PhET INTERACTIVE SIMULATIONS

Clicker Questions for *Isotopes and Atomic Mass*

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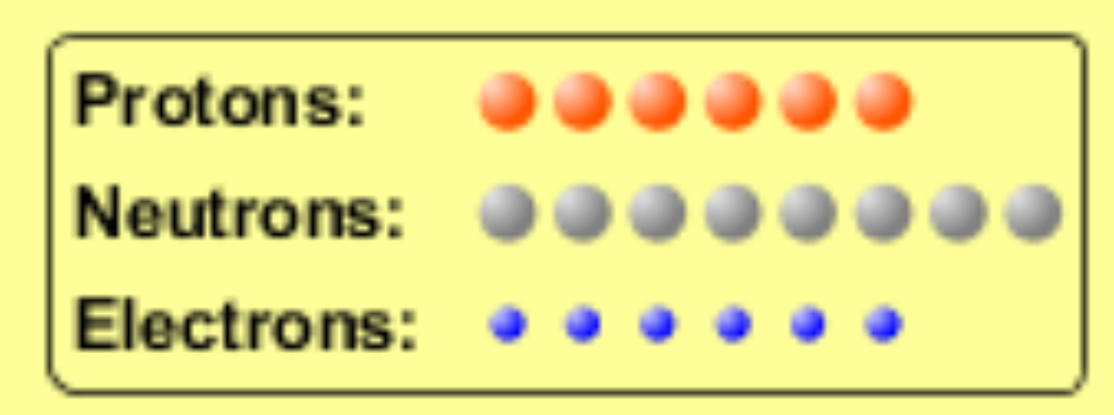
COURSE:

Introductory Chemistry

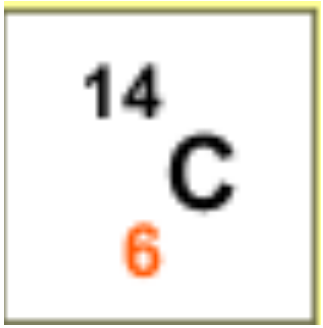
What would this be?

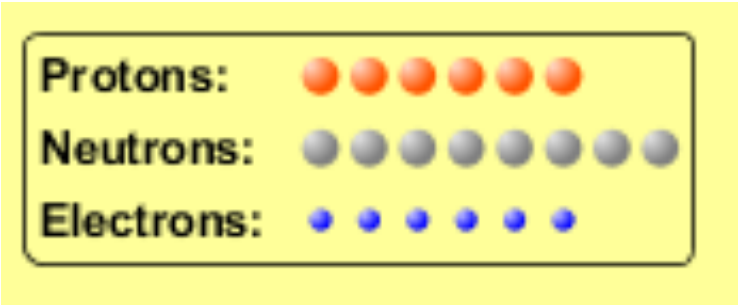
a. Carbon-12
b. Carbon-14
c. Oxygen-14
d. More than one of these



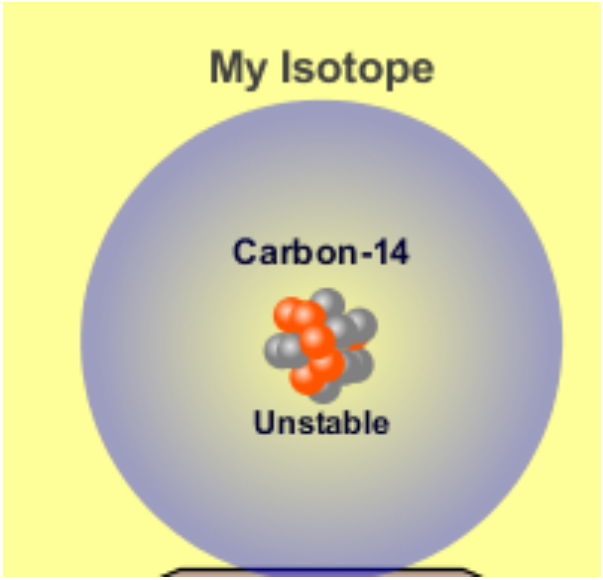
Reason:

