CHEM 4 lecture

Friday – September 11, 2020

Sec 4.9

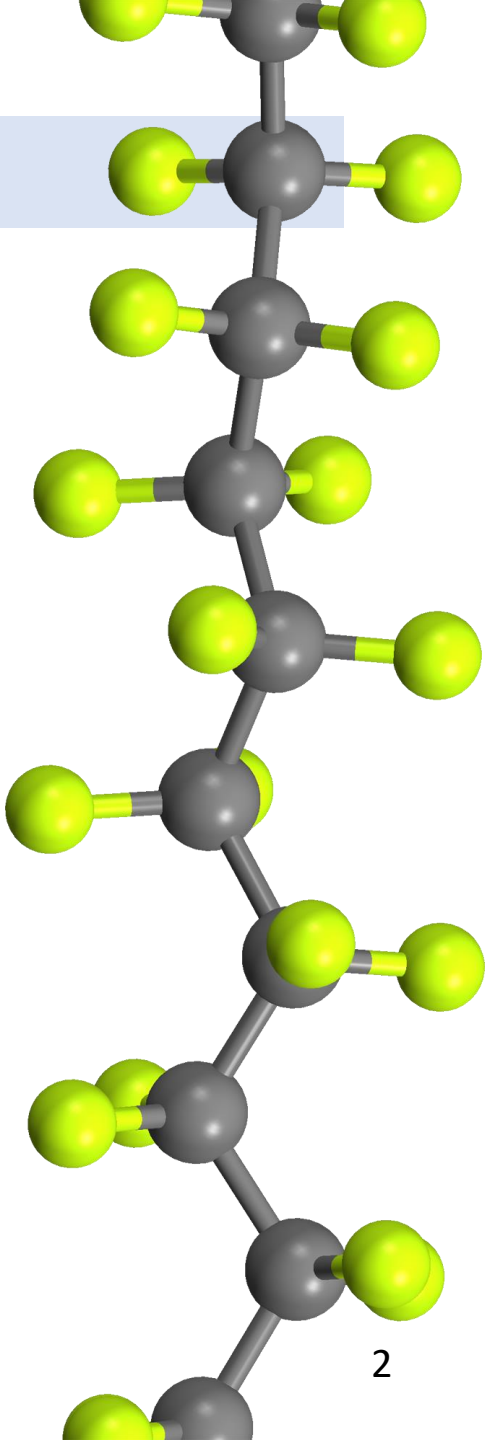
Atomic Mass

Are up keeping up with CHEM 4?

- ✓ **Website:** tinyurl.com/SacStateChem4
  - ✓ Check our **August/September calendar** (not Canvas) for daily assignments.
  - ✓ PowerPoint slides, reading assignments, and links to homework.

- ✓ **Optional:**
  - ✓ **Peer Assisted Learning** (PAL) – MW 12 noon is full.
  - ✓ **Commit to Study** (C2S) – Allows you to drop lowest exam.

- ✓ **Clickers count for points:**
  - ✓ Automatic 2 pts for each time you vote (right or wrong).
  - ✓ If you are here, but unable to vote, message me in Zoom chat.



Review clicker question (covers material from last class)
Go to LearningCatalytics.com and login with your MasteringChemistry login.

1) Based on what we have learned so far this semester which of the following statements is false? Feel free to use a **periodic table**.

A) A neutral atom of Sr-87 has 38 electrons.

B) An atom of Sr-87 has 49 neutrons.

C) All of positive charge in an atom of Sr-87 is contained in the nucleus.

D) An atom of Sr-87 is almost entirely empty space.

E) An atom of Sr-87 has the same mass as an atom of Sr-90.

F) Most of the mass of an atom of Sr-87 is contained in its small, dense nucleus.

Reading clicker question (covers material from today's assigned reading)
Go to LearningCatalytics.com and login with your MasteringChemistry login.

2) Based on your assigned reading for today (Sec 4.9) which of the following statements is false?

A) The atomic mass for carbon on our periodic table is 12.01 g.

