

## Computer-Based Released Items High School Introductory Physics Spring 2025

The spring 2025 High School Introductory Physics test was administered in two formats: a computer-based version and a paper-based version. Most students took the computer-based test. The paper-based test was offered as an accommodation for eligible students who were unable to use a computer. More information can be found on the MCAS Test Administration Resources page at [www.doe.mass.edu/mcas/admin.html](http://www.doe.mass.edu/mcas/admin.html).

The Department of Elementary and Secondary Education is releasing items from both versions of the test to provide information about the knowledge and skills that students are expected to demonstrate.

- Released items from the **computer-based test** are available online at [mcas.onlinehelp.cognia.org/released-items](http://mcas.onlinehelp.cognia.org/released-items).
- Released items from the **paper-based test** are available in PDF format on the Department’s website at [www.doe.mass.edu/mcas/release.html](http://www.doe.mass.edu/mcas/release.html).

This document provides information about each released item from the *computer-based test*, including the following: reporting category, standard covered, science practice category, item type, item description, and correct answer (for selected-response items only). Sample responses and scoring guidelines for essay items will be posted at [www.doe.mass.edu/mcas/student/](http://www.doe.mass.edu/mcas/student/).

### A Note about Testing Mode

Most of the operational items on the Introductory Physics test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice or multiple-select items that tested the same science content and assessed the same standard as the technology-enhanced item.

**High School Introductory Physics**  
**Spring 2025 Computer-Based Released Operational Items**

<b>CBT Item No.</b>	<b>Reporting Category</b>	<b>Standard</b>	<b>Science Practice Category</b>	<b>Item Type*</b>	<b>Item Description</b>	<b>Correct Answer (SR)**</b>
1	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.9	C. Evidence, Reasoning, and Modeling	SR	Describe how increasing the voltage of a battery in a series circuit affects the current through the circuit.	A
2	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.10	C. Evidence, Reasoning, and Modeling	SR	Analyze a velocity vs. time graph to determine which free-body force diagram represents the forces acting on an object during each time interval of the graph.	<i>see page 5</i>
3	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.2	A. Investigations and Questioning	SR	Determine the steps a student should take to calculate the final momentum of a system of two colliding objects.	<i>see page 5</i>
4	<i>Waves</i>	HS.PHY.4.5	C. Evidence, Reasoning, and Modeling	SR	Determine which model represents two waves that will cancel each other out when they interact.	A
5	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.5	None	SR	Explain why a disc that stores information in magnetic fields could be damaged by a nearby wire that carries a current.	D
6	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.4	B. Mathematics and Data	SR	Analyze the effects of distance and mass on gravitational force to determine which pairs of objects have the same gravitational forces acting on them.	B
7	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.9	C. Evidence, Reasoning, and Modeling	SR	Determine the resistor in a series circuit that has the greatest voltage drop across it and calculate the current through the circuit.	Part A: <i>see page 5</i> Part B: A
8	<i>Energy</i>	HS.PHY.3.3	C. Evidence, Reasoning, and Modeling	SR	Describe an energy conversion that takes place within a system.	D
9	<i>Energy</i>	HS.PHY.3.5	C. Evidence, Reasoning, and Modeling	SR	Interpret magnetic field lines to determine the orientation of a magnet.	<i>see page 5</i>
10	<i>Waves</i>	HS.PHY.4.5	C. Evidence, Reasoning, and Modeling	SR	Identify whether light traveling from air into a glass lens changes given characteristics of light, and determine the model that shows how light travels from air into the glass lens.	Part A: <i>see page 5</i> Part B: A
11	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.10	C. Evidence, Reasoning, and Modeling	SR	Identify a situation that two free-body force diagrams could represent.	D
12	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.4	B. Mathematics and Data	SR	Calculate the magnitude of the gravitational force on an object orbiting Earth.	C
13	<i>Waves</i>	HS.PHY.4.3	C. Evidence, Reasoning, and Modeling	SR	Determine what wave interaction occurs and what pattern forms when a laser light shines through two slits.	<i>see page 6</i>
14	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.2	C. Evidence, Reasoning, and Modeling	SR	Interpret data to determine the position at which an object has the greatest momentum.	B

