Directions
Read each question carefully and then answer it as well as you can. You must record all answers in this Practice Test Booklet.

For some questions, you will mark your answers by filling in the circles in your Practice Test Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided in this Practice Test Booklet. Only responses written within the provided space will be scored.

If you do not know the answer to a question, you may go on to the next question. When you are finished, you may review your answers and go back to any questions you did not answer.
The diagram shows part of a food web from the Chesapeake Bay.

Which of the following best describes the ecological relationships of the organisms in the food web?

A  Competition | Predator–Prey
--- | ---
zooplankton and menhaden | tern and osprey

B  Competition | Predator–Prey
--- | ---
tern and striped bass | striped bass and menhaden

C  Competition | Predator–Prey
--- | ---
osprey and striped bass | osprey and menhaden

D  Competition | Predator–Prey
--- | ---
osprey and zooplankton | zooplankton and tern
The diagram shows Earth and the direction of incoming sunlight.

At which two locations is it summer?

A. locations W and X  
B. locations W and Y  
C. locations X and Z  
D. locations Y and Z

A diagram of an animal cell is shown.

Which part of the cell is responsible for releasing energy during cellular respiration?

A. cell membrane  
B. cytoplasm  
C. mitochondrion  
D. nucleus  
E. vacuole
Which of the following best shows the appearance and positions of Earth and the Moon during a total lunar eclipse?

A

B

C

D
A student in a woodworking class made a drawing of a table, as shown.

INCHES

| 0 | 1 | 2 | 3 |

A. Determine the table’s actual length. Show your calculations and include units in your answer.

B. The student plans to show the design of the table to the other students in the class. The student is deciding whether to show the drawing above or an orthographic projection.

Describe one advantage of showing an orthographic projection instead of the drawing above.
At the beginning of summer, some paint was scratched off a student’s bicycle. The exposed metal where the bicycle was scratched had a shiny, silvery color. The student kept the bicycle outside all summer. By the end of summer, the exposed metal had changed to rust, which is dark orange in color.

The student did some research to find out what happened to the metal and learned that the bicycle is made of steel, which contains mostly iron. The student conducted two investigations to learn more about the process that changed the steel into rust.

**Investigation 1:** The student placed equal amounts of iron filings (small pieces of iron) into beakers X, Y, and Z. At the start of the investigation, all of the filings were gray. The student added nothing else to beaker X, water to beaker Y, and table salt (NaCl) and hydrogen peroxide (H₂O₂) to beaker Z. The student’s observations over a two-day period are shown in the table.

<table>
<thead>
<tr>
<th>Beaker</th>
<th>Substance(s) Added</th>
<th>Color of Filings on Day 1</th>
<th>Color of Filings on Day 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>none</td>
<td>all gray</td>
<td>all gray</td>
</tr>
<tr>
<td>Y</td>
<td>a few drops of water</td>
<td>all gray</td>
<td>some gray and some dark orange</td>
</tr>
<tr>
<td>Z</td>
<td>some table salt and a few drops of hydrogen peroxide</td>
<td>some gray and some dark orange</td>
<td>all dark orange</td>
</tr>
</tbody>
</table>
Investigation 2: The student combined table salt and hydrogen peroxide in a beaker, added small pieces of steel, and placed a thermometer in the beaker. After one minute, the student measured the mass of the contents in the beaker. The student measured the contents in the beaker again at 10 minutes and discovered the mass had decreased slightly. The student’s observations are shown in the table.

### Investigation 2

<table>
<thead>
<tr>
<th>Beaker Contents at 1 Minute</th>
<th>Beaker Contents at 10 Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a pale orange color</td>
<td>a dark orange color</td>
</tr>
<tr>
<td>bubbling</td>
<td>no longer bubbling</td>
</tr>
<tr>
<td>25°C</td>
<td>40°C</td>
</tr>
<tr>
<td>166.1 g</td>
<td>164.7 g</td>
</tr>
</tbody>
</table>

Select all the beakers from Investigation 1 that show evidence of a chemical change.

- (A) beaker X
- (B) beaker Y
- (C) beaker Z
When hydrogen peroxide reacts with iron, hydrogen peroxide first breaks apart to form water and oxygen. In the diagrams shown, hydrogen atoms are white and oxygen atoms are gray.

The law of conservation of mass determines the number of water and oxygen molecules produced in the reaction.

Which of the following models shows the correct number of water and oxygen molecules produced in the reaction?

A. Reactants     Products

B. Reactants     Products

C. Reactants     Products

D. Reactants     Products
In Investigation 2, an exothermic reaction occurred as energy was released. What is the **best** evidence that an exothermic reaction occurred in the beaker?