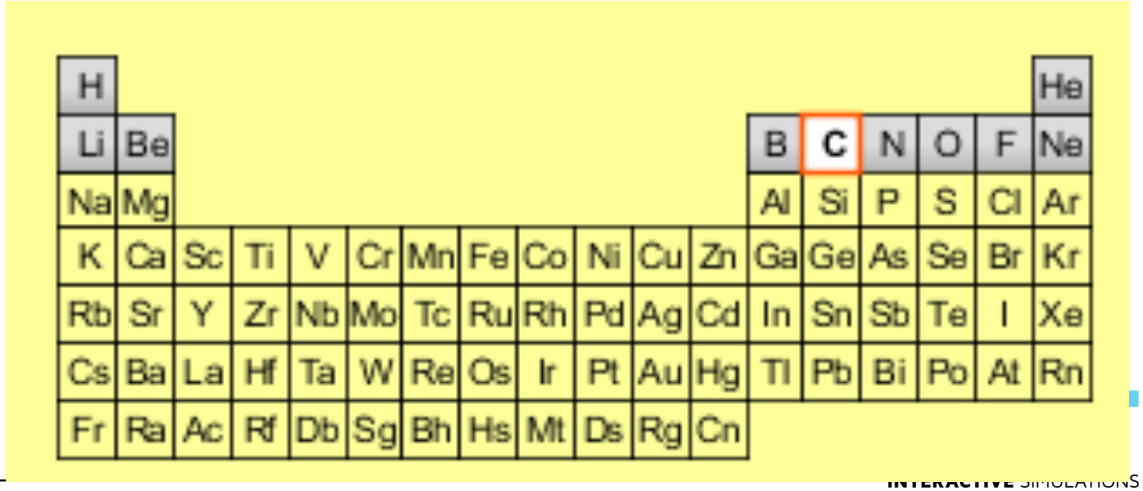
The number of protons tells the name of the atom; the mass is given by the sum of protons and neutrons





6 protons +8 neutrons

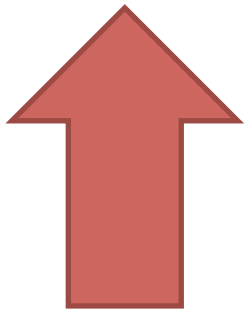




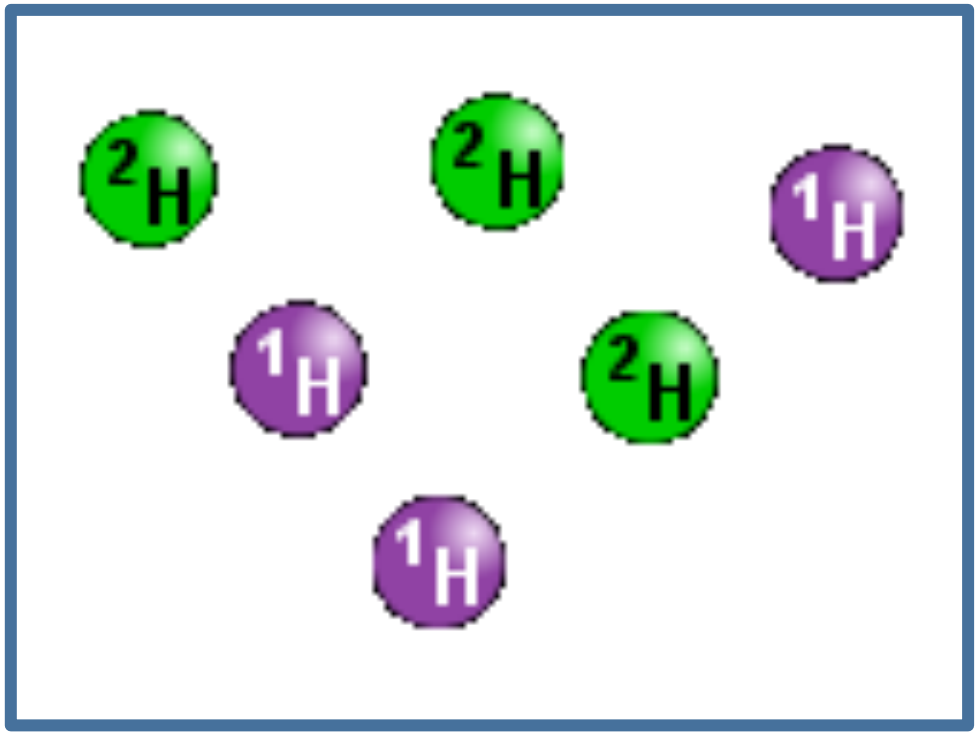
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn						