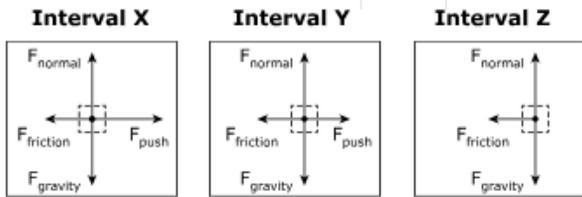
CBT Item No.	Reporting Category	Standard	Science Practice Category	Item Type*	Item Description	Correct Answer (SR)**
15	<i>Energy</i>	HS.PHY.3.2	B. Mathematics and Data	SR	Calculate the gravitational potential energy of an object.	C
16	<i>Energy</i>	HS.PHY.3.1	C. Evidence, Reasoning, and Modeling	SR	Determine which graph best represents an object's gravitational potential energy and kinetic energy.	D
17	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.3	A. Investigations and Questioning	CR	Calculate the change in momentum of an object, calculate the average net force on the object, and explain why an identified change to the setup of the investigation would reduce the average net force on the object.	
18	<i>Energy</i>	HS.PHY.1.8	C. Evidence, Reasoning, and Modeling	SR	Interpret a video to determine the type of nuclear process shown and identify that energy is released during the process.	C
19	<i>Waves</i>	HS.PHY.4.1	B. Mathematics and Data	SR	Calculate the wavelength of a sound wave.	B
20	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.1	B. Mathematics and Data	CR	Analyze the forces acting on an object to explain why the object moves to the left, calculate the acceleration of the object, and determine the magnitude and direction of an additional force that would result in a given acceleration.	
21	<i>Energy</i>	HS.PHY.3.4	C. Evidence, Reasoning, and Modeling	CR	Interpret a temperature vs. time graph of two objects in water to identify and explain the initial temperature of the water, describe when the objects will stop cooling, explain how more thermal energy was lost by one of the objects, and describe how the total heat transfer would be different if an object had a higher specific heat.	
22	<i>Energy</i>	HS.PHY.3.4	None	SR	Describe the flow of heat between ice and liquid water.	D
23	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.4	B. Mathematics and Data	SR	Compare the gravitational forces that two objects exert on a person.	C
24	<i>Waves</i>	HS.PHY.4.3	C. Evidence, Reasoning, and Modeling	SR	Identify whether each investigation provides evidence that light behaves like a particle or like a wave.	<i>see page 6</i>
25	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.2	B. Mathematics and Data	SR	Interpret a position vs. time graph for two objects that collided to determine which object was at rest before the collision, the direction the objects moved after the collision, and the magnitude of the net force on the system during the collision.	Part A: <i>see page 6</i> Part B: A
26	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.1	B. Mathematics and Data	SR	Analyze the forces acting on an object to determine which graph best represents the velocity of the object over time.	A
27	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.4	C. Evidence, Reasoning, and Modeling	SR	Analyze the effect of distance and charge on electrostatic force to order three pairs of charges by the magnitude of the forces between the charges in each pair.	<i>see page 6</i>
28	<i>Energy</i>	HS.PHY.3.3	B. Mathematics and Data	SR	Calculate the efficiency of a person pushing a crate up a ramp.	D

CBT Item No.	Reporting Category	Standard	Science Practice Category	Item Type*	Item Description	Correct Answer (SR)**
29	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.9	B. Mathematics and Data	SR	Calculate the total resistance of a series circuit.	B
30	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.10	B. Mathematics and Data	SR	Calculate the average acceleration of a car as it slows down.	A
31	<i>Energy</i>	HS.PHY.3.2	B. Mathematics and Data	SR	Interpret a temperature vs. energy graph to determine the temperature at which a substance changed state and how the graph would be different if a smaller mass of the substance were heated.	D;A
32	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.1	B. Mathematics and Data	SR	Interpret a diagram of the forces acting on an object to determine the acceleration of the object.	C
33	<i>Energy</i>	HS.PHY.3.2	None	SR	Determine in which situation water has the lowest average molecular kinetic energy.	B
34	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.3	B. Mathematics and Data	SR	Calculate the amount of time it takes an object to come to a stop after colliding with a material.	C
35	<i>Waves</i>	HS.PHY.4.1	None	SR	Explain why a light wave reaches an observer sooner than a sound wave.	<i>see page 6</i>
36	<i>Waves</i>	HS.PHY.4.1	None	SR	Explain why sound cannot be heard and light can be seen when a device is used on the moon.	<i>see page 7</i>
37	<i>Waves</i>	HS.PHY.4.1	B. Mathematics and Data	SR	Compare the wavelengths of two sound waves with different frequencies.	<i>see page 7</i>
38	<i>Waves</i>	HS.PHY.4.1	B. Mathematics and Data	CR	Calculate the period and wavelength of a sound wave and identify the wavelength of the sound wave in a model.	
39	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.10	C. Evidence, Reasoning, and Modeling	SR	Interpret a position vs. time graph to determine the velocity of an object.	B
40	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.10	C. Evidence, Reasoning, and Modeling	SR	Determine which free-body force diagram shows an object with zero net force.	D
41	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.9	B. Mathematics and Data	SR	Calculate the current through a resistor in a series circuit.	C
42	<i>Motion, Forces, and Interactions</i>	HS.PHY.2.5	None	SR	Explain why a compass needle moves when it is near a wire that is connected to a battery.	B
43	<i>Energy</i>	HS.PHY.3.1	B. Mathematics and Data	CR	Calculate the work done to lift two people, describe how the work done on the people affects their gravitational potential energy, describe how the gravitational potential energy and kinetic energy of an object change as the object falls to the ground, and calculate the velocity of the object just before it hits the ground.	