B) The atomic mass is an average mass for an element, accounting for the masses of its isotopes and their abundances.

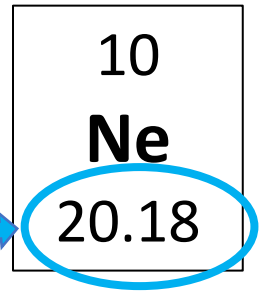
C) Any given element may have many different isotopes, but only 1 atomic number.

D) Some isotopes are not stable and can transform into other elements.

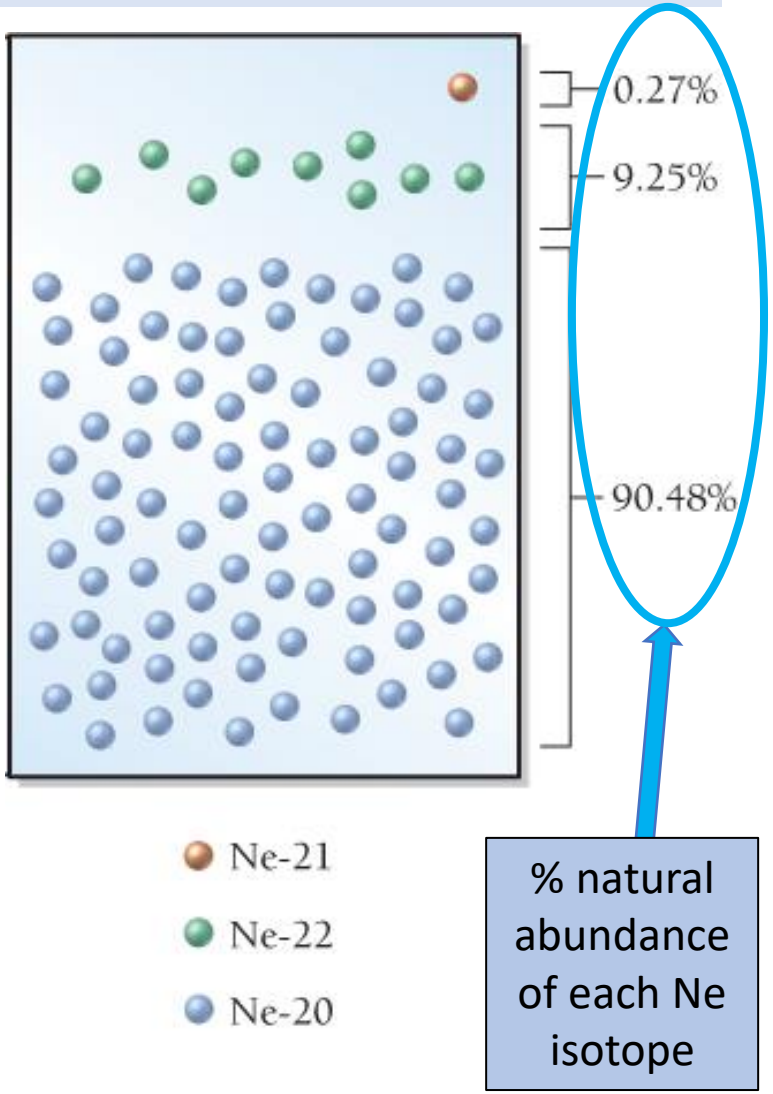
E) For an element having 2 different isotopes, its atomic mass will be closer to the mass of the most commonly occurring isotope.

Background: Atomic mass

- Let's look at Ne on the periodic table:



