

**chapter 2**

Indicate the answer choice that best completes the statement or answers the question.

1. Select the element that is located in period 4, group 7 of the periodic table.
  - a. rutherfordium
  - b. manganese
  - c. bromine
  - d. flerovium
  - e. technetium
2. Select the choice that is *not* an isotopic symbol of uranium.
  - a.  ${}^{235}_{92}\text{U}$
  - b.  ${}^{235}_{90}\text{U}$
  - c.  ${}^{238}_{92}\text{U}$
  - d.  ${}^{234}_{92}\text{U}$
  - e.  ${}^{232}_{92}\text{U}$
3. Select the statement that was *not* part of Dalton's atomic theory.
  - a. In the atom, negatively charged electrons are suspended in a sphere of positive charge.
  - b. Matter consists of tiny, indivisible particles called atoms.
  - c. Each atom of a particular element has the same mass, but atoms of different elements have different masses.
  - d. Atoms combine in small, whole-number ratios to form molecules.
  - e. Atoms of some pairs of elements can combine with each other in different whole-number ratios to form different compounds.
4. Group 2 elements react with group 16 elements in a 1:1 ratio. Given that, select the compound that is a likely product of the reaction of a group 2 element with a group 16 element.
  - a. LiCl
  - b.  $\text{K}_2\text{S}$
  - c.  $\text{Mg}_2\text{O}$
  - d. BrCl
  - e. CaO
5. Select a conclusion that Ernest Rutherford made from his various experiments.
  - a. In an atom, the number of negatively charged electrons is equal to the number of positively charged particles (protons).
  - b. Positive charge is spread throughout the atom.
  - c. The neutron has approximately the same mass as the proton.
  - d. Electrons move around the nucleus in well-defined orbits.

6. Approximate the atomic mass of a fictional element X with the following isotope data.

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Isotope	Abundance
$^{45}\text{X}$	75.0%
$^{47}\text{X}$	25.0%

- 45.0 u
- 45.5 u
- 46.0 u
- 46.5 u
- 47.0 u

7. Boron has two naturally occurring isotopes,  $^{10}\text{B}$  and  $^{11}\text{B}$ . The natural abundance of  $^{10}\text{B}$  is 19.9%. Calculate the natural abundance of  $^{11}\text{B}$ .

- 100%
- 79.1%
- 19.9%
- 80.1%

8. A 20 g sample of calcium carbonate decomposes in a flame to produce carbon dioxide gas and 11.2 g of calcium oxide. How much carbon dioxide was released in the decomposition?

- 0.2 g
- 20 g
- 11.2 g
- 28.8 g
- 8.8 g

9. Select the correct isotopic symbol for polonium-210.

- $^{210}_{15}\text{P}$
- $^{210}_{84}\text{P}$
- $^{84}_{210}\text{P}$
- $^{210}_{84}\text{Po}$
- $^{84}_{210}\text{Po}$

10. Iron has an atomic mass of 55.845 u. The mass numbers and percent abundance data of three of the four naturally occurring isotopes of iron are given in the table. Calculate the isotopic mass and percent abundance of the fourth isotope.

Isotope	Isotopic mass (u)	Percent abundance
$^{54}\text{Fe}$	53.9396	5.845
$^{56}\text{Fe}$	55.9349	91.754
$^{57}\text{Fe}$	56.9354	2.119

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$^{56}\text{Fe}$		
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- a. 58.9 u, 2.12%
- b. 57.9 u, 0.282%
- c. 58.3 u, 0.282%
- d. 59.8 u, 0.282%
- e. 58.9 u, 2.82%

11. Select the result that did *not* come from J. J. Thomson's work.

- a. Cathode rays have a negative charge.
- b. Cathode ray beams could be deflected if exposed to a magnetic or electrical field.
- c. The charge-to-mass ratio of a cathode ray was obtained.
- d. The positive charge of the atom is concentrated in a very small area.

12. Carbon has an atomic mass of 12.011 u and has two naturally occurring isotopes, one of which is  $^{12}\text{C}$ . Which isotope of carbon has the highest natural abundance?

