gay-Lussac’s law), and number of particles in a gas sample (Avogadro’s hypothesis).

## Content Limits
The item does not require the use of the ideal gas law. The item does not require and mathematical calculations involving Charles’ or Boyle’s law.

## Stimulus Attributes
Text or chart

## Response Attributes
None Specified

## Sample Item
A gas will increase in pressure inside of a sealed container when heated. Which of the following is the best explanation for this in terms of the kinetic theory of matter?

A) The particles of the gas increase in size and take up more room as they gain heat energy.  
B) The kinetic energy of the particles decreases causing an expanding in the volume of the gas.  
C) The particles in the gas expand outward with the increase in heat and the volume of the gas increases.  
D) The particles gain more energy and therefore move faster, causing more collisions with the walls of the container.
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
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</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.5</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Relate properties of atoms and their position in the periodic table to the arrangement of their electrons.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will explain how the position of an atom on the periodic table directly relates to its electron configuration. The student will identify that the electron configuration of an atom determines its physical and chemical properties. The student will identify that the group an atom is in on the periodic table corresponds to the number of valence electrons and the orbital those valence electrons occupy. The student will interpret that the atoms of a group on the periodic table have the same electron arrangements and therefore similar chemical and physical properties. The student will determine the number of valence electrons.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not require students to draw a Lewis dot structure or complete an orbital diagram and/or an electron diagram for a particular atom. Items may require that students know the chemical and physical properties of groups of elements on the periodic table.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text or periodic table reference is needed.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item       | Atom A has three valence electrons. Atom B also has three valence electrons. What would best describe their position on the periodic table relative to each other?  
A) both atoms would be in the same period as each other  
B) both atoms would be in the same group on the periodic table  
C) both atoms would be on the same row on the periodic table  
D) the two atoms would have to be side by side on the periodic table  
Correct Answer: B |
<table>
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<tbody>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.18</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Extended Response</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will know that the electromagnetic spectrum is made up of many different types of waves such as infrared, visible, ultraviolet, radio, x-rays, and gamma waves. The student can distinguish between wavelength and frequency. The student can explain the relationship between frequency, wavelength and energy. The student can identify practical uses of each type of electromagnetic wave based on its energy. The student will solve problems involving wavelength, frequency, and energy.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The student should not have to demonstrate the ability to calculate the energy of a wave. The student should not be given scenarios or applications that would not be addressed in physical science class.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Electromagnetic Spectrum, charts, graphs and text content can be used.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Given an electromagnetic spectrum: Which is true of infrared waves?</td>
</tr>
<tr>
<td></td>
<td>A) they give off more energy than gamma rays</td>
</tr>
<tr>
<td></td>
<td>B) they have higher frequencies than visible light waves</td>
</tr>
<tr>
<td></td>
<td>C) they have longer wavelengths than ultraviolet waves</td>
</tr>
<tr>
<td></td>
<td>D) they have shorter wavelengths than gamma waves</td>
</tr>
<tr>
<td>Correct Answer:</td>
<td>C</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Physics</td>
</tr>
<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.15</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Investigate and explain the relationships among current, voltage, resistance, and power.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will know the terms <em>current, voltage, resistance,</em> and <em>power</em>. Students will apply the terms <em>current, voltage, resistance,</em> and <em>power</em> to an electrical circuit. The student will be able to explain the relationship among current, voltage, resistance, and power in an electrical circuit.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not address the differences between series and parallel circuits.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>A circuit diagram, text and charts can be used.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Which circuit has the most current flowing through it?</td>
</tr>
</tbody>
</table>

A) 5 V battery with a 9 Watt light  
B) 9 V battery with a 16 Watt light bulb  
C) 12 V battery with a 15 Watt light bulb  
D) 12 V battery with a 18 Watt light bulb  

Correct Answer: D
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.2:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>SC.912.P.12.3</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Fill-In Response</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student will demonstrate knowledge of the terms position, velocity, and acceleration. The student will analyze the motion of an object and interpret the relationship between position, velocity, and acceleration as it relates to the time interval involved. The students will solve problems involving distance, velocity, speed, and acceleration. Students will interpret graphs of 1-D motion.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not include forces or the use of vectors in the analysis of the question.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>A diagram or graph.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
A motorcycle accelerates from a stop at a rate of $4\text{m/s}^2$ for 20 seconds. It then continues at a constant speed for 40 seconds. You may use the blank graph below to plot the speed vs. time of the motorcycle.

