
Welcome!

This is a chemistry lesson presenting a Cumulative Review Quiz which covers the material we have learned about scientific notation, units, atoms, and compounds.

I will be asking you many questions in this quiz.
Each time I ask a question, **you should attempt to answer the question on your own** before you scroll down to view my answer.

This is a lesson in the chapter “Atoms and Compounds”,
which is the second chapter of the course, “Chemistry, Explained Step by Step”.

This cumulative review quiz covers material from two chapters:
“Scientific Notation and Unit Conversion”, and
“Atoms, Molecules, and Compounds”.

You should complete those chapters before attempting this lesson.

CUMULATIVE REVIEW QUIZ

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1. What's the fundamental thing that determines the identity of an element?

The number of protons is the fundamental thing that determines the identity of an element.

All hydrogen atoms have 1 proton,
all helium atoms have 2 protons,
all lithium atoms have 3 protons,
all berylium atoms have 4 protons,
etc.

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2. Consider the atom represented by the symbol ^{22}Ne.
Figure out as much as you can about this atom.

From the symbol, we know that ^{22}Ne has a mass number of 22.
From the periodic table, we know that neon has an atomic number of 10.

atomic number = number of protons
mass number = number of protons + number of neutrons

From the atomic number, we know that ^{22}Ne has 10 protons,
which combined with the mass number means that it has 12 neutrons.

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3. Define the term *atomic mass*.
What are the units for atomic mass?

Naturally occurring elements are usually a *mixture* of different isotopes.
The *atomic mass* of an element is defined as
a *weighted average* of the masses of the individual isotopes in that mixture.
The units for atomic mass are amu.

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4. True or False? If false, rewrite the statement so that it is true.
When working with unit conversion,
the larger unit goes with the smaller number, and
the smaller unit goes with the larger number.

True.

You can use this slogan to check that an equation relating two units is written correctly,
to check that a conversion ratio is written correctly,
or to check that the result of a unit conversion is correct.

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5. What is the name of the compound $Cu(NO_3)_2$?

Answer: The name of $Cu(NO_3)_2$ is copper(II) nitrate.

Analysis:
$Cu(NO_3)_2$ contains a metal (copper) and two nonmetals (nitrogen and oxygen),
so $Cu(NO_3)_2$ is an ionic compound.

Copper is a transition metal that takes two possible charges,
so we have to figure out the charge on the copper.

We use the following notation to figure out
what the individual charge on the copper would have to be
in order for the compound to have zero net charge.

Group Charges	**+2**	**-2**
	Cu_1	$(NO_3)_2$
Individual Charges	?	-1

The individual charge on copper must be +2.

Therefore, the correct name for $Cu(NO_3)_2$ is copper(II) nitrate.

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6. Write 638,000,000 in scientific notation.

Answer:
638,000,000 = 6.38 × 10^{8}

Solution:

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638,000,000 = 638,000,000. × 1
            = 638,000,000. × 10^0
                    ↓        ↑
            = 6.38000000   × 10^8
            = 6.38         × 10^8
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The first step is to move the decimal point to the left eight times
and write a ↓ next to the coefficient.

This method for working with scientific notation is explained in the lesson on Scientific Notation.

Our final answer is:
638,000,000 = 6.38 × 10^{8}

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7. In the periodic table, what do the whole numbers and the decimal numbers represent? Give both the *name* and the *meaning* of each concept.

The whole numbers in the periodic table represent the *atomic number* for each element.

atomic number = number of protons

The decimal numbers in the periodic table represent the *atomic mass* for each element.
The atomic mass for an element is weighted average
of the masses of the individual isotopes in a naturally occurring sample of the element.

In the next chapter on Stoichiometry,
we will learn an alternative way to interpret the decimal numbers in the periodic table.

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8. Define the term *mass*.
What are the units for mass?
Arrange the units from biggest to smallest.
Give names and abbreviations.
Which units are most appropriate for ordinary sized objects,
and which units are most appropriate for atomic-scale objects?

