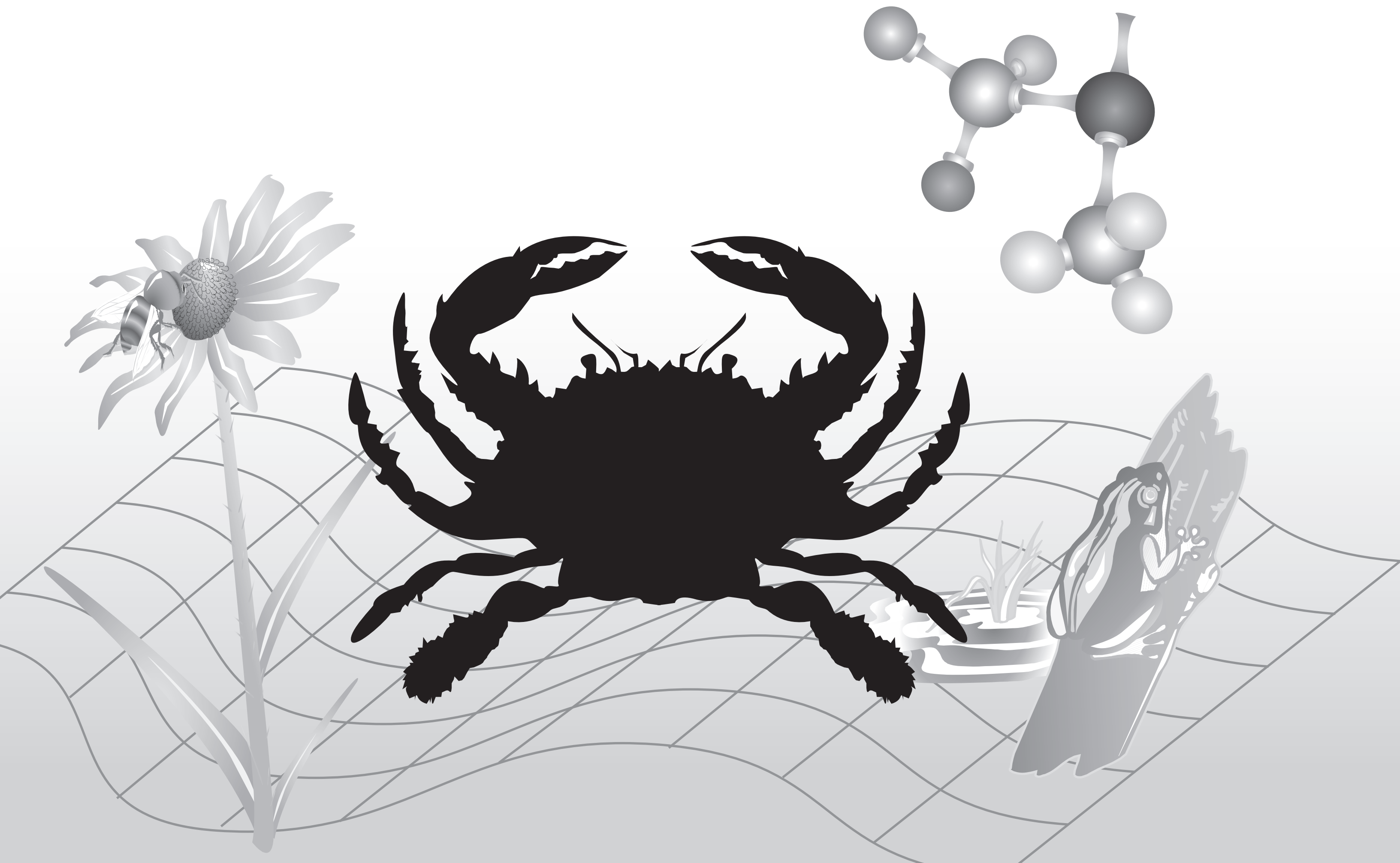
HSA

Maryland High School Assessment

MCAP Maryland Comprehensive Assessment Program



MISA

Maryland Integrated Science Assessment

Practice Test

Developed and published under contract with the Maryland State Department of Education by Measured Progress.

Session 1

Contents

Read the information. Use the information to answer the questions.

Sodium and Magnesium Reactions

To begin a study of chemical reactions, a teacher shows the students in a chemistry class two videos. Each video shows the reaction of a different metal. Students first observe the reaction of the metal sodium (Na) with water (H_2O). In the video, 500 mg of sodium from an oil-filled container is placed into a beaker of water at room temperature (20°C). The sodium quickly bursts into flames and explodes with a loud popping sound.