Which of these pairs of atoms are isotopes?

	Pair A		Pair B		Pair C	
# of protons	6	8	5	2	12	12
# of neutrons	8	8	5	3	12	14



What is the approximate average mass of a hydrogen atom in this sample?



a. 6 amu

b. 2 amu

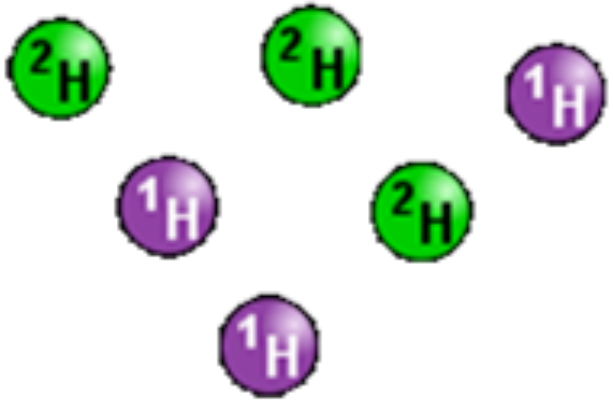
c. 1.5 amu

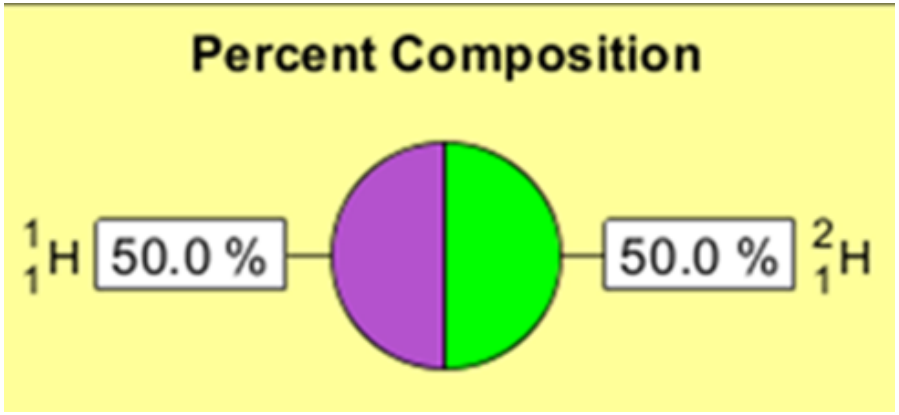
d. 1 amu

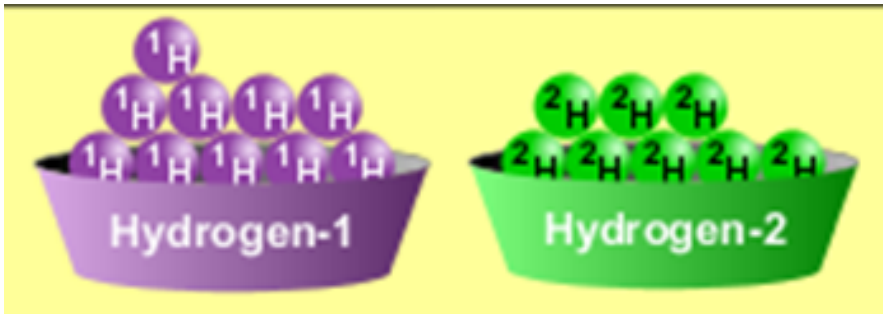
