

MHSA Science—Spring 2009

The table below shows the entire MHSA science test design. Scores are based on common items only, half of which are released and can be found in this document.

Test Design

| CONTENT AREA | COMMON | | FIELD TEST ITEMS | | TOTAL ITEMS PER STUDENT | | TESTING TIME | POINTS |
|--------------|--------|----|------------------|----|-------------------------|----|--------------|--------|
| | MC | CR | MC | CR | MC | CR | | |
| SCIENCE | 40 | 4 | 8 | 1 | 48 | 5 | 120 MIN. | 56 |

Each item on the MHSA measures a content standard of Maine's 2007 *Learning Results*.

Science Content Standards Assessed on the MHSA

D. The Physical Setting

1. Universe and Solar System
2. Earth
3. Matter and Energy
4. Force and Motion

E. The Living Environment

1. Biodiversity
2. Ecosystems
3. Cells
4. Heredity and Reproduction
5. Evolution

Item Information Chart

Please refer to the item information chart on the next page for in-depth information on each science released item. The released item numbers in the chart correspond to item numbers in the practice test and on the MHSA Class Analysis Report.

Constructed-Response Scoring Guides

A constructed-response scoring guide includes score point descriptions used to determine the score. Training notes that follow the scoring guide provide in-depth descriptions or particular information also used to determine the score.

Student Work

At least one sample student response is provided for each score point with annotations that explain the reasoning behind the assigned score.

MHSA Science Released Item Information

| Released Item Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|----------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|------|
| Practice Test Page Number | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 8 | 9 |
| Content Standards | E2 | E3 | D1 | D3 | E2 | D2 | D2 | D2 | D4 | D4 | D3 | D1 | D4 | D2 | E1 | E3 | E1 | E4 | E5 | D3 | E2 | D3 |
| Item Type | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | MC | CR | CR |
| Possible Points | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| Key | A | C | B | B | D | B | B | A | D | D | C | D | D | B | C | C | A | B | A | B | | |
| % Who Chose A or Earned 1 Point | 66 | 12 | 5 | 10 | 7 | 26 | 23 | 58 | 27 | 22 | 5 | 11 | 25 | 6 | 16 | 11 | 79 | 5 | 59 | 21 | 25 | 24 |
| % Who Chose B or Earned 2 Points | 6 | 42 | 81 | 42 | 5 | 37 | 46 | 4 | 21 | 5 | 5 | 11 | 7 | 78 | 10 | 9 | 6 | 65 | 7 | 58 | 29 | 22 |
| % Who Chose C or Earned 3 Points | 7 | 33 | 3 | 24 | 6 | 9 | 9 | 28 | 9 | 41 | 71 | 38 | 24 | 5 | 63 | 46 | 4 | 8 | 8 | 9 | 22 | 5 |
| % Who Chose D or Earned 4 Points | 18 | 10 | 10 | 16 | 80 | 21 | 17 | 5 | 38 | 28 | 15 | 35 | 43 | 9 | 5 | 30 | 10 | 20 | 23 | 8 | 3 | 0 |
| Statewide Average Student Score | | | | | | | | | | | | | | | | | | | | | 1.6 | 0.85 |

Content Standards: See “MDOE Regulation 132—Learning Results: Parameters for Essential Instruction” at <http://www.maine.gov/education/lres/pei/index.html>.

Item Type: MC = multiple-choice, CR = constructed-response

Answer Key: the letter of the correct answer choice

Constructed-Response Item 21

21. The following are examples of industrial impacts on ecosystems.

| | | |
|-------------------|------------------|-----------------------|
| air pollution | filling wetlands | habitat fragmentation |
| thermal pollution | water pollution | parking lot paving |

- a. Choose three of these examples or use three of your own examples.
- b. Discuss the impact of each on the speed of changes occurring in various ecosystems.

Scoring Guide for Constructed-Response Item 21

| Score | Description |
|--------------|--|
| 4 | Response demonstrates thorough understanding of the impact of industry on the speed of change in ecosystems. Student correctly uses three examples to explain the impact of industrialization on speed of changes occurring in ecosystems. Response is well developed and contains no errors. |
| 3 | Response demonstrates general understanding of the impact of industry on the speed of change in ecosystems. Student uses three examples to explain the impact of industrialization on speed of changes occurring in ecosystems. Response is general and either contains an error in the description or fails to address speed. |
| 2 | Response demonstrates limited understanding of the impact of industry on the speed of change in ecosystems. Student uses two examples in an attempt to explain the impact of industrialization on speed of changes occurring in ecosystems. Response is incomplete and contains errors, omissions, or misconceptions. |
| 1 | Response demonstrates little understanding of the impact of industry on the speed of change in ecosystems. Student uses one example in an attempt to explain the impact of industrialization on speed of changes occurring in ecosystems. Response is very weak and contains errors, omissions, or misconceptions. |
| 0 | Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured. |
| Blank | No response. |

Training Notes for Constructed-Response Item 21

Descriptions must be of changes to ecosystems to be counted: changes peculiar to humans (“People will have more trouble breathing”) or environment (“Ice caps will melt . . .”) are not counted unless related to other organisms in ecosystem (“. . . which will flood coastlines and disrupt coastal species’ habitats”).

Common misconception is to confuse algae blooms and milfoil when discussing runoff/water pollution.

Algae blooms are caused by changes in water temperature and nutrient content, which is frequently affected by runoff contaminated with fertilizer.