\* Science item types are selected-response (SR) and constructed-response (CR). All selected-response items are worth 1 point unless otherwise noted.

\*\* Answers are provided here for selected-response items only. Pages 5–7 of this document provide correct answers for technology-enhanced (TE) items. Sample responses and scoring guidelines for constructed-response items will be posted at [www.doe.mass.edu/mcas/student/default.html](http://www.doe.mass.edu/mcas/student/default.html).

**Correct Answer for CBT Item #2: Technology-Enhanced Item**



**Correct Answer for CBT Item #3: Technology-Enhanced Item**

Step 1:

Step 2:

Step 3:

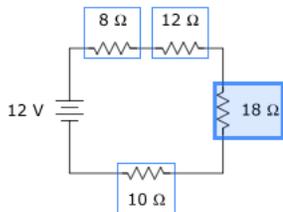
Step 1:

Step 2:

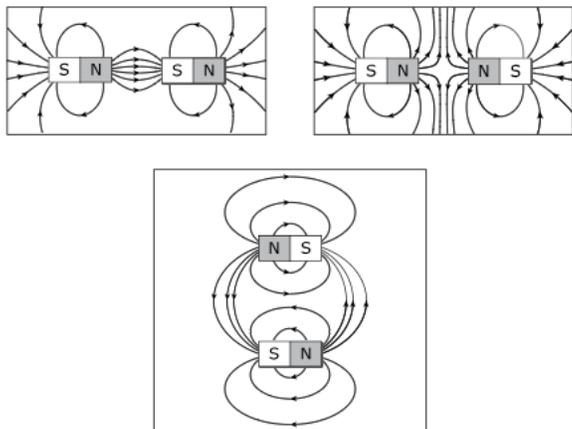
Step 3:

OR

**Correct Answer for CBT Item #7 Part A: Technology-Enhanced Item**



**Correct Answer for CBT Item #9: Technology-Enhanced Item**



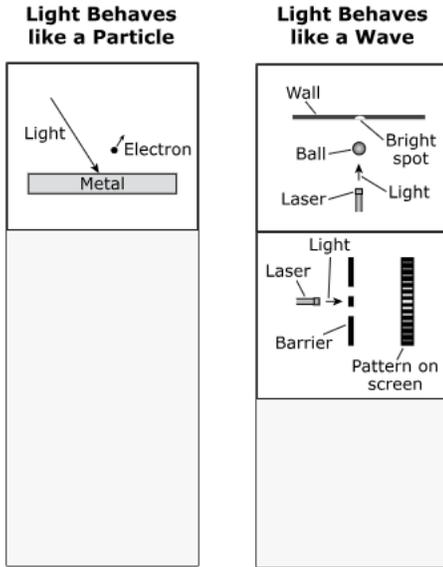
**Correct Answer for CBT Item #10 Part A: Technology-Enhanced Item**

Characteristic of Light	Changes	Does Not Change
period	<input type="radio"/>	<input checked="" type="radio"/>
speed	<input checked="" type="radio"/>	<input type="radio"/>
wavelength	<input checked="" type="radio"/>	<input type="radio"/>

### Correct Answer for CBT Item #13: Technology-Enhanced Item

When a crest of a wave of light traveling through one slit overlaps with a crest of a wave of light traveling through the other slit,  occurs, and one of the  lines in the pattern is formed.

### Correct Answer for CBT Item #24: Technology-Enhanced Item

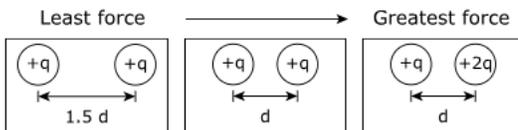


### Correct Answer for CBT Item #25 Part A: Technology-Enhanced Item

Before the collision, cart  was at rest.

After the collision, the carts

### Correct Answer for CBT Item #27: Technology-Enhanced Item



### Correct Answer for CBT Item #35: Technology-Enhanced Item

The first wave to reach the player's friend is the  wave because it travels the same distance in  the other wave.

### Correct Answer for CBT Item #36: Technology-Enhanced Item

The astronaut would not be able to hear the sound because sound waves are  waves.

The astronaut would be able to see the light because light waves are  waves.

### Correct Answer for CBT Item #37: Technology-Enhanced Item

The sound wave emitted by the green color button would have a .