General Chemistry I

Chapter 2: Isotopes and Nuclear chemistry
Dr. Stone

CHEM 1100 Exam 1 Fall 2017 Dr Stone **Name: _____ ID: A**

Exam 1: Useful equations and constants

D = m/v	2.205 lbs = kg	28.35 g = ounce (dry)
0.62 miles = km	2.54 cm = inch	29.57 mL = ounce (liquid)
1.05669 qt = L	K = 273.15 + C	mL = cm^3

$$F = \frac{9}{5}C + 32$$

Multiple Choice

*Identify the choice that **best** completes the statement or answers the question. Put your answer **on this test and on your scantron**. You will not get your scantron back. You will be able to view your scantron in Dr. Stone's office.*

How many pm are in 20 nm?

A. 2.0×10^{4} pm

B. 20×10^{3} pm

C. 2.0×10^{-2} pm

D. 2.0×10^{22} pm

E. None of these

How many pm are in 20 nm?

A. 2.0×10^4 pm

B. 20×10^3 pm

C. 2.0×10^{-2} pm

D. 2.0×10^{22} pm

E. None of these

$$20\text{nm} \times \frac{\text{m}}{1 \times 10^9\text{nm}} \times \frac{1 \times 10^{12}\text{pm}}{\text{m}}$$

Isotope Abundance

The number under each element is a **weighted average** of the percent abundance of all the isotopic masses.

Carbon has 3 naturally occurring isotopes: ^{12}C, ^{13}C, ^{14}C

^{12}C is present in **98.930%** of a sample of carbon
^{13}C is present in **1.0700**% of a sample of carbon
^{14}C is present in a very small amount, so it is not included

Isotope	Mass	**weighted average:** Mass x %/100%.
Carbon-12	12.000000 amu.	12.0000000 x **98.930**/100 = 11.8716
Carbon-13	13.003355 amu.	13.003355 x **1.0700**/100 = .1391
		Total = 12.0107
		= 12.011 amu

What is the abundance of each isotope of Bromine?

The masses of each isotope are:
$^{79}Br = 78.9183$
$^{81}Br = 80.9163$
The weighted average is 79.9091

A. ^{79}Br =49.6%, ^{81}Br = 50.4%
B. ^{79}Br = 50.4%, ^{81}Br = 49.6%
C. ^{79}Br =70.3%, ^{81}Br = 29.7%
D. ^{79}Br =29.7%, ^{81}Br = 70.3%
E. None of these

Use 2 equations to solve for 2 unknowns

1. The first equation is that sum of both isotopes is 100%: % ^{79}Br + % ^{81}Br =100%, divide all by 100 to remove %

2. Let x = fraction of ^{79}Br and y = fraction of ^{81}Br: x+ y = 1

3. The second equation is the weighted average:

   x (mass ^{79}Br) + y (mass ^{81}Br) = weighted average

4. Rearrange the first equation to solve for y: y = 1-x

5. Substitute the rearranged y=1-x into the second equation.

   x (mass ^{79}Br) + (1-x)(mass ^{81}Br). = weighted average

6. Put in values and calculate

Calculate the % abundance of Bromine isotopes

The masses of each isotope are:

^{79}Br = **78.9183**, % ^{79}Br/100% = x

^{81}Br = **80.9163**, % ^{81}Br/100% = y

The weighted average is **79.9091**

x + y =1, y = 1-x

x(**78.9183**) + y(**80.9163**) = **79.9091**

x(78.9183) + (1-x)(80.9163) = 79.9091

Distribute

x(78.9183) + 80.9163 - 80.9163x = 79.9091

Combine terms:-1.998x = -1.0072

Solve for x:

$x = \frac{-1.0072}{-1.998} = 0.504$ Multiply by 100% to get % = 50.4% ^{79}Br

What is the abundance of each isotope of Bromine?

The masses of each isotope are:

$^{81}Br = 78.9183$

$^{79}Br = 80.9163$

The weighted average is 79.9091

A. ^{79}Br =49.6%, ^{81}Br = 50.4%

B. ^{79}Br =50.4%, ^{81}Br = 49.6%

C. ^{79}Br =70.3%, ^{81}Br = 29.7%

D. ^{79}Br =29.7%, ^{81}Br = 70.3%

E. None of these

Nuclear Chemistry

These particles can come out of a nucleus:

Name of particle	Symbol	Mass	Charge
Alpha	$^{4}_{2}He$	4 amu	2
Beta	$^{0}_{-1}e$	$\frac{1}{1822}$ amu	-1
Gamma	γ	No mass	No charge
Neutron	$^{1}_{0}n$	1 amu	No charge

What experiment used alpha particles?

A. Thompson cathode ray

B. Millikan oil drop

C. Marsden-Geiger-Rutherford Gold Foil

D. Millikan cathode ray

E. None of these

What experiment used alpha particles?