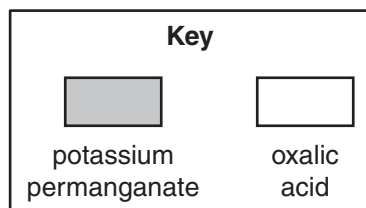
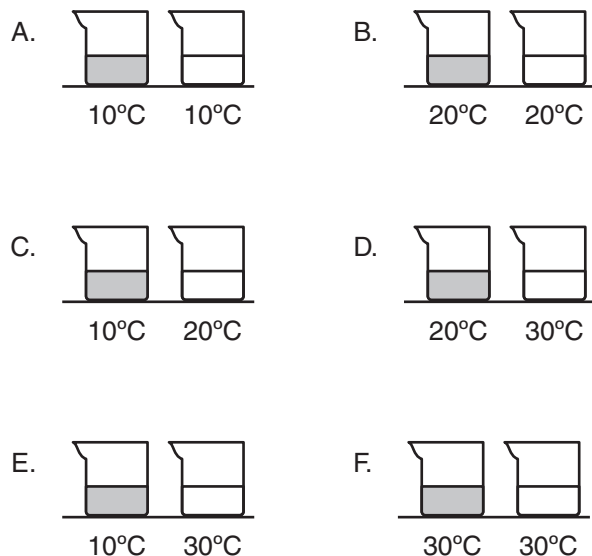
Milfoil (Eurasian Watermilfoil) is an invasive species generally spread by fragments on watercraft moved from a contaminated to an uncontaminated lake. (This is unlikely to be correctly related to an industrial impact.)

For credit for either, response must show a correct understanding of which is being discussed, and relate it to industrial impacts.

Constructed-Response Item 22

22. A purple solution of potassium permanganate is mixed with a colorless solution of oxalic acid. When the solutions are mixed, a chemical reaction changes the color of the mixture to yellow. A stopwatch is used to measure the amount of time it takes for the mixture to turn yellow, which represents the rate of the reaction.

Students want to test the effect of temperature on the rate of the reaction. The starting temperatures of the solutions are given for the six experimental conditions shown below.



- Choose the three experimental conditions that best show the effect of temperature on reaction rate. Explain your answer.
- Identify one factor other than temperature that could affect reaction rate. Explain your answer.
- Identify one factor that does not affect reaction rate. Explain your answer.

Scoring Guide for Constructed-Response Item 22

| Score | Description |
|-------|---|
| 4 | Response demonstrates a thorough understanding of factors that affect the rate of chemical reactions. The response chooses three experimental conditions that best show the effect of temperature on the rate of the reaction and explains the answer. The response also identifies one other factor that affects reaction rate and one factor that does not and explains why. Response has no errors or omissions. |
| 3 | Response demonstrates a general understanding of factors that affect the rate of chemical reactions. Response has one error or omission. |
| 2 | Response demonstrates a limited understanding of factors that affect the rate of chemical reactions. Response has errors and omissions. |
| 1 | Response demonstrates a minimal understanding of factors that affect the rate of chemical reactions. Response is minimal or one correct response. |
| 0 | Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured. |
| Blank | No response. |

Training Notes for Constructed-Response Item 22

a. Response includes one of the following sets of experimental conditions:

Experimental conditions A, B, and F. Mixing pairs of solutions that have the same starting temperature will result in a known reaction temperature at which the reaction rate can be measured. Also, the three different reaction temperatures in A, B, and F are important for comparing temperature and reaction rate.

Experimental conditions A, C, and E or D, E, and F. Mixing solutions in which the temperature of one of the solutions in each pair is constant and in which the temperature of the other solution in each pair increases by equal amounts allows a comparison to be made between temperature and reaction rate.

b. Response includes one of the following factors:

- concentration of reactants (as concentration of reactants increases, molecules of the reactants are more likely to come in contact with each other, which increases the rate of reaction)
- surface area of the reactants (e.g., powder vs. liquid) (as the surface area of the reactants increases, the amount of one reactant exposed to the other increases, which increases the reaction rate)
- ambient air temperature (reaction rate depends on temperature because as the temperature increases the reactant molecules are moving more rapidly and coming into contact with each other more often, which increases the reaction rate)
- stirring or agitating the solutions (stirring causes fresh reactant molecules to come in contact with each other more often which increases the reaction rate)
- addition of a catalyst (catalysts provide an alternate energy pathway in which the potential energy barrier between reactants and products is lowered)
- contaminated glassware/reaction vessel (if the glassware is contaminated with a catalyst, the reaction rate will increase—see explanation for addition of catalyst)

Note: Training Notes continued on next page.

- c. Response includes one of the following factors: (no credit is given for irrelevant factors such as wearing goggles, time of day, etc.)
- pressure (pressure only affects reaction rates of gases)
 - volume of solutions/amount of solutions (changing the volume only affects the amount of product formed by increasing the number of molecules available for the reaction but the speed at which they react stays the same)
 - size of container/reaction vessel (changing the size of the reaction vessel does not change how often or with how much energy the reaction molecules interact)
 - presence of spectator ions (spectator ions are not involved in the reaction and therefore do not affect the rate of reaction)
 - order of adding solutions (changing the order of adding solutions does not change how often or with how much energy the reaction molecules interact)
 - presence of light/sunlight (only certain biological reactions such as photosynthesis depend on the energy from sunlight to proceed)

Each part is worth 2 points (1 point for correct answer and 1 point for thorough explanation).

6 points = 4

4 or 5 points = 3

2 or 3 points = 2

1 point = 1