The *mass* of an object is defined as
the *quantity of matter* contained in that object.

We have discussed the following units for mass, arranged from biggest to smallest:

kilograms = kg
grams = g
milligrams = mg
atomic mass units = amu

Kilograms, grams, and milligrams are most convenient for ordinary-sized objects, and
amu are most appropriate for atomic-scale objects.

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9. Complete this table.

power of 10	name	ordinary notation
10^{9}		
10^{6}		
10^{3}		
10^{2}		
10^{1}		
10^{0}		
10^{-1}		
10^{-2}		
10^{-3}		
10^{-6}		
10^{-9}		

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power of 10	name	ordinary notation
10^{9}	one billion	1,000,000,000
10^{6}	one million	1,000,000
10^{3}	one thousand	1,000
10^{2}	one hundred	100
10^{1}	ten	10
10^{0}	one	1
10^{-1}	one tenth	.1
10^{-2}	one hundredth	.01
10^{-3}	one thousandth	.001
10^{-6}	one millionth	.000 001
10^{-9}	one billionth	.000 000 001

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10. Write 9.09×10^{-5} in ordinary notation.

Answer:
$9.09 \times 10^{-5} = 0.000\ 090\ 9$

Solution:

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9.09 × 10-5 =  9.09     × 10-5
                 ↓        ↑
            = .0000909  × 10⁰
            = .0000909  × 1
            = .0000909
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The first step is to replace 10^{-5} with 10^{0}
and write a ↑ next to the power of ten.

Our final answer is:
$9.09 \times 10^{-5} = .000\ 090\ 9$

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11. Describe the particles that make up an atom.
What is the charge on each particle?
In what part of the atom is each particle located?
What is the mass of each particle, rounded to the nearest whole number of amu's?

Atoms are made up of protons, neutrons, and electrons.

A proton has +1 charge and mass of approximately 1 amu.
Protons are located in the nucleus (center) of the atom.

A neutron has 0 charge and mass of approximately 1 amu.
Neutrons are located in the nucleus.

An electron has -1 charge and mass of approximately 0 amu (when rounded to the nearest whole number).
Electrons are located outside the nucleus.

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12. Lithium has two naturally occurring isotopes, ^{6}Li (mass = 6.015122 amu, abundance = 7.59%) and ^{7}Li (mass = 7.016004 amu, abundance = 92.41%). Use this data to calculate the atomic mass of lithium.
How can you check your answer?

Answer:
The atomic mass of lithium is 6.941 amu.

Solution:
? = atomic mass of lithium

We have the masses and natural abundances of each isotope:

Lithium-6: mass = 6.015122 amu, abundance = 7.59%
Lithium-7: mass = 7.016004 amu, abundance = 92.41%

We calculate the atomic mass,
which is a weighted average of the isotopic masses:

atomic mass = 0.0759(6.015122) + 0.9241(7.016004)

So: atomic mass = 6.941 amu

So, the atomic mass of lithium is 6.941 amu.

You can check your answer by comparing it to the value reported in the periodic table.
You should find that the periodic table reports
an atomic mass for lithium of 6.941 amu,
which matches the value we calculated.

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13. Consider a nitrogen atom that contains 8 neutrons.
How would you write the symbol for this particular nitrogen atom?
Include a subscript and superscript.

Answer:
For this particular nitrogen atom, we can write its symbol as: $_{7}{}^{15}\mathrm{N}$

Analysis:
From the periodic table, we know that the atomic number for nitrogen is 7.

atomic number = number of protons

So this nitrogen atom has 7 protons.

We are told that this particular nitrogen atom has 8 neutrons.

mass number = number of protons + number of neutrons

So, for this nitrogen atom,
mass number = 7 + 8

So: mass number = 15

In this notation,
the superscript represents the *mass number*, and
the subscript represents the *atomic number*.

Therefore, the symbol for this particular nitrogen atom is: $_{7}{}^{15}\mathrm{N}$.

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14. What is the name of the compound ClF_3?

Answer:
The name of ClF_3 is chlorine trifluoride.