Reason: 3/6 gives 50% of each, so…

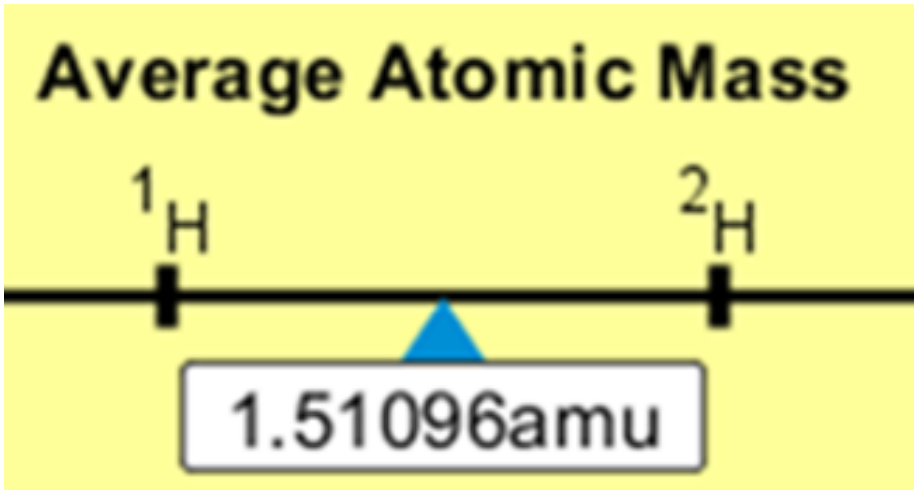
0.5*2 + 0.5*1 = 1.5 amu

or 3*2 + 2*1 = 1.5 amu









Why are there more digits in the answer in the sim?

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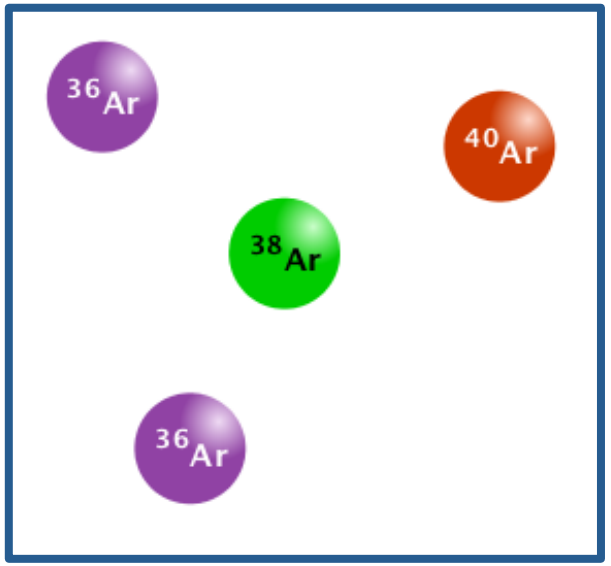
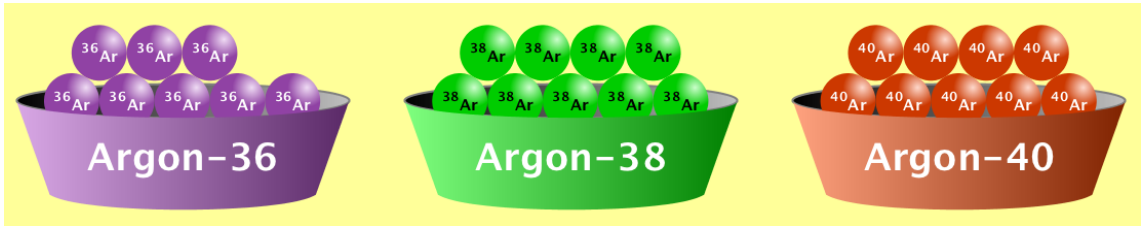
What is the approximate average mass of an argon atom in this sample?