What is the motorcycle's speed at 15 seconds?

Correct Answer: 60 m/s

What is the motorcycle’s speed at 45 seconds?

Correct Answer: 80 m/s
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.3</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Interpret and apply Newton's three laws of motion.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to explain Newton’s three laws. The student is able to apply Newton’s three laws of motion to a given scenario. The student is able to identify how Newton’s three laws govern an object’s behavior in a given scenario. Students will explain that when the net force on an object is zero, no acceleration occurs; thus, a moving object continues to move at a constant speed in the same direction, or, if at rest, it remains at rest (Newton’s first law). Students will explain that when a net force is applied to an object its motion will change, or accelerate (according to Newton’s second law, F = ma). Students will predict and explain how when one object exerts a force on a second object, the second object always exerts a force of equal magnitude but of opposite direction and force back on the first: F1 on 2 = –F1 on 1 (Newton’s third law).</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require a mathematical calculation. The item does not require knowledge or use of the concepts of momentum or impulse.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>A diagram, or text.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
A diagram shows a balloon that is moving in one direction while escaping air is moving in the opposite direction. Which best explains what causes the balloon to move?

A) action reaction forces  
B) friction forces  
C) gravitational forces  
D) inertia  

Correct Answer: A
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.4</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Describe how the gravitational force between two objects depends on their masses and the distance between them.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will describe Newton’s law of universal gravitation in terms of the attraction between two objects, their masses, and the inverse square of the distance between them. The student is able to describe how the gravitational force between two objects is dependent on the masses of the objects. The student is able to describe how the distance between two objects influences the gravitational force between them.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require a calculation of gravity. The item does not require the use the numerical value of the acceleration of gravity on earth. The item does not require the student to explain how objects accelerate in gravitational fields.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text or diagrams.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Four pairs of objects have the masses shown below, along with the distances between them. Which pair of objects would have the greatest gravitational force between them?</td>
</tr>
</tbody>
</table>

A) 1 Kilogram and 1 kilogram, 1 meter apart  
B) 1 kilogram and 2 kilograms, 1 meter apart  
C) 2 kilograms and 1 kilogram, 2 meters apart  
D) 2 kilograms and 2 kilograms, 1 meter apart

Correct Answer: D
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.7</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Recognize that nothing travels faster than the speed of light in a vacuum which is the same for all observers no matter how they or the light source are moving.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students are able to understand the relationship between increased speed, mass, and the energy required to move it.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>Students will not be required to know the speed of light, only that nothing is faster. Students will recognize that regardless of the speed of an observer or source, in a vacuum, the speed of light is always c.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text, diagram or chart.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Why is it impossible for an object to move faster than the speed of light?</td>
</tr>
<tr>
<td></td>
<td>A) because light behaves as both a particle and a wave</td>
</tr>
<tr>
<td></td>
<td>B) beyond the speed of light, moving objects are undetectable</td>
</tr>
<tr>
<td></td>
<td>C) light is the only form of energy that can move</td>
</tr>
<tr>
<td></td>
<td>D) the faster something moves, the more mass it has, requiring an infinite amount of energy</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: D</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Chemistry</td>
</tr>
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</tr>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.11</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Describe phase transitions in terms of kinetic molecular theory.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to describe the process of phase changes in matter in terms of particle motion, energy, and attraction of the particles in the sample of matter.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not involve plasma as a phase.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Diagram, table, or text.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>A sample of water is heated in a beaker until it begins to boil and turn to steam. Which of the following best describes the transition of liquid water to steam?</td>
</tr>
</tbody>
</table>

A) The particles gain so much energy, the attraction between them cannot hold them together and they leave the surface of the liquid to travel into the air.
B) The particles gain so little energy, the attraction between them cannot hold them together and they leave the surface of the liquid to travel into the air.
C) The particles’ motion becomes so random and chaotic there is no more room for them to vibrate and they are flung into the air above the surface of the water.
D) The particles in the water gain energy and begin to move in a more organized way, causing them to leave the surface of the water and travel into the atmosphere.

