RLP-PSA · RLP Physical Science A — Matter, Bonding, Reactions and the Nucleus

Unit 1: Atoms and the Periodic Table

Practice Workbook. The same problems, in the same order, as the Practice sections of the online lessons.

Name _____ Period _____

Lesson 1.1 — Gold That Never Rusts: Inside the Atom

FLUENCY

1. How many protons, neutrons and electrons are in a neutral atom of carbon-14?

2. How many protons, neutrons and electrons are in a neutral atom of sodium-23?

3. How many protons, neutrons and electrons are in a neutral atom of gold-197?

4. How many protons, neutrons and electrons are in a neutral atom of uranium-235?

5. How many protons, neutrons and electrons are in a neutral atom of lithium-7?

6. An ion has 12 protons and 10 electrons. What is its charge, and what element is it?

7. An ion has 16 protons and 18 electrons. Give its symbol and charge.

APPLICATION

8. Carbon-12 and carbon-14 are both carbon. Explain what is the same and what is different about their atoms, and why they react the same way chemically.

9. A student says iron could be turned into gold by a chemical reaction if we found the right one. Use atomic number to explain why no chemical reaction can do this.

10. A proton has mass about 1 u and an electron about 1/1,836 u. In a neutral gold-197 atom, estimate what fraction of the atom's mass the electrons contribute.

CHALLENGE

11. An atom has mass number 40 and 22 neutrons. A second atom has mass number 40 and 20 neutrons. Identify both, and say whether they are isotopes of each other.

REVIEW

12. Convert 25 mL to L.

13. Convert 100 kPa to atm.

14. What volume does 20.0 g of water (density 1.0 g/cm^3) occupy?

Lesson 1.2 — Metals, Nonmetals and Reactivity Patterns

FLUENCY

1. Classify as metal, nonmetal or metalloid: magnesium, sulfur, silicon, copper, chlorine.

2. Give the group number and period of zinc, magnesium and iron.

3. In the vinegar lab, name the independent variable, the dependent variable and two controlled variables.

4. Which gas forms when magnesium reacts with vinegar, and what is the evidence you can observe?

5. Predict which conducts electricity: an aluminum foil strip, a sulfur lump, a copper wire, a plastic straw.

APPLICATION

6. Your live bubbling score for zinc at 2 minutes was 2, and your score from the video replay was 1. What does this disagreement tell you, and how could you reduce it?

7. A 0.10 g piece of magnesium reacts completely in vinegar: $Mg + 2CH_3COOH \rightarrow Mg(CH_3COO)_2 + H_2$. Using 24.305 g/mol for Mg and 2.016 g/mol for H_2, what mass of hydrogen forms?

8. A student's iron nail showed no bubbles in 5 minutes and she concluded iron does not react with acid. Evaluate the conclusion and suggest a modified test.

CHALLENGE

9. Calcium (group 2, period 4) was not tested. Predict where it would fall in your Mg, Zn, Fe, Cu ranking, and justify with its position relative to magnesium.

REVIEW

10. A sample has mass 18.4 g and volume 20.0 cm^3. Find its density and, using a density table, suggest what it could be.

11. Convert 300 km/h to m/s.

12. Oxygen-16: how many protons, neutrons and electrons?

Lesson 1.3 — Arguing from Periodic Trends

FLUENCY

1. Order Li, Na, K and Rb from highest to lowest first ionization energy.

2. Which has the higher first ionization energy, sodium or chlorine? Why?

3. How many valence electrons do the atoms of group 1, group 2, group 17 and group 18 have?

4. Which halogen is most reactive, and which least: F, Cl, Br, I?

5. What is the difference between the first ionization energies of sodium (5.14 eV) and potassium (4.34 eV)?

APPLICATION

6. NIST first ionization energies across period 2 are Li 5.39, Be 9.32, B 8.30, C 11.26, N 14.53, O 13.62, F 17.42, Ne 21.56 eV. Describe the overall trend, identify the two exceptions, and say whether they overturn the trend.

7. Write a claim, evidence and reasoning for: 'Cesium is more reactive than lithium.'

8. Make a bar chart (sketch) of the group 1 ionization energies Li to Cs, then state what the graph shows in one sentence.

CHALLENGE

9. Helium (24.59 eV) has the highest first ionization energy of any element even though it has only 2 protons. Explain using distance and shielding.

REVIEW

10. Convert 1250 km to m.

11. An ion has 20 protons and 18 electrons. Write its symbol.

12. Name a metal that bubbled vigorously in vinegar and one that did not bubble at all.

Lesson 1.4 — Modeling Electron Shells, Ions and Isotopes

FLUENCY

1. Write the shell arrangement for oxygen, magnesium, phosphorus and potassium.

2. Predict the ion formed by calcium, fluorine, aluminum and sulfur.

3. Write formulas for the ionic compounds of: K and Cl; Mg and O; Ca and Cl; Al and Cl.

4. Write formulas for Na with O, and for Mg with N (N forms N^{3-}).

APPLICATION

5. Copper in nature is 69.15% Cu-63 (62.9296 u) and 30.85% Cu-65 (64.9278 u). Calculate the average atomic mass.

6. Magnesium is 78.99% Mg-24 (23.98504 u), 10.00% Mg-25 (24.98584 u) and 11.01% Mg-26 (25.98259 u). Calculate its average atomic mass.

7. Use the shell model to explain why sodium and chlorine combine in a 1 : 1 ratio but magnesium and chlorine combine in a 1 : 2 ratio.

CHALLENGE

8. An element X has two isotopes: X-10 and X-11, and its average atomic mass is 10.81 u. Treating the isotope masses as exactly 10 and 11, what percentage is X-11?

REVIEW

9. What is the mass of 5.0 cm^3 of copper (density 8.96 g/cm^3)?

10. Which is more reactive, rubidium (4.18 eV) or sodium (5.14 eV)? One-sentence reason.

11. Which particle count decides the element, which decides the isotope, and which decides the charge?

Unit 1 checkpoint

1. A neutral atom has 17 protons and 18 neutrons. What is its mass number?
   A. 17
   B. 18
   C. 35
   D. 52
2. Which pair are isotopes?
   A. Na and Na⁺
   B. C-12 and C-14
   C. K-40 and Ca-40
   D. O₂ and O₃
3. Which element is most reactive?
   A. Lithium
   B. Sodium
   C. Potassium
   D. Magnesium
4. Magnesium bubbled vigorously in vinegar and copper did not. The best explanation is that
   A. copper is heavier
   B. magnesium loses its outer electrons much more easily
   C. copper is a nonmetal
   D. the copper sample was bigger
5. Aluminum forms Al³⁺ and oxygen forms O^{2−}, so aluminum oxide is Al_{_____}O_{_____}.
6. The number of protons in an atom is its _____ number.
7. True or false: First ionization energy generally increases across a period from left to right.
8. True or false: A weighted average atomic mass lies closer to the mass of the least common isotope.
9. Chlorine is 75.76% Cl-35 (34.97 u) and 24.24% Cl-37 (36.97 u). Its average atomic mass is about
   A. 35.00 u
   B. 35.45 u
   C. 36.00 u
   D. 36.50 u
10. In an engineering problem, 'the process must not use more than a set amount of fresh water' is a
    A. criterion
    B. constraint
    C. hypothesis
    D. variable
11. True or false: Graphite conducting electricity means carbon is a metal.

12. Which statement is a testable scientific question?
    A. Is gold the most beautiful metal?
    B. Does an iron nail rust faster in salt water than in tap water?
    C. Should we mine lithium?
    D. Why do people like gold?