The reaction equation is $2Na + 2H_2O \rightarrow 2NaOH + H_2$.

In the next video, the students observe the reaction of the metal magnesium (Mg) with water. In the video, 500 mg of magnesium is placed into a beaker of water at room temperature. The video shows that it takes several hours for bubbles to form on the magnesium.

The bubbles that form are hydrogen (H_2) gas, according to the reaction equation $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$.

The students wonder, "What causes the reactivity of sodium and magnesium to be so different?" They decide to use The Periodic Table of the Elements and gather more information to answer this question.

Clues from Sodium and Magnesium Compounds

Students research sodium and magnesium compounds to gain more data to answer their question. They learn that sodium readily forms the following compounds:

- sodium chloride (NaCl)
- sodium fluoride (NaF)
- sodium oxide (Na_2O)
- sodium sulfide (Na_2S)

They also learn that magnesium forms compounds with some of the same nonmetal elements that sodium does. The following compounds form with magnesium:

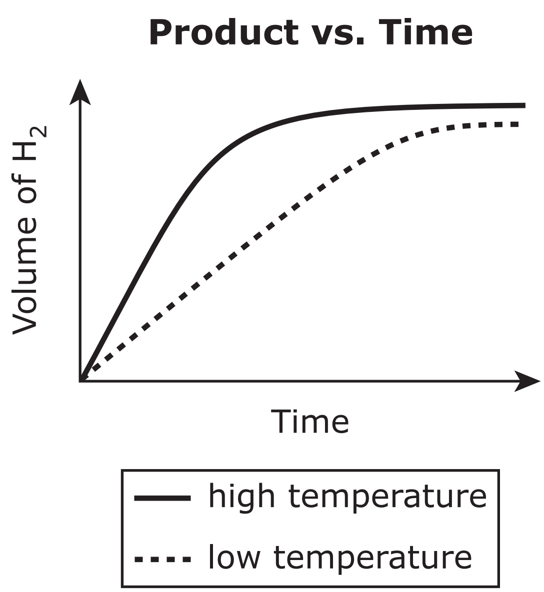
- magnesium chloride ($MgCl_2$)
- magnesium fluoride (MgF_2)
- magnesium oxide (MgO)
- magnesium sulfide (MgS)

By examining the positions of these elements on The Periodic Table of the Elements (see reference sheet), the students see some patterns in the way sodium and magnesium react with nonmetals.

Effect of Temperature on Reaction Rate

The students wondered how the speed of the magnesium and water reaction could be increased. They decide to investigate whether adding heat to the reaction will affect the reaction rate. They place 50 mg of magnesium into a test tube with 10 mL of water. They heat the test tube with a flame. Within seconds, the magnesium begins to bubble rapidly, producing hydrogen gas.

The students compare the results of the magnesium and water reaction at 25°C to the results of the reaction with heat added. They draw a graph to represent their hypothesis about the rate of product formation for the reaction at different temperatures.



1 The students study the equations for the reactions of Na and Mg with H_2O to explain the outcomes of the reactions. Which observation would provide the **best** evidence that matter is conserved in the reaction of Na and H_2O?

A The number of atoms of Na is the same on both sides of the equation.

B The number of electrons and protons in Na is equal to the number of electrons and protons in H and O.

C The mass of Na and H_2O that reacts is greater than the mass of H_2 produced.

D The mass of NaOH produced is equal to the mass of H_2O that is changed into steam as the Na explodes into flames.

2 The students consider the bonds that form in the reactions of Na and Mg with H_2O. Which statement accurately describes the bonds that each atom forms?

A Mg bonds more easily than Na.

B Na forms more bonds than Mg.

C Mg and Na both form ionic bonds.

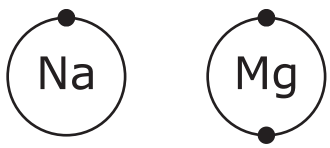
D Na and Mg both form covalent bonds.

3 The students create a model to help show why Na and Mg react differently. They want to show the outer electron states of both elements and explain why this affects the reactivity of both elements.

Part A

Which model shows the number of valence electrons for Na and Mg?