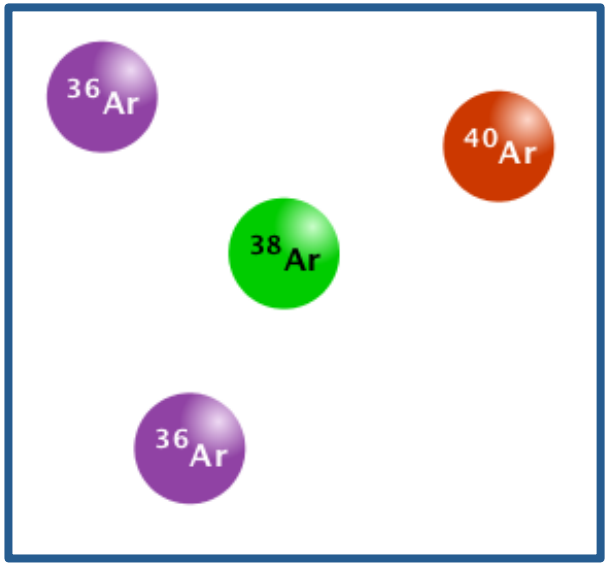


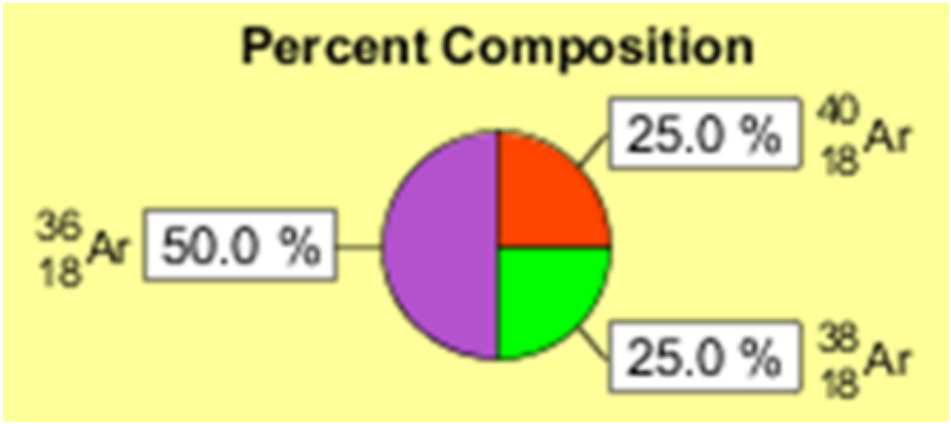
a. 40 amu b. 38 amu c. 37.5 amu

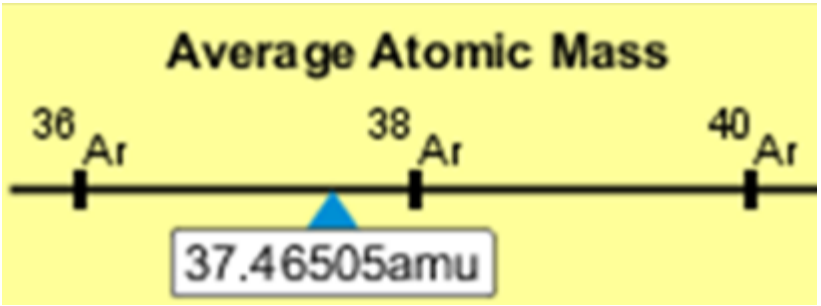
Calculation:

0.5*36 + 0.25*38 + 0.25*40 = 37.5 amu









	Number of $^{6}_{3}Li$ atoms Mass of 1 atom = 6.01512 amu	Number of $^{7}_{3}Li$ atoms Mass of 1 atom = 7.01600 amu	Average atomic mass of sample (amu)
Sample 1	3	2	6.41548
Sample 2	6	4	

