



*Release of Spring 2021
MCAS Test Information*

from the

*High School Chemistry
Paper-Based Test*

June 2021

**Massachusetts Department of
Elementary and Secondary Education**



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High School Chemistry Test

The spring 2021 high school Chemistry test was a legacy assessment that was based on learning standards in the Chemistry content strand of the October 2006 version of the *Massachusetts Science and Technology/Engineering Curriculum Framework*. The 2006 framework is available on the Department website at www.doe.mass.edu/frameworks/archive.html. Massachusetts adopted a new curriculum framework in science and technology/engineering in 2016. A plan for transitioning the MCAS assessments to the new framework is available at www.doe.mass.edu/mcas/tdd/sci.html?section=transition.

Chemistry test results are reported under the following four MCAS reporting categories:

- Atomic Structure and Periodicity
- Bonding and Reactions
- Properties of Matter and Thermochemistry
- Solutions, Equilibrium, and Acid-Base Theory

The table at the conclusion of this document indicates each item's reporting category and the framework learning standard each item assesses. In order to support future test development, items from the spring 2021 Chemistry test are not included in this publication. The omission of these items will have no impact on the reporting of results.

Test Sessions

The high school Chemistry test included two separate test sessions. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

Each student taking the high school Chemistry test was provided with a Chemistry Formula and Constants Sheet/Periodic Table of the Elements. Copies of both sides of this formula sheet appear on the following pages.

Each student also had sole access to a calculator with at least four functions and a square-root key.

During both Chemistry test sessions, the use of bilingual word-to-word dictionaries was allowed for current and former English learner students only. No other reference tools or materials were allowed.

Massachusetts Comprehensive Assessment System Chemistry Formula and Constants Sheet

Common Polyatomic Ions

Ion	Ionic Formula
Ammonium	NH_4^+
Carbonate	CO_3^{2-}
Hydroxide	OH^-
Nitrate	NO_3^-
Phosphate	PO_4^{3-}
Sulfate	SO_4^{2-}

Combined Gas Law: $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

Ideal Gas Law: $PV = nRT$

Dilution Formula: $M_1 V_1 = M_2 V_2$

Molar Volume of Ideal Gas at STP: 22.4 L/mol

Ideal Gas Constant: $R = 0.0821 \text{ L} \cdot \text{atm/mol} \cdot \text{K} = 8.31 \text{ L} \cdot \text{kPa/mol} \cdot \text{K}$

STP: 1 atm (101.3 kPa), 273 K (0°C)

Absolute Temperature Conversion: $K = ^\circ\text{C} + 273$

Definition of pH: $\text{pH} = -\log [\text{H}_3\text{O}^+] = -\log [\text{H}^+]$

Avogadro's Number: 6.02×10^{23} particles/mol

Nuclear Symbols

Name	Symbol
Alpha particle	α or ${}^4_2\text{He}$
Beta particle	β or ${}^0_{-1}e$
Gamma ray	γ
Neutron	1_0n

Periodic Table of the Elements

Periodic table of the Elements

Mass numbers in parentheses are those of the most stable or most common isotope.

Lanthanide Series

Actinide Series

High School Chemistry

Spring 2021 Unreleased Operational Items

Item No.	Reporting Category	2006 Standard
1	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.4
2	<i>Atomic Structure and Periodicity</i>	STE.CH.Per3.3
3	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.5
4	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.4
5	<i>Bonding and Reactions</i>	STE.CH.Bond4.4
6	<i>Bonding and Reactions</i>	STE.CH.Reac5.5
7	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.6
8	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Sol7.5
9	<i>Properties of Matter and Thermochemistry</i>	STE.CH.PM1.3
10	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.1
11	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Acid8.3
12	<i>Bonding and Reactions</i>	STE.CH.Bond4.1
13	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Sol7.1
14	<i>Bonding and Reactions</i>	STE.CH.Reac5.6
15	<i>Atomic Structure and Periodicity</i>	STE.CH.Per3.4
16	<i>Properties of Matter and Thermochemistry</i>	STE.CH.PM1.1
17	<i>Bonding and Reactions</i>	STE.CH.Reac5.4
18	<i>Bonding and Reactions</i>	STE.CH.Bond4.3
19	<i>Atomic Structure and Periodicity</i>	STE.CH.Per3.3
20	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.4
21	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.3
22	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Sol7.4
23	<i>Properties of Matter and Thermochemistry</i>	STE.CH.PM1.2
24	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.7
25	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.2
26	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Acid8.2
27	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.1
28	<i>Atomic Structure and Periodicity</i>	STE.CH.Per3.1
29	<i>Bonding and Reactions</i>	STE.CH.Reac5.1
30	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Acid8.1
31	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.2
32	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Sol7.6
33	<i>Bonding and Reactions</i>	STE.CH.Bond4.1
34	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.2

Item No.	Reporting Category	2006 Standard
35	<i>Properties of Matter and Thermochemistry</i>	STE.CH.SM6.5
36	<i>Bonding and Reactions</i>	STE.CH.Bond4.6
37	<i>Properties of Matter and Thermochemistry</i>	STE.CH.PM1.2
38	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.2
39	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Sol7.2
40	<i>Atomic Structure and Periodicity</i>	STE.CH.AS2.3
41	<i>Bonding and Reactions</i>	STE.CH.Bond4.2
42	<i>Solutions, Equilibrium, and Acid-Base Theory</i>	STE.CH.Sol7.3
43	<i>Bonding and Reactions</i>	STE.CH.Reac5.3
44	<i>Atomic Structure and Periodicity</i>	STE.CH.Per3.2
45	<i>Bonding and Reactions</i>	STE.CH.Reac5.2