Correct Answer: A
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.12</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explain how various factors, such as concentration, temperature, and presence of a catalyst affect the rate of a chemical reaction.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to explain how the concentration of reactants affects the rate of a reaction. The student is able to explain how the temperature affects the rate of a chemical reaction. The student is able to explain how the presence of a catalyst lowers the activation energy of a reaction. Various factors could include: temperature, pressure, solvent and/or solute concentration, steric, surface area, and catalysts. The rate of reaction is determined by the activation energy, and the pathway of the reaction can be shorter in the presence of enzymes or catalysts.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not extend to the concept of Le Chatelier's principle. The item does not rely on the student's knowledge of molarity or other concentration units. The item should not address the concept of equilibrium.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Diagram, chart, text</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item        | For the reaction, Magnesium + Hydrochloric Acid → Magnesium Chloride + Hydrogen, which one of the following is most likely to cause an increase in the reaction rate? 
A) addition of a catalyst
B) addition of more Magnesium Chloride
C) cooling the reaction vessel with ice on the outside of it
D) performing the reaction in plastic beaker
Correct Answer: A |
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.1:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Differentiate among the four states of matter.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
</tbody>
</table>

**Benchmark Clarification**
The student is able to define the terms *solid*, *liquid*, and *gas.* The student is able to differentiate between solids, liquids and gases given a picture of each. The student is able to differentiate between solids, liquids and gases based on a physical description of each. The student is able to explain solids, liquids, and gases in terms of their volume or shape as a fixed or non-definite property. Students will differentiate among the four states of matter (solid, liquid, gas and plasma) in terms of energy, particle motion, and phase transitions.

**Content Limits**
The item does not address the kinetic theory of matter. The item does not address melting or boiling points of a particular type of matter such as water.

**Stimulus Attributes**
Picture chart or text.

**Response Attributes**
None Specified

**Sample Item**

<table>
<thead>
<tr>
<th></th>
<th>Shape</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample A</td>
<td>Not Definite</td>
<td>Definite</td>
</tr>
<tr>
<td>Sample B</td>
<td>Not Definite</td>
<td>Not Definite</td>
</tr>
<tr>
<td>Sample C</td>
<td>Definite</td>
<td>Definite</td>
</tr>
</tbody>
</table>

Three samples of matter and their volume and shape are shown above. Of the three samples, which one(s) are not a liquid?

A) A and B  
B) B and C  
C) A and C  
D) A only

Correct Answer: B
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.2:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Differentiate between physical and chemical properties and physical and chemical changes of matter.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to define physical properties of matter. The student is able to define chemical properties of matter. The student is able to distinguish between physical and chemical properties of a substance. The student is able to define chemical change. The student is able to define physical change. The student is able to distinguish between chemical and physical changes in matter. Students will discuss volume, compressibility, density, conductivity, malleability, reactivity, molecular composition, freezing, melting and boiling points. Students will describe simple laboratory techniques that can be used to separate homogeneous and heterogeneous mixtures (e.g. filtration, distillation, chromatography, evaporation).</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not involve the kinetic theory of matter to explain how matter undergoes physical changes in terms of melting or boiling. The item should deal with chemicals or physical processes familiar to a student in the physical science classroom.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text, chart, or diagram.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>The melting of wax is a physical change, yet the burning of wax is a chemical change. What is the essential difference between a physical change and a chemical change of wax in a burning candle?</td>
</tr>
<tr>
<td></td>
<td>A) Melted wax is in a different phase of matter than solid wax.</td>
</tr>
<tr>
<td></td>
<td>B) A higher temperature is needed to burn wax then to melt wax.</td>
</tr>
<tr>
<td></td>
<td>C) Melted wax can be separated into other substances, while solid wax cannot.</td>
</tr>
<tr>
<td></td>
<td>D) The burning of wax forms new compounds while the melting of wax does not.</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: D</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Chemistry</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.4</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explore the scientific theory of atoms (also known as atomic theory) by describing the structure of atoms in terms of protons, neutrons and electrons, and differentiate among these particles in terms of their mass, electrical charges and locations within the atom.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to describe the structure of the atom in terms of nucleus and electron cloud. The student is able to relate what subatomic particles reside in the two parts of the atom. The student is able to describe the charge on each of the three subatomic particles that make up the atom.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require the student to identify the number of subatomic particles in a particular atom. The item does not require any knowledge of the periodic table.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text or diagram.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>A student is asked to build a model of an atom with six protons and six electrons. The student is then asked to make an identical model of the same atom, but make it an ion. What does the student have to do to be successful in this project?</td>
</tr>
</tbody>
</table>