Is the average atomic mass closer to the mass of a lithium-6 atom or a lithium-7 atom?

a. Lithium-6

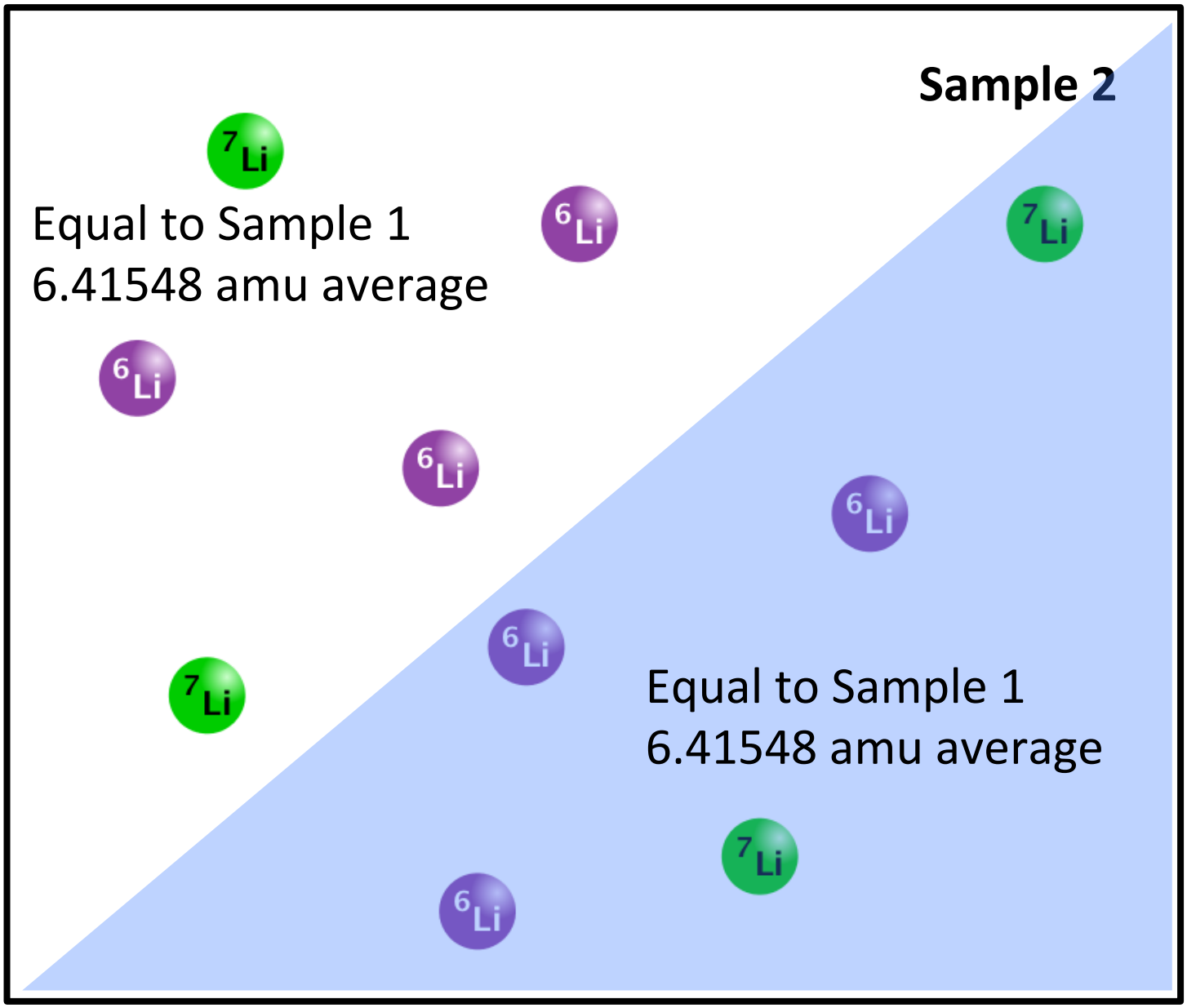
b. Lithium-7

To figure this out, let's start with some small samples…

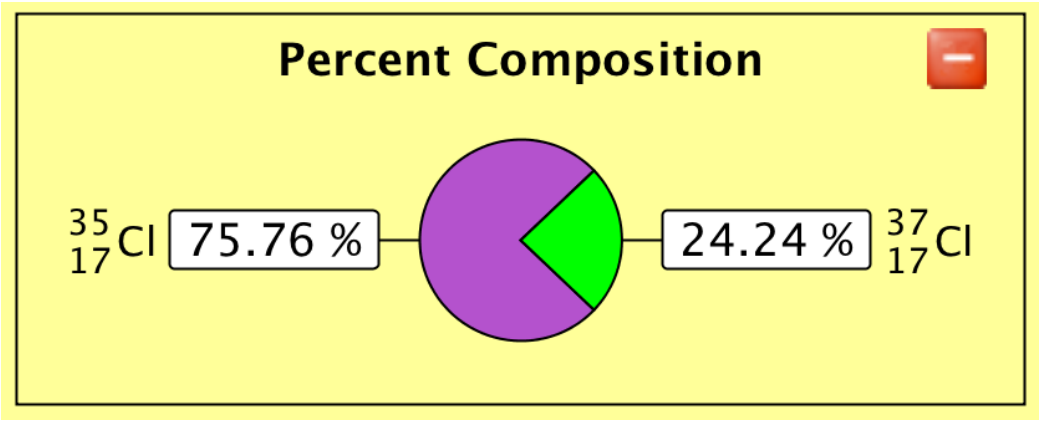
	Number of $^{6}_{3}Li$ atoms Mass of 1 atom = 6.01512 amu	**Number