- A. The mass decreased.
- B. The bubbling stopped.
- C. There was a change in the color.
- D. There was an increase in temperature.
Rust is produced when iron reacts with oxygen. The table shows some characteristics of a sample of iron and of a sample of rust.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Iron Sample</th>
<th>Rust Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>density (g/cm³)</td>
<td>7.86</td>
<td>5.26</td>
</tr>
<tr>
<td>magnetic</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>mass (g)</td>
<td>563.2</td>
<td>426.7</td>
</tr>
<tr>
<td>melting point (°C)</td>
<td>1535</td>
<td>1565</td>
</tr>
<tr>
<td>temperature (°C)</td>
<td>21</td>
<td>21</td>
</tr>
</tbody>
</table>

A. Identify the **three** characteristics from the table above that can be used to support the claim that iron and rust are different substances.

B. Explain why the characteristics you identified in Part A help support the claim that iron and rust are different substances.

C. The model shown represents the reaction between iron and oxygen that results in rust.

```
Fe + O₂ → Fe₂O₃
```

Iron    Oxygen    Rust

Based on the model, explain why iron and rust are different substances.
The paths of two air masses, X and Y, are shown in the diagram.

Air mass X is a cold air mass. Air mass Y is a warm air mass. When the air masses meet, winter storms may be produced.

Which of the following most likely contributes to the formation of these storms?

A. Cold air mass X moves over warm air mass Y, and evaporation occurs.
B. Warm air mass Y moves over cold air mass X, and condensation occurs.
C. Cold air mass X mixes with warm air mass Y, and the overall temperature increases.
D. Warm air mass Y mixes with cold air mass X, and the overall temperature decreases.

Which of the following describes what primarily causes the ocean tides in Massachusetts?

A. convection from plate tectonics
B. gravity from the Moon and the Sun
C. convection from Earth’s north and south poles
D. magnetism from Earth’s north and south poles
This question has two parts.

Part A

The diagram shows a building with four parts labeled, W, X, Y, and Z.

Which part of the diagram represents the foundation of the building?

- A  W
- B  X
- C  Y
- D  Z

Part B

Which of the following describes the foundation?

- A  It is a flat surface that people can walk on, but it does not help to support the building.
- B  It is a part that the entire building is built upon, and it keeps the building from sinking into the ground.
- C  It is a vertical wall that blocks access and visibility, but it provides structural support for the building.
- D  It is a cover that protects the building, and it shields anything inside from sunlight and precipitation.
A student is investigating waves with a piece of rope. The student places the rope on the floor and then moves one end of the rope back and forth, as shown. The wave the student makes has a specific amplitude, frequency, and wavelength.

A. Which of the following diagrams correctly identifies the different parts of the wave?

- **A**  Frequency  
  Amplitude

- **B**  Frequency  
  Wavelength

- **C**  Wavelength  
  Amplitude

- **D**  Wavelength  
  Frequency

B. Describe how the student’s hand motion could be changed to make a wave with a greater frequency.

C. Describe how the student’s hand motion could be changed to make a wave that carries more energy in each wavelength. Explain your reasoning.
A student uses a keyboard on a laptop to type a message into an instant messaging program. The processor in the laptop runs the instant messaging program’s commands. The laptop uses Wi-Fi to connect to the internet. Another student reads the message on a phone.

Which of the following correctly categorizes the parts of the communication system?

<table>
<thead>
<tr>
<th>Category</th>
<th>Part of System</th>
</tr>
</thead>
<tbody>
<tr>
<td>source</td>
<td>Wi-Fi</td>
</tr>
<tr>
<td>encoder</td>
<td>phone</td>
</tr>
<tr>
<td>transmitter</td>
<td>keyboard</td>
</tr>
<tr>
<td>receiver</td>
<td>laptop’s processor</td>
</tr>
</tbody>
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<tr>
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<td>laptop’s processor</td>
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<tr>
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<tr>
<td>transmitter</td>
<td>laptop’s processor</td>
</tr>
<tr>
<td>receiver</td>
<td>keyboard</td>
</tr>
</tbody>
</table>
The map shows a ridge on the ocean floor. The dashed lines on either side of the ridge represent different parts of the ocean floor. The parts of the ocean floor are labeled with their ages in millions of years.

Based on the information in the map, which of the following best describes the ridge?

- **A** The ridge is a young volcanic mountain range formed by two plates colliding.
- **B** The ridge is a boundary between two plates that are moving away from the ridge.
- **C** The ridge is an ancient volcanic mountain range located in the middle of an oceanic plate.
- **D** The ridge is a boundary between two plates that are sliding back and forth along the ridge.
A student is eating an apple.

Part A

Which of the following describes how the student’s body systems work together to release energy from the apple?

A. The digestive system breaks down the apple into usable molecules, and the circulatory system delivers the usable molecules to the cells.

B. The respiratory system breaks down the apple into usable molecules, and the digestive system delivers the usable molecules to the cells.

C. The circulatory system breaks down the apple into usable molecules, and the excretory system delivers the usable molecules to the cells.

