

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

$$D = m/v$$

$$0.62 \text{ miles} = \text{km}$$

$$1.05669 \text{ qt} = \text{L}$$

$$2.205 \text{ lbs} = \text{kg}$$

$$2.54 \text{ cm} = \text{inch}$$

$$K = 273.15 + C$$

$$28.35 \text{ g} = \text{ounce (dry)}$$

$$29.57 \text{ mL} = \text{ounce (liquid)}$$

$$\text{mL} = \text{cm}^3$$

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

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

C. 2.0×10^{-2} pm

D. 2.0×10^{22} pm

E. None of these

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 = <u>.1391</u>
		Total = 12.0107
		= 12.011 amu

What is the abundance of each isotope of Bromine?

The masses of each isotope are:

$${}^{79}\text{Br} = 78.9183$$

$${}^{81}\text{Br} = 80.9163$$

The weighted average is 79.9091

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

Use 2 equations to solve for 2 unknowns

1. The first equation is that sum of both isotopes is 100%: $\% \text{ } ^{79}\text{Br} + \% \text{ } ^{81}\text{Br} = 100\%$, 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:

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

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

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

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

6. Put in values and calculate

Calculate the % abundance of Bromine isotopes

The masses of each isotope are:

$${}^{79}\text{Br} = \mathbf{78.9183}, \quad \% {}^{79}\text{Br}/100\% = x$$

$${}^{81}\text{Br} = \mathbf{80.9163}, \quad \% {}^{81}\text{Br}/100\% = y$$

The weighted average is **79.9091**

$$x + y = 1, \quad y = 1 - x$$

$$x(\mathbf{78.9183}) + y(\mathbf{80.9163}) = \mathbf{79.9091}$$

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

Distribute

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

$$\text{Combine terms: } -1.998x = -1.0072$$

Solve for x:

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

What is the abundance of each isotope of Bromine?

The masses of each isotope are:

$$^{81}\text{Br} = 78.9183$$

$$^{79}\text{Br} = 80.9163$$

The weighted average is 79.9091

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

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

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

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

E. None of these

Nuclear Chemistry

These particles can come out of a nucleus:

Name of particle	Symbol	Mass	Charge
Alpha	${}^4_2\text{He}$	4 amu	2
Beta	${}^0_{-1}\text{e}$	$\frac{1}{1822}$ amu	-1
Gamma	γ	No mass	No charge
Neutron	${}^1_0\text{n}$	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

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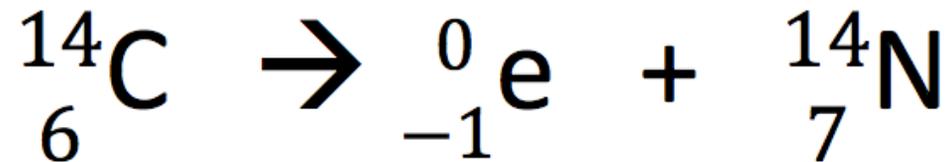
D. Millikan cathode ray

E. None of these

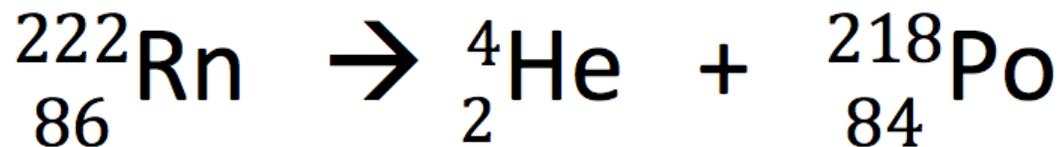
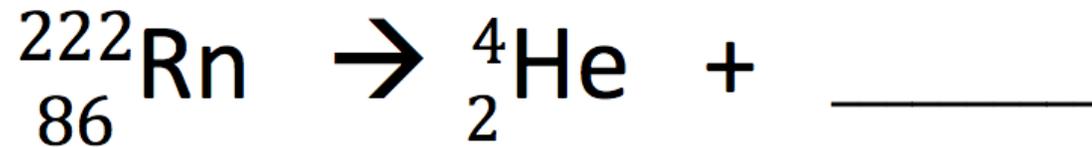
Nuclear Chemistry reactions:

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

Carbon-14 is a beta emitter:



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



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

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What is the formula for dinitrogen tetroxide?



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

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E. None of these

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

$$\frac{98.2 \text{ miles}}{1} \times \frac{1.60934 \text{ Km}}{0.620 \text{ miles}} \times \frac{1000 \text{ m}}{1 \text{ Km}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}}$$

$$= 43.9964 \text{ m/sec}$$

Scientific notation and significant figures:

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

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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-}

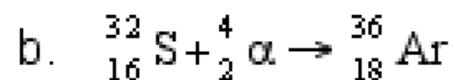
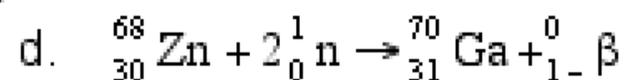
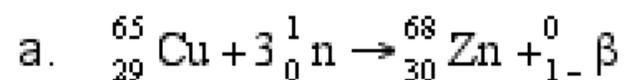
B. Cl

C. Cl^{-}

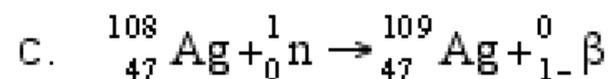
D. Cl^{+}

E. K^{+}

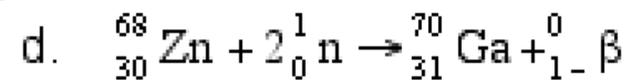
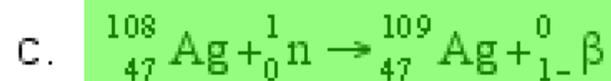
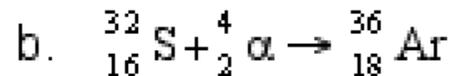
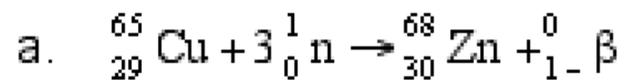
Which stellar nuclear reaction is *not* correctly written?



e. They are all correct



Which stellar nuclear reaction is *not* correctly written?



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