A



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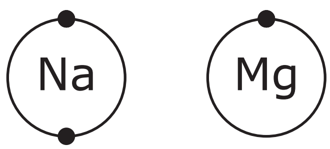

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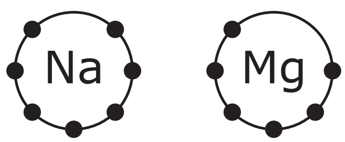
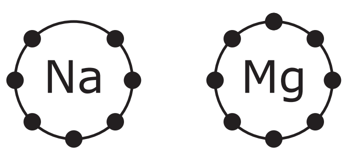


D



Part B

Which statement **best** explains why Na is more reactive with water than Mg?

A Na has a higher electronegativity than Mg.

B Na has fewer valence electrons than Mg.

C Na is more common in nature than Mg.

D Na is a metal and Mg is not.

4 Calcium (Ca) is in the same group as Mg. Explain how Ca will react. Select all that apply.

A Ca will not react in a similar way to Mg because the number of valence electrons is the same.

B Ca will react in a similar way to Mg because the number of valence electrons is different.

C Ca will not react in a similar way to Mg because the number of valence electrons is different.

D Ca will react in a similar way to Mg because the number of valence electrons is the same.

E If Ca reacted with H_2O, it would form two ionic bonds with OH.

F If Ca reacted with H_2O, it would form two covalent bonds with OH.

5 Which statement **best** explains the students' predictions shown in the Product vs. Time graph?

A An increase in temperature would increase the rate of reaction.

B An increase in temperature would decrease the rate of reaction.

C The amount of product would remain stable over time.

D The amount of product would decrease as the time increased.

6 **CR** Explain what is happening at the molecular level in the Product vs. Time graph. Support your reasoning with evidence.

Write your answer in your Answer Sheet.

GO ON

Read the information. Use the information to answer the questions.

Trees in Urban Parks

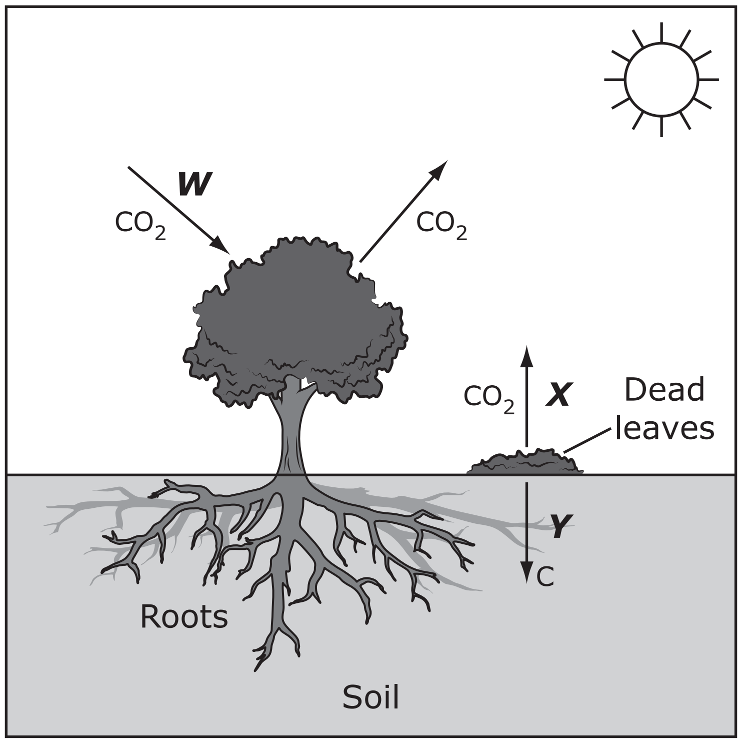
The Baltimore City Parks and Recreation Department plans to remove a group of trees in an urban park to expand a parking lot. Before the trees can be removed a study needs to be completed to determine the possible effect of tree removal on the park's ecosystem. Trees in urban parks in Baltimore store about 43 tons of carbon per acre, and 1.2 tons of carbon per acre is lost each year from the removal of trees.

A tree scientist calculated the amount of carbon stored by the trees scheduled to be removed in the park. First, the scientist measured the circumference of the trunk of five trees. Then, the scientist used a tool called a clinometer to calculate the height of each tree. The scientist entered these measurements into a formula to estimate the amount of carbon stored in each tree. The results are shown in the table.