of $^{7}_{3}Li$ atoms** Mass of 1 atom = 7.01600 amu	**Average atomic mass of sample (amu)**
Sample 1	3	2	6.41548
Sample 2	6	4	**?**

Will the average atomic mass of sample 2 be…

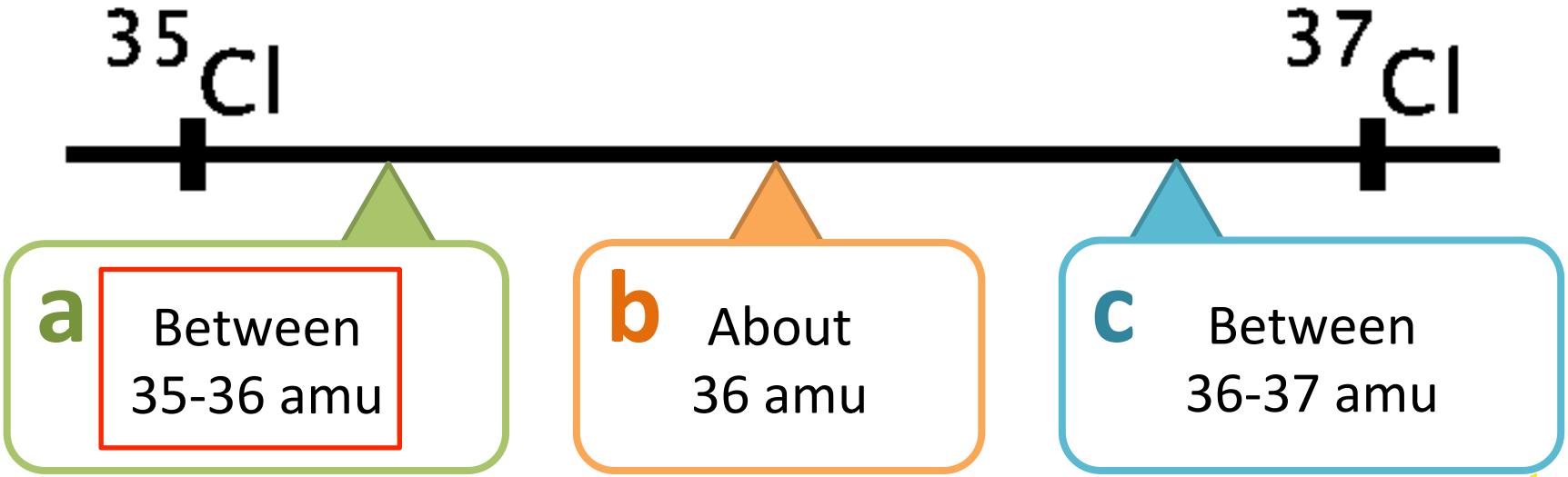
a. More than Sample 1
b. Same as Sample 1
c. Less than Sample 1
d. I don't know how to determine this.