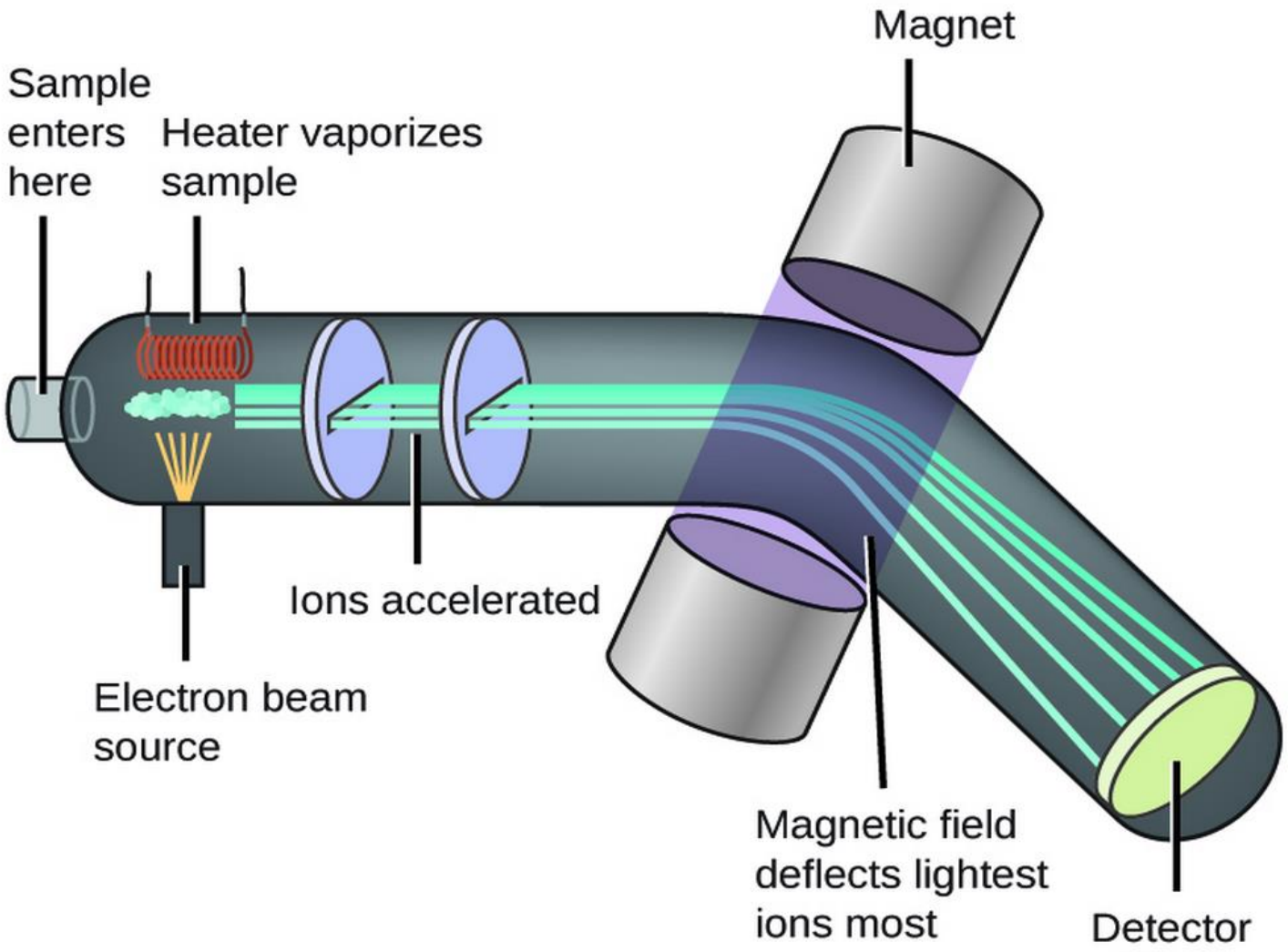
- This is the **atomic mass**.
- The units of atomic mass are **atomic mass units** (amu).
- There isn't a single Ne atom in the whole universe that actually has a mass of 20.18 amu.
- The **atomic mass** is the *weighted* average of the element taking into account the masses of all of its different isotopes and their **% natural abundances**.