Analysis:
ClF_3 contains only nonmetals.
So, ClF_3 is a covalent compound.

The elements appear in the same order in the name as in the formula.

There is one chlorine atom, but the rule is that the prefix mono- is omitted for the first element in the name.
There are three fluorine atoms, so we use the prefix tri-.

Therefore, the correct name for ClF_3 is chlorine trifluoride.

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15. How do you write the formula for carbon disulfide?

Answer: The chemical formula for carbon disulfide is CS_2.

Analysis:
Carbon disulfide contains nonmetals only.
Therefore, carbon disulfide is a covalent compound.

The elements appear in the same order in the name as in the formula.
"Di-" means 2 sulfur atoms.
Since there is no prefix on carbon, one atom is implied.

Therefore, the correct formula for carbon disulfide is CS_2.

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16. What are isotopes?

Isotopes are atoms with the same number of protons but different numbers of neutrons.

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17. What is the chemical formula for sodium phosphate?

Answer: The chemical formula for sodium phosphate is Na_3PO_4.

Analysis:
Sodium phosphate contains a metal (sodium) and two nonmetals (phosphorus and oxygen).
Therefore, sodium phosphate is an ionic compound.

When writing formulas for ionic compounds, it is your job to determine the subscripts.
We choose subscripts that will result in a net charge of zero.

The following notation demonstrates that subscripts of $_3$ for Na^+ and $_1$ for PO_4^{3-} will result in a net charge of zero:

Group Charges	**+3**	**-3**
	Na_3	$(PO_4)_1$
Individual Charges	+1	-3

Therefore, the correct formula for sodium phosphate is Na_3PO_4.

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18. What is the definition of atomic number?
What is the symbol for atomic number?
What are the units for atomic number?
If you know the name of an element, is it possible to determine its atomic number from the periodic table?

Atomic number = number of protons

Atomic number = Z

Atomic number is a unitless concept.

If you know the name of an element, then *yes*, it is possible to determine its atomic number from the periodic table:

The whole numbers in the periodic table represent the atomic numbers for each element.

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19. What are ions?

An ion is an atom or a group of atoms with a net electric charge.

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20. What is the definition of mass number?
What is an alternative interpretation of the mass number of an atom?
What is the symbol for mass number?
What are the units for mass number?

Mass number = number of protons + number of neutrons

Mass number = A

Mass number is a unitless concept.

The mass number of an atom can also be interpreted as
the numerical value of the mass of the atom when expressed in amu,
rounded to the nearest whole number.

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21. Write two conversion ratios between kPa and Pa.
Write two conversion ratios between mg and g.

$$\frac{1\ \text{kPa}}{10^3\ \text{Pa}} \quad \text{and} \quad \frac{10^3\ \text{Pa}}{1\ \text{kPa}}$$

$$\frac{1\ \text{mg}}{10^{-3}\ \text{g}} \quad \text{and} \quad \frac{10^{-3}\ \text{g}}{1\ \text{mg}}$$

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22. What is the atomic symbol for potassium?

The atomic symbol for potassium is K.

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23. From memory, write down the full Metric Prefix Table. Include:
the name of each prefix, the abbreviation, the power of ten, and the name of the number it represents.
Arrange the table from the prefix that represents the biggest number, at the top, to the prefix that represents the smallest number, at the bottom. Include the number 1 in the table, so that the table will indicate which metric prefixes represent numbers that are bigger than 1, and which represent numbers that are less than 1.

Here is the Metric Prefix Table:

giga	$G = 10^{9}$	one billion
mega	$M = 10^{6}$	one million
kilo	$k = 10^{3}$	one thousand
	10^{0}	one
centi	$c = 10^{-2}$	one hundredth
milli	$m = 10^{-3}$	one thousandth
micro	$\mu = 10^{-6}$	one millionth
nano	$n = 10^{-9}$	one billionth

You have reached the end of this Cumulative Review Quiz.

The next lesson is not yet available.
When it is available, you should be able to find the next lesson on my website