   A) Put the electrons in the middle of the model and distribute the protons around it. The ion will have seven protons.
   B) Put six protons in the center of the model, and six electrons around the outside, then add one proton or take away a proton to make an ion.
   C) Put six protons in the center of the atom and distribute the electrons around the protons. The ion will look the same but have seven or five electrons.
   D) Place electrons and protons in the center of the atom, and then create an ion by adding one more proton and one more electron to the center of the atom.

Correct Answer: C
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.7:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Interpret formula representations of molecules and compounds in terms of composition and structure.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to read a formula representation of a molecule or compound and describe the elements in that compound, and the number of each atom in that compound. Students will write chemical formulas for simple covalent (HCl, SO2, CO2, and CH4), ionic (Na+ + Cl− → NaCl) and molecular (O2, H2O) compounds. Students will predict the formulas of ionic compounds based on the number of valence electrons and the charges on the ions.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require the formula weight or and knowledge of the molecule to solve the problem. The item does not require the student to distinguish the type of bonding between the atoms in a molecule or compound. The item does not require the student to predict what elements would bond to other elements and in what ratios.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Chemical formula &amp; text.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item        | Which of the answer choices below best describes the components of the following compound (NH₄)₂ SO₄?  
A) 1 Nitrogen, 4 Hydrogen, 2 Sulfur, 4 Oxygen  
B) 1 Nitrogen, 4 Hydrogen, 2 Sulfur, 8 Oxygen  
C) 2 Nitrogen, 8 Hydrogen, 1 Sulfur, 4 Oxygen  
D) 2 Nitrogen, 8 Hydrogen, 4 Sulfur, 4 Oxygen  
Correct Answer: C |
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.8</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Characterize types of chemical reactions, for example: redox, acid-base, synthesis, and single and double replacement reactions.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>Students will be able to recognize the following chemical reactions: reduction, oxidation, acid base, synthesis, single replacement and double replacement, given the complete reaction. Students will classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require students to balance the reaction. The item does not require the student to predict the products of a reaction. The item does not require the student to identify energy changes for a particular reaction. The item does not require the student to identify specific species in the reaction such as identifying which species is oxidized or which species is the base.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Complete chemical reactions, and text.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Look at the following reaction: $2\text{Al(s)} + 3\text{CuCl}_2(\text{aq}) \rightarrow 2\text{AlCl}_3(\text{aq}) + 3\text{Cu(s)}$ This is an example of what type of reaction?</td>
</tr>
<tr>
<td></td>
<td>A) decomposition</td>
</tr>
<tr>
<td></td>
<td>B) double replacement</td>
</tr>
<tr>
<td></td>
<td>C) single replacement</td>
</tr>
<tr>
<td></td>
<td>D) Synthesis</td>
</tr>
<tr>
<td>Correct Answer:</td>
<td>C</td>
</tr>
<tr>
<td>Reporting Category</td>
<td>Chemistry</td>
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<td>--------------------</td>
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</tr>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.11:</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Relate acidity and basicity to hydronium and hydroxyl ion concentration and pH.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student can relate the term pH to the acidity or alkalinity of a solution. The student is able to define acidity of a solution in terms of the concentration of the hydronium ion. The student is able to define basicity of a solution based on the concentration of the hydroxyl ion. Students will use experimental data to illustrate and explain the pH scale to characterize acid and base solutions. Students will compare and contrast the strengths of various common acids and bases.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require the student to calculate the pH of a solution given the concentration of any ion. The item does not require the calculation of any ion given the pH of a solution.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text or chart.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item        | In a particular solution, the concentration of several ions is measured. The solution is found to have a high concentration of Hydronium ions (H30+), and a low concentration of Hydrox1 (OH-) ions. The pH of the solution is most likely which of the following?