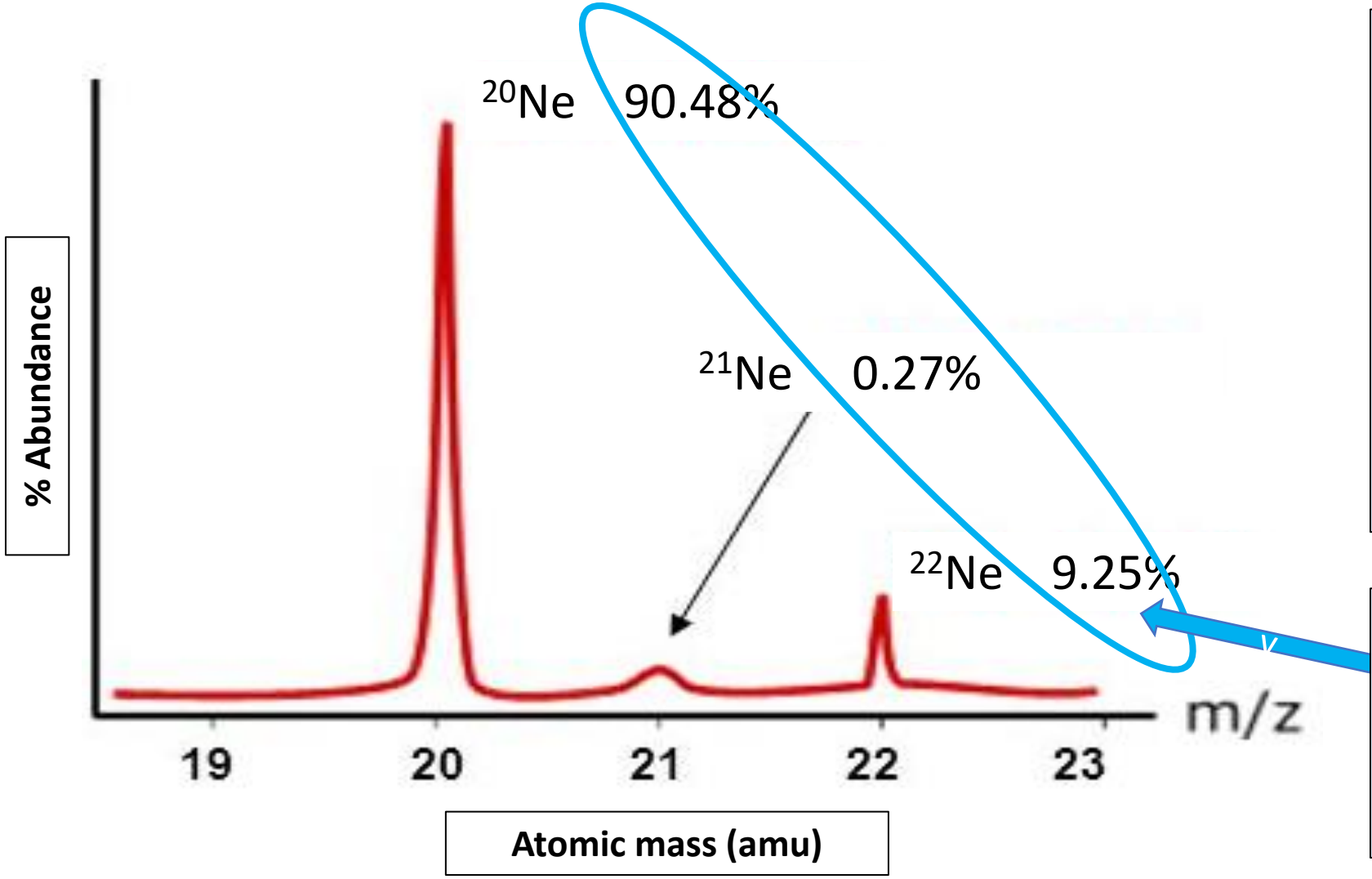
- How do scientist know the masses and % abundance for an atom's isotopes? They use a **mass spectrometer**…

Background: Mass Spectrometer (measuring isotope mass and % abundance)

Background: Mass Spectrometer (measuring isotope mass and % abundance)



Background: Mass spectra of neon



In addition to telling us that neon has 3 isotopes, the mass spectrometer also provides the mass (x-axis) and the % abundance (y-axis) for each isotope.