Carbon Stored in Urban Trees

Tree Number	Circumference (m)	Tree Height (m)	Estimated Carbon Stored (kg)
1	0.25	10	15
2	1.25	40	539
3	0.50	16	43
4	0.75	18	95
5	1.00	36	315
Total			1007

The scientist also recorded observations from around the park. For example, there were leaves and small branches on the ground beneath the trees. The scientist used the data and observations from the urban trees to make a partial model of the carbon cycle.



Trees and the Global Carbon Cycle

The data show the total carbon stored in trees, while the model shows how carbon moves through the carbon cycle. The scientist wants to compare the locally collected data and model with global carbon data and carbon cycle models to predict the potential impact of tree removal from the park.

The total amount of carbon stored in forests changes each year as carbon moves through the hydrosphere, atmosphere, geosphere, and biosphere. First, the scientist gathered historical data from 1990–1999. Global carbon (C) estimates are shown in the tables.

Global Carbon Stored Each Year from 1990–1999

Location	Carbon Stored (gigatons* of C per year)
atmosphere	3.2
ocean	2.2
forests	2.5
total	7.9

*1 gigaton = 1 billion tons

Global Carbon Lost Each Year from 1990–1999

Process	Carbon Loss (gigatons* of C per year)
fossil fuel burning	6.5
deforestation	1.5
total	8.0

*1 gigaton = 1 billion tons

After 1999, fossil fuel burning increased and deforestation decreased. The scientist estimated that compared to the time frame of 1990–1999, during 2000–2007 the atmosphere stored an average of 0.9 more gigatons of carbon per year; the oceans, 0.1 more gigatons per year; and the forests, 0.2 fewer gigatons per year.

7 Which statement describes a relationship shown between the Carbon Stored in Urban Trees data and the partial model of the carbon cycle?

A The amount of carbon from the atmosphere stored by trees in the urban park is based on the size of the trunk and tree height.

B The amount of carbon stored by trees in the urban park is small because the trees constantly release carbon to the atmosphere.

C Carbon is stored and lost in equal amounts because the dead leaves release the carbon originally stored by trees.

D Carbon is stored in the trees because the carbon from the soil is used to build the trunk of the tree.

8 Which equation shows the process in the model by which carbon dioxide is stored in the tree?

A energy + $6O_2 \rightarrow C_6H_{12}O_6 + H_2O$

B $C_6H_{12}O_6 + 6H_2O \rightarrow 6CO_2 + 6O_2$

C $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

D $6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O$ + energy

9 Which statement **best** describes a carbon exchange process that occurs in the carbon cycle model?

A Carbon is stored in the biosphere in part *Y* and moves to the atmosphere in part *W*.

B Carbon is stored in the biosphere in part *W* and moves to the geosphere in part *Y*.

C Carbon moves from the biosphere to the atmosphere in parts *W* and *Y*.

D Carbon moves from the biosphere to the geosphere in parts *X* and *Y*.

10 Which statement **best** describes how the Carbon Stored in Urban Trees data table should be improved to better support the model and represent the cycling of carbon?

A It should include the amount of carbon lost to the atmosphere due to respiration by the trees.

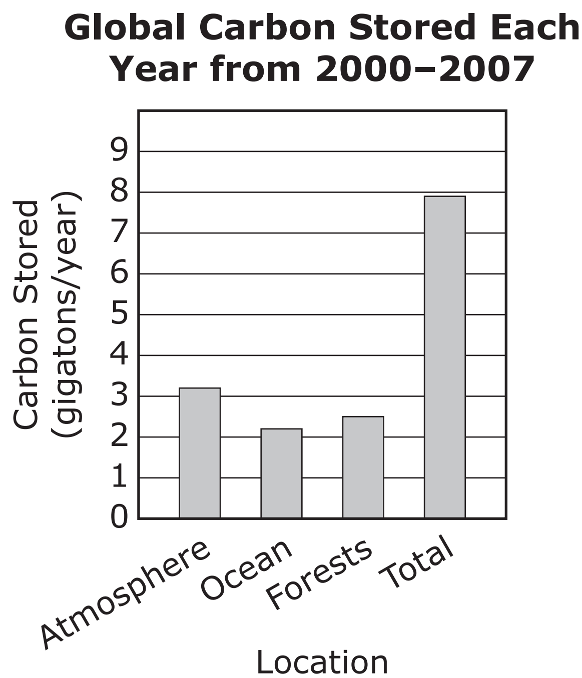
B It should include the amount of carbon stored in the soil due to photosynthesis by the trees.