A) 2  
B) 7  
C) 8  
D) 12  

Correct Answer: B |
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physical Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Energy</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.10.6 (Physical Science Honors Only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Create and interpret potential energy diagrams, for example: chemical reactions, orbits around a central body, motion of a pendulum.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to create a diagram relating the potential energy of an object in a defined system to its position given the necessary information. The student is able to identify the changes in potential energy of an object in a particular diagram showing its changing position over time.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item does not require the student to calculate potential energies. The item should not have the student describe changes in energy as a function of energy loss due to heat. The item should not address energy transformations.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Diagram, Chart, or Text.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
Using the diagram above, at which point does the pendulum have the most potential energy?

A) Point A  
B) Point B  
C) Point C  
D) Both Points A & C

Correct Answer: D

**Short Answer using same diagram:**
Using the diagram of the pendulum above, describe at what point(s) the pendulum has the most potential energy and why.

2 points: Student is able to describe the correct point(s) and explain why.  
1 point: Student is able to describe the correct point(s) but not explain why.  
0 points: Student is not able to describe the correct point(s).
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.1 (Physical Science Honors Only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Distinguish between scalar and vector quantities and assess which should be used to describe an event.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to define the terms, <em>scalar</em> and <em>vector</em>. The student is able to describe what measurements require a scalar quantity or a vector quantity.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should address measurements typically made in physical science and limited to basic physics principles.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text and Diagrams.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>Students should be able to identify the proper response (vector or scalar) among a list of choices</td>
</tr>
<tr>
<td>Sample Item</td>
<td>Which of the following would not be considered a vector measurement?</td>
</tr>
<tr>
<td></td>
<td>A) the force applied to a baseball while throwing it</td>
</tr>
<tr>
<td></td>
<td>B) the mass of a thrown baseball</td>
</tr>
<tr>
<td></td>
<td>C) the momentum of a thrown baseball</td>
</tr>
<tr>
<td></td>
<td>D) the velocity of a baseball as it travels through the air</td>
</tr>
<tr>
<td></td>
<td>Correct Answer: B</td>
</tr>
</tbody>
</table>

**Short Answer using same concept:**
Describe a vector measurement. Explain why. (Answers may vary)

2 points: Student is able to identify a vector measurement and explain why.
1 point: Student is able to identify a vector measurement but not explain why.
0 points: Student is not able to identify a vector measurement.
<table>
<thead>
<tr>
<th>Reporting Category</th>
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</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.5 (Physical Science Honors Only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Apply the law of conservation of linear momentum to interactions, such as collisions between objects.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to define the concept of <em>momentum</em>. The student is able to explain how momentum is conserved in a collision between objects.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not address differences between elastic and inelastic collisions. The item should not involve mathematical calculations of momentum beyond comparing initial and final momentums.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text or Diagram.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
A bullet is fired into a 3 Kg wood block that is sitting on top of the ice of a frozen lake. The bullet has a momentum of 450 Kgm/s. The bullet enters the wood block and stops. If we assume the ice is a frictionless surface, what should happen to the momentum of the wood block after the bullet enters it?

A) The block will not change its momentum at all and will not move.  
B) The wood block would have a much smaller momentum than the bullet had and will barely move.  
C) The block will have nearly the same momentum as the bullet did and move in the same direction the bullet was moving.  
D) The wood block will have a larger momentum than the bullet did and move in the same direction as the bullet was moving.

