WKS 4-2
Atomic Structure & Isotopes

Name Answer Key
Period _____ **Date** _____

1) List the location and properties of the three fundamental subatomic particles.

Proton: p^+, ${}^{1}_{1}p$; ${}^{1}_{1}H$: in nucleus, has charge of +1, mass of 1.0073 amu

Neutron: n^0, ${}^{1}_{0}n$: in nucleus, charge of 0, mass of 1.0089 amu

Electron e^-, ${}^{0}_{-1}e$: in electron cloud, charge of –1, mass of $1/1823$ amu

2) What are isotopes? What is the mass number and how does it relate to isotopes?

Atoms of the same element with different numbers of neutrons and so different mass numbers.

3) Complete the table below. All atoms are electrically neutral.

Isotope Name	Symbol	Atomic Number	# Protons	# Neutrons	Mass Number
a) Calcium-40	${}^{40}_{20}Ca$	20	20	20	40
b) Helium-4	${}^{4}_{2}He$	2	2	2	4
c) Osmium-190	${}^{190}_{76}Os$	76	76	114	190
d) Neon-22	${}^{22}_{10}Ne$	10	10	12	22
e) Californium-252	${}^{252}_{98}Cf$	98	98	154	252
f) Zinc-65	${}^{65}_{30}Zn$	30	30	35	65

4) Iridium (Ir, atomic #77) has two naturally-occurring isotopes, Ir-191 and Ir-193. Given that the average atomic mass of Ir is 192.2 amu, which isotope is more abundant? Explain your reasoning.

Ir-193 is more abundant. The atomic mass is closer to 193 than to 191, so the average mass is closer (more heavily weighted) to 193, indicating that Ir-193 must be present in larger quantity.

5) Silicon has three natural isotopes: Si-28 (27.9769 amu, 92.23%), Si-29 (28.9765 amu 4.67%), and Si-30 (29.9738 amu, 3.10%). Calculate the atomic mass of silicon.

$$\text{Atomic Mass}_{Mg} = \left(27.9769\ \text{amu} \times \frac{92.23\%}{100\%}\right) + \left(28.9765\ \text{amu} \times \frac{4.67\%}{100\%}\right) + \left(29.9738\ \text{amu} \times \frac{3.10\%}{100\%}\right)$$

$$= 25.80\ \text{amu} + 1.353\ \text{amu} + 0.9292\ \text{amu} = \boxed{28.09\ \text{amu}}$$

6) On Mars, the isotopic distribution of neon is different from that on Earth. The isotopic masses are still 19.9924 amu (Ne-20), 20.9938 amu (Ne-21) and 21.9914 amu (Ne-22). Their Martian abundances are 25.00%, 15.00% and 60.00%, respectively. What mass would Ne have on the Martian periodic table?

$$\text{Atomic Mass}_{Ne} = \left(19.9924\ \text{amu} \times \frac{25.00\%}{100\%}\right) + \left(20.9938\ \text{amu} \times \frac{15.00\%}{100\%}\right) + \left(21.9914\ \text{amu} \times \frac{60.00\%}{100\%}\right)$$

$$= 4.998\ \text{amu} + 3.149\ \text{amu} + 13.19\ \text{amu} = \boxed{21.34\ \text{amu}}$$

7) The table below shows the three isotopes for unknown element X, along with their isotopic masses and abundances. Calculate the atomic mass of element, showing all your work, then identify it.

Isotope	Mass (amu)	Abundance (%)	Contribution	Atomic Mass & Element
X-36	35.968	× 0.34 /100	= 0.12 amu	= 39.95 amu; **Argon**
X-38	37.963	× 0.063 /100	= 0.024 amu	
X-40	39.962	× 99.60 /100	= 39.802 amu	