C It should include the amount of oxygen released by the trees due to photosynthesis.

D It should include the amount of oxygen consumed by the trees due to respiration.

11 Use the data from Global Carbon Stored Each Year from 1990–1999 and the change in global carbon storage to calculate the global carbon stored in each location, each year, from 2000–2007. Then, choose the graph that represents the amount of global carbon stored in each location from 2000–2007.

A



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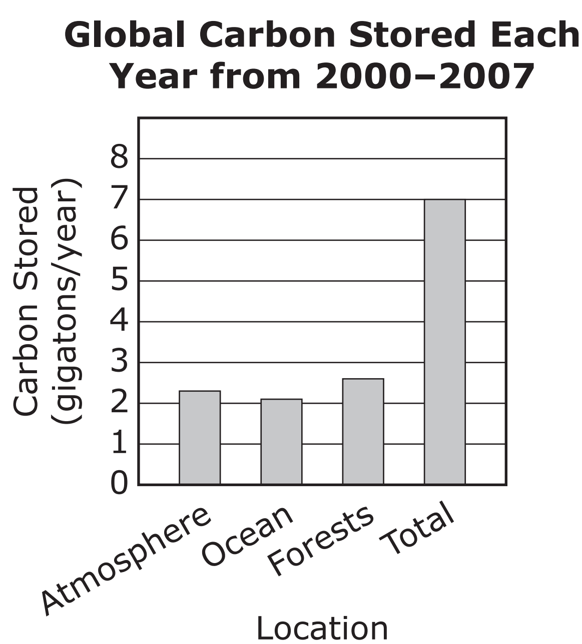
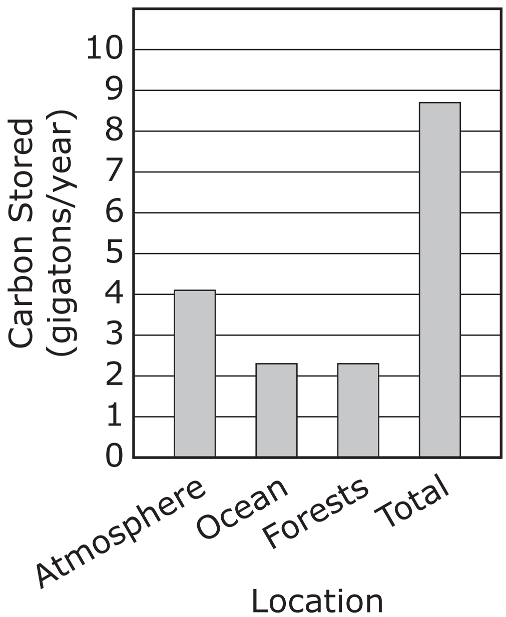


11 *Continued...*

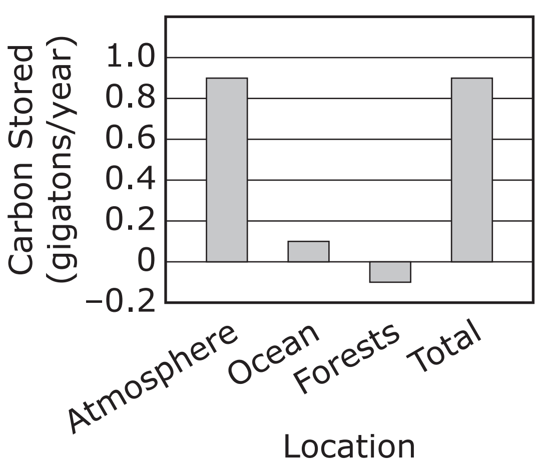
C

Global Carbon Stored Each Year from 2000–2007



D

Global Carbon Stored Each Year from 2000–2007



12
CR

Describe how the removal of the trees from the urban park will impact the cycling of carbon among the atmosphere, geosphere, and biosphere, as shown in the carbon cycle model. Identify the limitations of the model in accounting for all of Earth's carbon.

Write your answer in your Answer Sheet.