Notice: the % abundance of all the isotopes must add up to 100%

Background: Calculating atomic mass

- Calculate the atomic mass of neon given the following Mass Spectrometer data:

Isotope	Mass	% abundance
Ne-20	19.9924 amu	90.48 %
Ne-21	20.9939 amu	0.27 %
Ne-22	21.9914 amu	9.25 %

÷ by 100% to convert "% abundance" into "fraction"

Atomic mass = (fraction isotope 1)(mass isotope 1) + (fraction isotope 2)(mass isotope 2) + …

= (0.9048)(19.9924) + (0.0027)(20.9939) + (0.0925)(21.9914)

= 18.089 + 0.056684 + 2.0342

= 20.179884

Atomic mass = 20.18 amu

goes on periodic table

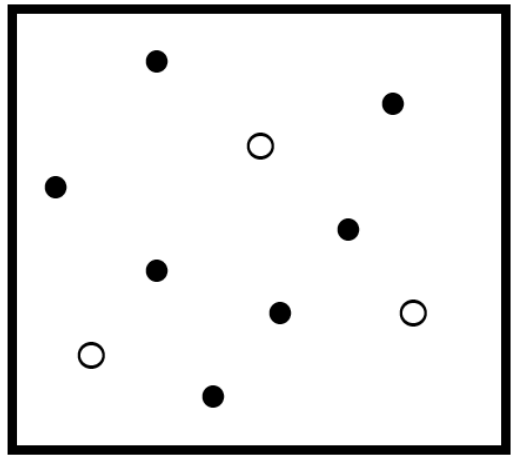
10
Ne
20.18

Closest to the mass of Ne-20 since that isotope is present in the highest abundance

Progress clicker question (covers material we are learning now)

3) Over the weekend, Jeff created a new element (Z = 130) and named it jeffrium (symbol = Jf). A sample of 10 atoms of Jf indicating the % abundance of its 2 isotopes is shown in the box below. What atomic mass should be written on the periodic table for Jf?

A) 130 amu
B) 335.8 amu
C) 336.4 amu
D) 337.0 amu
E) 337.4 amu
F) 338.2 amu



KEY
○ Jf-335 (334.9 amu)
● Jf-338 (337.9 amu)

Answer: The drawing shows ten atoms of Jf with 3 out of 10 (i.e. 30%) being Jf-335 and 7 out of 10 (i.e. 70%) being Jf-338.

Atomic mass = (0.30)(334.9 amu) + (0.70)(337.9 amu)

= 100.47 amu + 236.53 amu

= 337.0 amu

Progress clicker question: More practice calculating atomic mass

4) Silver has two naturally occurring isotopes: Ag-107 and Ag-109. If Ag-107 has a mass of 106.905 amu and an abundance of 51.84%, what is the mass of Ag-109?

A) 107.87 amu
B) 108.97 amu
C) 52.45 amu
D) 55.42 amu
E) 52.49 amu
F) 108.84 amu

47
Ag
107.9

from periodic table | given | given | = 100% - other % | unknown

Atomic mass = (fraction isotope 1)(mass isotope 1) + (fraction isotope 2)(mass isotope 2)

Answer: 107.9 amu = (0.5184)(106.905 amu) + (0.4816)(**X**)

107.9 amu = 55.420 amu + 0.4816(**X**)

52.48 amu = 0.4816(**X**)

X = **108.97 amu**

Challenge question: Prepare for start of next class.

Rubidium has two isotopes: Rb-85 (mass = 84.9118 amu) and Rb-87 (mass = 86.9092 amu). What is the % abundance of the lighter isotope?

A) roughly 26%
B) roughly 28%
C) roughly 30%
D) roughly 31%
E) roughly 69%
F) roughly 70%
G) roughly 72%
H) roughly 74%

37
Rb
85.47

from periodic table | Unknown = **X** | given | Unknown = **Y** | given

Atomic mass = (fraction isotope 1)(mass isotope 1) + (fraction isotope 2)(mass isotope 2)