D. The excretory system breaks down the apple into usable molecules, and the respiratory system delivers the usable molecules to the cells.

Part B

Body cells use oxygen to release energy from the molecules that were part of the apple. Which body system brings in oxygen from the environment, and how do body cells use the oxygen to release energy?

A. The circulatory system brings in oxygen, and body cells use the oxygen for cell division.

B. The excretory system brings in oxygen, and body cells use the oxygen for cell digestion.

C. The digestive system brings in oxygen, and body cells use the oxygen for cellular respiration.

D. The respiratory system brings in oxygen, and body cells use the oxygen for cellular respiration.
Rock layers W, Y, and Z and fault X are shown. The rock layers and the fault were formed at different times.

Which of the following shows the order of formation from oldest to youngest?

A. W → X → Y → Z
B. Z → Y → X → W
C. W → Y → X → Z
D. Z → X → Y → W
A farmer tested the effect of fertilizer on the growth of 1000 pea plants. The farmer recorded the following observations.

<table>
<thead>
<tr>
<th></th>
<th>Plants without Fertilizer</th>
<th>Plants with Fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Plants</strong></td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>10–20</td>
<td>15–30</td>
</tr>
<tr>
<td><strong>Flower Color</strong></td>
<td>75% purple 25% white</td>
<td>75% purple 25% white</td>
</tr>
</tbody>
</table>

A. Based on the observations, identify one characteristic of the pea plants that was mainly influenced by genetics. Support your answer with evidence from the information in the table.

B. Based on the observations, identify one characteristic of the pea plants that was influenced by both genetics and the environment. Support your answer with evidence from the information in the table.
Which of the following best shows the structure of the universe?

A

Universe → Earth → Solar System → Milky Way Galaxy

B

Universe → Solar System → Milky Way Galaxy → Earth

C

Universe → Milky Way Galaxy → Solar System → Earth

D

Universe → Solar System → Earth → Milky Way Galaxy
A manufacturer is considering using four different materials to construct a pan for cooking on a stove. The table shows the thermal conductivity and melting point of each material. A material with a higher thermal conductivity value conducts more thermal energy.

<table>
<thead>
<tr>
<th>Material</th>
<th>Thermal Conductivity (W/K•m)</th>
<th>Melting Point (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminum</td>
<td>236</td>
<td>933</td>
</tr>
<tr>
<td>copper</td>
<td>400</td>
<td>1357</td>
</tr>
<tr>
<td>iron</td>
<td>68</td>
<td>1422</td>
</tr>
<tr>
<td>stainless steel</td>
<td>17</td>
<td>1783</td>
</tr>
</tbody>
</table>

Which materials should be used for the pan?

A. The manufacturer should use aluminum for the bottom of the pan and iron for the handle.

B. The manufacturer should use aluminum for the bottom of the pan and copper for the handle.

C. The manufacturer should use iron for the bottom of the pan and stainless steel for the handle.

D. The manufacturer should use copper for the bottom of the pan and stainless steel for the handle.
A student used a computer simulation to investigate how the kinetic energy of an object changes as the object’s mass changes. The object moves at a constant speed during the simulation. The graph shows the kinetic energy of the object with three different masses. The student also ran the simulation with a fourth mass of 8 kg, which is not shown on the graph.
Which graph shows the kinetic energy of the object with the 8 kg mass?

(A) 

(B) 

(C) 

(D)
A plant species produces two types of seeds, rounded seeds and wrinkled seeds. The allele for rounded seeds (\( R \)) is dominant to the allele for wrinkled seeds (\( r \)). A plant heterozygous for this trait (\( Rr \)) is crossed with a homozygous plant (\( rr \)).

**Part A**

Which Punnett square correctly shows this cross?

- **A**
  
  \[
  \begin{array}{ccc}
  R & r & r \\
  r & Rr & r \\
  r & Rr & r \\
  r & Rr & r \\
  \end{array}
  \]

- **B**
  
  \[
  \begin{array}{ccc}
  R & R & \\
  r & Rr & Rr \\
  r & Rr & Rr \\
  \end{array}
  \]

- **C**
  
  \[
  \begin{array}{ccc}
  R & r & r \\
  r & Rr & r \\
  r & Rr & r \\
  r & Rr & r \\
  \end{array}
  \]

- **D**
  
  \[
  \begin{array}{ccc}
  R & R & r \\
  R & Rr & Rr \\
  r & Rr & rr \\
  \end{array}
  \]

**Part B**

What is the probability that an offspring will have rounded seeds?

- **A** 0
- **B** \( \frac{1}{4} \)
- **C** \( \frac{1}{2} \)
- **D** \( \frac{3}{4} \)
- **E** 1
A computer touch screen allows users to enter information. Users have complained that the touch screen is too difficult to operate because the system does not indicate when a choice has been selected.

The complaints are which element of the universal systems model?

A feedback
B goal
C inputs
D processes