A. Thompson cathode ray

B. Millikan oil drop

C. Marsden-Geiger-Rutherford Gold Foil

D. Millikan cathode ray

E. None of these

Nuclear Chemistry reactions:

Balance total mass numbers and total charge on each side of the equation:

Carbon-14 is a beta emitter:

$$^{14}_{6}C \rightarrow ^{0}_{-1}e + ^{14}_{7}N$$

What is the new element when Radon-222 emits an alpha particle?

$$^{222}_{86}Rn \rightarrow {}^{4}_{2}He + \_\_\_\_\_$$

$$^{222}_{86}Rn \rightarrow {}^{4}_{2}He + {}^{218}_{84}Po$$

What is the correct name for Fe_2O_3

A. Iron(II) oxide

B. Diiron trioxide

C. Iron oxide

D. Iron(III) oxide

E. None of these

What is the correct name for Fe_2O_3

A. Iron(II) oxide

B. Diiron trioxide

C. Iron oxide

D. Iron(III) oxide

E. None of these

What is the formula for dinitrogen tetroxide?

A. N_2O_3

B. N_2O_4

C. $NaNO_3$

D. N_2O_6

E. None of these

What is the formula for dinitrogen tetroxide?

A. N_2O_3

B. N_2O_4

C. $NaNO_3$

D. N_2O_6

E. None of these

What is the speed of a 98.2mph baseball in m/sec?

Given on the test: 0.62 miles = Km

A. 1.69×10^{1} m/sec

B. 43.9996415 m/sec

C. 4.40×10^{1} m/sec

D. 5.70×10^{8} m/sec

E. None of these

What is the speed of a 98.2mph baseball in m/sec?

Given on the test: 0.62 miles = Km

A. 1.69×10^{1} m/sec

B. 43.9996415 m/sec

C. 4.40×10^{1} m/sec

D. 5.70×10^{8} m/sec

E. None of these

What is the speed of a 98.2 mph baseball in m/sec?

$$\frac{98.2 \text{ miles}}{} \times \frac{\text{Km}}{0.620 \text{miles}} \times \frac{1000\text{m}}{\text{Km}} \times \frac{\text{hr}}{60 \text{ min}} \times \frac{\text{min}}{60\text{sec}}$$

= 43.9964 m/sec

Scientific notation and significant figures:

$= 4.40 \times 10^{1}$ m/sec

What is the speed of a 98.2 mph baseball in m/sec?

$$\frac{98.2\ \text{miles}}{\text{hr}} \times \frac{\text{Km}}{0.620\ \text{miles}} \times \frac{1000\text{m}}{\text{Km}} \times \frac{\text{hr}}{60\ \text{min}} \times \frac{\text{min}}{60\text{sec}}$$

= 43.9964 m/sec

Scientific notation and significant figures:

$= 4.40 \times 10^{1}$ m/sec

Sodium nitrite, which is used in meat processing, has been implicated as a possible health hazard because it can react with amines present in meat to form trace quantities of carcinogenic nitrosamines. What is the formula of sodium nitrite?

a. Na_2NO_3 b. $NaNO_2$ c. $NaNO_3$ d. Na_2NO_4 e. Na_2NO_2

Sodium nitrite, which is used in meat processing, has been implicated as a possible health hazard because it can react with amines present in meat to form trace quantities of carcinogenic nitrosamines. What is the formula of sodium nitrite?

a. Na_2NO_3 b. $NaNO_2$ c. $NaNO_3$ d. Na_2NO_4 e. Na_2NO_2

What is the symbol of the ion having 17 protons and 18 electrons?

A. S^{2-}
B. Cl
C. Cl^{-}
D. Cl^{+}
E. K^{+}

What is the symbol of the ion having 17 protons and 18 electrons?

A. S^{2-}
B. Cl
C. Cl^{-}
D. Cl^{+}
E. K^{+}

Which stellar nuclear reaction is *not* correctly written?

a. $^{65}_{29}\mathrm{Cu} + 3\,^{1}_{0}\mathrm{n} \rightarrow {}^{68}_{30}\mathrm{Zn} + {}^{0}_{1-}\beta$

b. $^{32}_{16}\mathrm{S} + {}^{4}_{2}\alpha \rightarrow {}^{36}_{18}\mathrm{Ar}$

c. $^{108}_{47}\mathrm{Ag} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{109}_{47}\mathrm{Ag} + {}^{0}_{1-}\beta$

d. $^{68}_{30}\mathrm{Zn} + 2\,^{1}_{0}\mathrm{n} \rightarrow {}^{70}_{31}\mathrm{Ga} + {}^{0}_{1-}\beta$

e. They are all correct

Which stellar nuclear reaction is *not* correctly written?

a. $^{65}_{29}\mathrm{Cu} + 3\,^{1}_{0}\mathrm{n} \rightarrow {}^{68}_{30}\mathrm{Zn} + {}^{0}_{1-}\beta$

b. $^{32}_{16}\mathrm{S} + {}^{4}_{2}\alpha \rightarrow {}^{36}_{18}\mathrm{Ar}$

c. $^{108}_{47}\mathrm{Ag} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{109}_{47}\mathrm{Ag} + {}^{0}_{1-}\beta$

d. $^{68}_{30}\mathrm{Zn} + 2\,^{1}_{0}\mathrm{n} \rightarrow {}^{70}_{31}\mathrm{Ga} + {}^{0}_{1-}\beta$

e. They are all correct