- a.  $^6\text{C}$
- b.  $^{11}\text{C}$
- c.  $^{12}\text{C}$
- d.  $^{13}\text{C}$
- e.  $^{14}\text{C}$

13. Select the isotopic symbol that is *not* correct.

- a.  $^2\text{H}$
- b.  $^3\text{H}$
- c.  $^{80}_{34}\text{Se}$
- d.  $^{131}\text{I}$
- e.  $^{232}_{90}\text{Th}$

14. Which of these elements is a transition metal?

- a. Ca
- b. Cu
- c. Ce
- d. Cl
- e. Cs

15. A 25.0 g sample of a compound contains 9.03 g of calcium and 15.97 g of chlorine. Select the statement that is *not* true.

- a. The compound is made up of two elements.

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- b. The compound is 64% chlorine.  
c. A 15.0 g sample of calcium chloride contains 5.4 g of calcium.  
d. A 15.0 g sample of calcium chloride contains 9.6 g of calcium.
16. Select the correct isotopic symbol for a phosphorus-32 isotope that has a  $-3$  charge.
- P-32
  - ${}_{32}\text{P}^{3-}$
  - $(\text{P}^{32})^{3-}$
  - $\text{p}^{32}$
  - ${}_{15}^{32}\text{P}^{3-}$
17. Select the way in which elements are arranged in the modern periodic table.
- in ascending order of their atomic masses
  - in ascending order of their isotopic masses
  - in ascending order of their atomic numbers
  - in ascending order of their relative reactivities
18. Elemental chlorine,  $\text{Cl}_2$ , is a gas that has corrosive chemical properties. Select an element that is likely to have similar chemical properties.
- $\text{N}_2$
  - Ne
  - Ti
  - $\text{Ga}_2$
  - $\text{F}_2$
19. Sodium and oxygen can react to form sodium oxide,  $\text{Na}_2\text{O}$ . Predict the chemical formula of the product of the reaction between lithium and sulfur.
- LiS
  - $\text{Li}_2\text{S}$
  - $\text{LiS}_2$
  - $\text{LiS}_3$
20. Select the element that the chemical symbol Og represents.
- osmium
  - oxygen
  - oganesson
  - organellium
  - ogmium

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21. Select the correct number of protons and electrons in  $\text{Hf}^{4+}$ .
- 72 protons and 4 electrons
  - 72 protons and 76 electrons
  - 72 protons and 68 electrons
  - 178 protons and 174 electrons
  - 178 protons and 182 electrons
22. Use the periodic table to identify the trend in the neutron-to-proton ratio for the elements. *Hint: Arbitrarily choose two elements from the periodic table (one with a very low atomic number and one with a very high atomic number). For each one, approximate a reasonable number of neutrons based on the atomic mass, and determine the ratio of neutrons to protons.*
- As atomic number increases, the ratio of an element's neutrons to protons stays approximately the same.
  - As atomic number increases, the ratio of an element's neutrons to protons increases.
  - As atomic number increases, the ratio of an element's neutrons to protons decreases.
  - As atomic number increases, the ratio of an element's protons to neutrons increases.
  - As atomic number increases, the ratio of an element's electrons to neutrons increases.
23. What element has atoms with an average mass of approximately twice the mass of a sulfur atom?
- germanium
  - copper
  - nitrogen
  - selenium
24. A 15 g sample of propane combusts in the presence of oxygen to produce 45 g of carbon dioxide and 24.5 g of water vapor. Select the mass of oxygen that reacted with the propane.
- 11 g
  - 15 g
  - 28.8 g
  - 54.5 g
  - 69.5 g
25. Select the correct chemical symbol for tin.
- Tl
  - Ti
  - Th
  - Tn
  - Sn
26. Select the correct chemical symbol for hydrogen.
- Hf
  - Hg

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- c. Ge
- d. H
- e. He

27. Determine the relative number of each type of element in the formula  $\text{Cr}(\text{NO}_3)_3$ .
28. A compound has 82 protons, 82 electrons, and 123 neutrons. Write its isotopic symbol including both the mass number and the atomic number.
29. A sample of carbon monoxide,  $\text{CO}$ , contains 12.011 g of carbon and 15.999 g of oxygen. A sample of carbon dioxide,  $\text{CO}_2$ , contains 12.011 g of carbon and 31.998 g of oxygen. Show that  $\text{CO}$  and  $\text{CO}_2$  follow the law of multiple proportions.
30. What is the collective name for the group 18 elements?
31. Fill in the missing cells of this table.