Correct Answer: C

**Short Answer using same concept:**

A bullet is fired into a 3 Kg wood block that is sitting on top of the ice of a frozen lake. The bullet has a momentum of 450 Kgm/s. The bullet enters the wood block and stops. If we assume the ice is a frictionless surface, what should happen to the momentum and direction of the wood block after the bullet enters it?

2 points: Student correctly describes the momentum and direction of the block.  
1 point: Student correctly identifies either the momentum or direction of the block.  
0 points: Student incorrectly identifies the momentum and direction of the block.
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Motion</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.12.6 (Physical Science Honors Only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Qualitatively apply the concept of angular momentum.</td>
</tr>
<tr>
<td>Also Assesses</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to define angular momentum. The student is able to describe with words or with diagrams the momentums and velocities involved with an object traveling in a circular path</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not require any mathematical computations regarding this concept. The item does not extend to planetary bodies. The item does not require knowledge of centrifugal or centripetal forces.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Diagram or Text.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
A motorcycle is traveling due south. What is the angular momentum vector of the front wheel of the motorcycle?

A) East  
B) North 
C) South 
D) West 

Correct Answer: C

**Short Answer using same concept:**
A motorcycle is traveling due south. Describe angular momentum and identify the angular momentum vector of the front wheel of the motorcycle?

2 points: Student correctly identifies angular momentum and the angular momentum vector of the front wheel of the motorcycle.  
1 point: Student correctly identifies angular momentum or the angular momentum vector of the front wheel of the motorcycle.  
0 point: Student incorrectly identifies the angular momentum and the angular momentum vector of the front wheel of the motorcycle.
<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Matter</td>
</tr>
<tr>
<td>Benchmark Number</td>
<td>SC.912.P.8.3 (Physical Science Honors Only)</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Explore the scientific theory of atoms (also known as atomic theory) by describing changes in the atomic model over time and why those changes were necessitated by experimental evidence.</td>
</tr>
<tr>
<td>Also Assess</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Item Types</td>
<td>Multiple Choice, Short Answer</td>
</tr>
<tr>
<td>Benchmark Clarification</td>
<td>The student is able to explain that current theories regarding the atom have changed continuously over time. The student is able to identify how laboratory investigations prompted those changes in the theory.</td>
</tr>
<tr>
<td>Content Limits</td>
<td>The item should not require the recall of specific experiments or individuals involved in the atomic theory. The item should not address a specific aspect of the atomic theory or require an explanation why the theory was invalid.</td>
</tr>
<tr>
<td>Stimulus Attributes</td>
<td>Text or Diagram.</td>
</tr>
<tr>
<td>Response Attributes</td>
<td>None Specified</td>
</tr>
</tbody>
</table>
| Sample Item | Earnest Rutherford developed an experiment that showed protons can pass through gold atoms untouched and/or un-deflected. Sometimes the protons were deflected by something, but this did not happen too often. His experiment changed how scientists viewed the structure of the atom. Which of the following most likely made the change to what they thought about the structure of the atom?  
A) the atom contains empty space with nothing in it  
B) the atom has moving electrons at different positions in the atom  
C) the atom is solid and round in shape  
D) the atom must have been composed of charged particles  

Correct Answer: A  

**Short Answer using same concept:**
Earnest Rutherford developed an experiment that showed protons can pass through gold atoms untouched and/or un-deflected. Sometimes the protons were deflected by something, but this did not happen too often. His experiment changed how scientists viewed the structure of the atom. Describe what may have caused some of the protons to deflect and others to pass through un-deflected.

2 points: Students identify that some protons hit the nucleus of the atom and deflect off. And students identify the other protons pass through the electron cloud.
1 point: Students identify that some protons hit the nucleus of the atom and deflect off or students identify the other protons pass through the electron cloud.
0 points: Students are unable to correctly identify that some protons hit the nucleus of the atom and bounced off and other protons passed through the electron cloud.