STOP

Periodic Table of the Elements

Atomic number — 14
Symbol — **Si**
Atomic mass — 28.086
Silicon — Name

	Group 1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 **H** 1.008 Hydrogen																	2 **He** 4.0026 Helium
2	3 **Li** 6.941 Lithium	4 **Be** 9.012 Beryllium											5 **B** 10.81 Boron	6 **C** 12.011 Carbon	7 **N** 14.007 Nitrogen	8 **O** 15.999 Oxygen	9 **F** 18.998 Fluorine	10 **Ne** 20.179 Neon
3	11 **Na** 22.990 Sodium	12 **Mg** 24.305 Magnesium											13 **Al** 26.982 Aluminum	14 **Si** 28.086 Silicon	15 **P** 30.974 Phosphorus	16 **S** 32.066 Sulfur	17 **Cl** 35.453 Chlorine	18 **Ar** 39.948 Argon
4	19 **K** 39.098 Potassium	20 **Ca** 40.08 Calcium	21 **Sc** 44.956 Scandium	22 **Ti** 47.88 Titanium	23 **V** 50.942 Vanadium	24 **Cr** 51.996 Chromium	25 **Mn** 54.938 Manganese	26 **Fe** 55.847 Iron	27 **Co** 58.933 Cobalt	28 **Ni** 58.69 Nickel	29 **Cu** 63.546 Copper	30 **Zn** 65.39 Zinc	31 **Ga** 69.72 Gallium	32 **Ge** 72.61 Germanium	33 **As** 74.922 Arsenic	34 **Se** 78.96 Selenium	35 **Br** 79.904 Bromine	36 **Kr** 83.80 Krypton
5	37 **Rb** 85.468 Rubidium	38 **Sr** 87.62 Strontium	39 **Y** 88.906 Yttrium	40 **Zr** 91.224 Zirconium	41 **Nb** 92.906 Niobium	42 **Mo** 95.94 Molybdenum	43 **Tc** (98) Technetium	44 **Ru** 101.07 Ruthenium	45 **Rh** 102.906 Rhodium	46 **Pd** 106.42 Palladium	47 **Ag** 107.868 Silver	48 **Cd** 112.41 Cadmium	49 **In** 114.82 Indium	50 **Sn** 118.71 Tin	51 **Sb** 121.763 Antimony	52 **Te** 127.60 Tellurium	53 **I** 126.904 Iodine	54 **Xe** 131.29 Xenon
6	55 **Cs** 132.905 Cesium	56 **Ba** 137.33 Barium	57 **La** 138.906 Lanthanum	72 **Hf** 178.49 Hafnium	73 **Ta** 180.948 Tantalum	74 **W** 183.84 Tungsten	75 **Re** 186.207 Rhenium	76 **Os** 190.23 Osmium	77 **Ir** 192.22 Iridium	78 **Pt** 195.08 Platinum	79 **Au** 196.967 Gold	80 **Hg** 200.59 Mercury	81 **Tl** 204.383 Thallium	82 **Pb** 207.2 Lead	83 **Bi** 208.980 Bismuth	84 **Po** (209) Polonium	85 **At** (210) Astatine	86 **Rn** (222) Radon
7	87 **Fr** (223) Francium	88 **Ra** 226.025 Radium	89 **Ac** 227.028 Actinium	104 **Rf** (261) Rutherfordium	105 **Db** (262) Dubnium	106 **Sg** (263) Seaborgium	107 **Bh** (262) Bohrium	108 **Hs** (265) Hassium	109 **Mt** (266) Meitnerium	110 (269)								

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

Lanthanide Series	58 **Ce** 140.12 Cerium	59 **Pr** 140.908 Praseodymium	60 **Nd** 144.24 Neodymium	61 **Pm** (145) Promethium	62 **Sm** 150.36 Samarium	63 **Eu** 151.97 Europium	64 **Gd** 157.25 Gadolinium	65 **Tb** 158.925 Terbium	66 **Dy** 162.50 Dysprosium	67 **Ho** 164.930 Holmium	68 **Er** 167.26 Erbium	69 **Tm** 168.934 Thulium	70 **Yb** 173.04 Ytterbium	71 **Lu** 174.967 Lutetium
Actinide Series	90 **Th** 232.038 Thorium	91 **Pa** 231.036 Protactinium	92 **U** 238.029 Uranium	93 **Np** 237.048 Neptunium	94 **Pu** (244) Plutonium	95 **Am** (243) Americium	96 **Cm** (247) Curium	97 **Bk** (247) Berkelium	98 **Cf** (251) Californium	99 **Es** (252) Einsteinium	100 **Fm** (257) Fermium	101 **Md** (258) Mendelevium	102 **No** (259) Nobelium	103 **Lr** (262) Lawrencium

HS MISA
PRACTICE TEST

1 2 3 4 5 A B C D E Printed in the USA