Element	Protons	Neutrons	Mass number
K		21	
	14		27
		46	81
	30	34	

32. Hydrogen and helium have one and two protons, respectively, but a helium atom has four times the mass of a hydrogen atom. The existence of what neutral subatomic particle, suggested by Rutherford and demonstrated by Chadwick, explains this discrepancy?
33. What group of the periodic table is known as the alkaline earth metals?
34. Sulfur has five naturally occurring isotopes of varying abundances:  $^{32}\text{S}$ ,  $^{33}\text{S}$ ,  $^{34}\text{S}$ ,  $^{35}\text{S}$ , and  $^{36}\text{S}$ . To the nearest integer, what would the atomic mass of sulfur be if all five isotopes were equally abundant?
35. How many electrons are in an ion with a +3 charge formed from the lightest metal in group 13 of the periodic table?
36. What is the collective name for the group 17 elements?
37. The mass of  $^{12}\text{C}$  atom is *exactly* 12 u and there are  $6.022 \times 10^{23}$  u per gram. Using the correct number of significant figures, what is the mass of a  $^{12}\text{C}$  atom in grams?
38. Which subatomic particles are found in the nucleus of an atom?
39. Chromium has an atomic mass of 51.996 u. The mass numbers and percent abundance data of the four stable isotopes of chromium are given in the table. Fill in the empty cells.

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Isotope	Isotopic mass (u)	Percent abundance
$^{50}\text{Cr}$	49.9460	4.345
$^{52}\text{Cr}$	51.9405	83.789
$^{53}\text{Cr}$		
$^{54}\text{Cr}$	53.9389	2.365

40. What group of the periodic table is known as the alkali metals?
41. Suppose that 55.0 g of aluminum oxide decomposes to give elemental aluminum, Al, and 25.9 g of O<sub>2</sub> gas. Determine the percent aluminum in aluminum oxide.
42. Determine the relative number of each type of element in the formula NaClO<sub>4</sub>.
43. Give the element symbol for the metalloid in group 13 of the periodic table.

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

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**Answer Key**

1. b
2. b
3. a
4. e
5. a
6. b
7. d
8. e
9. d
10. b
11. d
12. c
13. a
14. b
15. d
16. e
17. c
18. e
19. b
20. c
21. c
22. b
23. b
24. d



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25. e

26. d

27. one chromium atom, three nitrogen atoms, nine oxygen atoms

28.  $^{205}_{82}\text{Pb}$ 

29. Calculate the carbon-to-oxygen (C:O) ratios for each compound. For CO:  $\frac{12.011 \text{ g C}}{15.999 \text{ g O}} = 0.75073$ . For CO<sub>2</sub>:  $\frac{12.011 \text{ g C}}{31.998 \text{ g O}} = 0.37537$ . Compare the C:O ratios of CO and CO<sub>2</sub>:  $\frac{\text{C:O ratio for CO}}{\text{C:O ratio for CO}_2} = \frac{0.75073}{0.37537} = 2.0000$ . The ratio of C:O masses between these two compounds is a whole number, so CO and CO<sub>2</sub> follow the law of multiple proportions.

30. noble gases

31.

Element	Protons	Neutrons	Mass number
K	19	21	40
Si	14	13	27
Br	35	46	81
Zn	30	34	64

32. neutrons

33. Group 2 (or 2A)

34. 34 u

35. 10

36. halogens

37.  $1.993 \times 10^{-23} \text{ g}$ 

38. protons and neutrons

39. 52.939 u, 9.501%

40. Group 1 (or 1A)

41. 52.9%

42. one sodium atom, one chlorine atom, four oxygen atoms

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43. B