Sample 2
7Li
Equal to Sample 1
6.41548 amu average
6Li
7Li
6Li
6Li
6Li
6Li
7Li
Equal to Sample 1
6.41548 amu average
7Li
6Li

In nature, chlorine has the following composition:



The average atomic mass of a natural sample of chlorine is…



Neon has three naturally occurring isotopes:

^{20}Ne	19.992 amu
^{21}Ne	20.994 amu
^{22}Ne	21.991 amu

10
Ne
20.18

Which isotope has the highest natural abundance?

a. ^{20}Ne
b. ^{21}Ne
c. ^{22}Ne
d. All isotopes have the same abundance
e. Impossible to tell from this information

Magnesium has three naturally occurring isotopes:

^{24}Mg	23.985 amu
^{25}Mg	24.986 amu
^{26}Mg	25.983 amu

In a sample with an average atomic mass of 24.98 amu, which isotope is the most abundant?

a. ^{24}Mg
b. ^{25}Mg
c. ^{26}Mg
d. All isotopes have the same abundance
e. Impossible to tell from this information

Neon has three naturally occurring isotopes:

10
Ne
20.18

^{20}Ne

^{21}Ne

^{22}Ne

Which isotope has the highest natural abundance?

Can we answer the question without being given the exact isotopic masses?

a. Yes

b. No

Neon has three naturally occurring isotopes:

^{20}Ne

^{21}Ne

^{22}Ne

Which isotope has the highest abundance *in a sample of Ne*?

Can we answer the question without being given the average atomic mass of the sample?

a. Yes

b. No

Neon has three naturally occurring isotopes:

^{20}Ne

^{21}Ne

^{22}Ne

Which isotope has the highest abundance in a sample of Ne with average atomic mass of _____?

Can we answer the question for any sample, no matter what the average atomic mass?

a. Yes

b. No

Challenge problem:

Argon has three stable isotopes, with these atomic masses:

^{36}Ar	35.968 amu
^{38}Ar	37.963 amu
^{40}Ar	39.962 amu

You measure the average atomic mass of several different samples of argon, and are asked to predict the most abundant isotope in each sample.

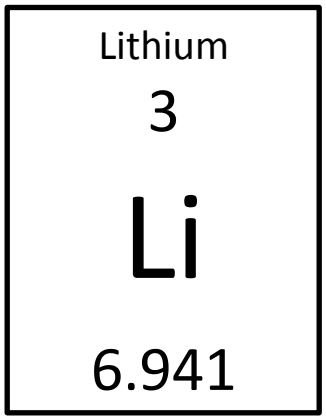
For which of these samples is this prediction **impossible**?

Sample A, a naturally-occurring sample of argon

Sample B, average atomic mass = 36.5 amu

Sample C, average atomic mass = 37.5 amu

Sample D, average atomic mass = 39.5 amu



Complete the following sentence with a unit.

On average, lithium weighs 6.941 ____.

a. g / atom
b. g / mol
c. amu / mol
d. amu / atom
e. More than one of the above