

Chapter 1: Elements & Compounds

Introduction

1. Which of the following correctly describes one of the differences between compounds and mixtures?
 - (a) Compounds contain more than one element but mixtures do not.
 - (b) Compounds have a constant composition but mixtures do not.
 - (c) It is easier to separate the elements in a compound than it is to separate the elements in a mixture.
 - (d) All of these statements are true.
 - (e) None of these statements are true.

Answer: (b)

2. Which of the following postulates of Dalton's atomic theory is/are still valid today?
 - (I) Matter consists of particles called atoms.
 - (II) Atoms are indestructible and indivisible.
 - (III) All atoms of an element are identical.
 - (IV) Atoms of different elements differ in mass.
 - (V) When the atoms of different elements combine to form compounds they combine in simple whole number ratios.
 - (a) All of these statements are still valid today.
 - (b) I and II are still valid, but not III, IV and V.
 - (c) I, II and III are still valid, but not IV and V.
 - (d) I, IV and V are still valid, but not II and III.
 - (e) II and III are still valid, but not I, IV and V.

Answer: (d)

3. Calculate the number of protons in the average potassium atom if the atomic weight of potassium is 39 amu and the atomic number of this element is 19.
 - (a) 19
 - (b) 20
 - (c) 39
 - (d) 58
 - (e) The number of protons is impossible to determine from this information.

Answer: (a)

Isotopes

4. The earth is constantly bombarded by cosmic rays emitted by the sun. The total energy received in the form of cosmic rays is small — no more than the energy received by the planet from starlight. But the energy of a single cosmic ray is very large, on the order of 200 million kJ/mol. These highly energetic rays react with atoms in the atmosphere to produce neutrons that then react with nitrogen atoms in the atmosphere to produce ^{14}C , which decays back to ^{14}N with a half-life of 5730 years by emitting an electron.

What is the difference between ^{14}C and ^{14}N atoms?

- (a) They have the same number of protons but different numbers of neutrons.
- (b) They have the same number of neutrons but different numbers of protons.
- (c) They have the same number of neutrons and protons but different numbers of electrons.
- (d) ^{14}N has one more proton and one less neutron than ^{14}C .
- (e) ^{14}N has one more neutron and one less proton than ^{14}C .

Answer: (d)

5. Which of the following atoms have the same number of neutrons?

(I) ^{233}Th (II) ^{235}U (III) ^{238}U (IV) ^{238}Np

- (a) I and II
- (b) I, II and IV
- (c) II and III
- (d) III and IV
- (e) All of these atoms have the same number of neutrons.

Answer: (a)

6. Which statement correctly describes the difference between the ^{12}C , ^{13}C and ^{14}C isotopes of carbon?

- (a) They have the same number of protons but different numbers of electrons.
- (b) They have the same number of neutrons but different numbers of electrons.
- (c) They have the same number of electrons but different numbers of protons.
- (d) They have the same number of protons but different numbers of neutrons.
- (e) They have the same number of protons, electrons, and neutrons but different atomic masses.

Answer: (d)

Atoms and Ions

7. What is the symbol for the atom or ion that has 34 neutrons, 29 protons, and 27 electrons?

- (a) $^{34}\text{Se}^{2-}$
- (b) $^{29}\text{Cu}^{2+}$
- (c) $^{63}\text{Se}^{2-}$
- (d) $^{63}\text{Cu}^{2+}$
- (e) $^{27}\text{Co}^{2+}$

Answer: (d)

8. How many electrons are in $^{52}\text{Cr}^{3+}$?

- (a) 3
- (b) 21
- (c) 24
- (d) 27
- (e) 28

Answer: (b)

9. How many protons are in $^{32}\text{S}^{2-}$?

- (a) 2
- (b) 14
- (c) 16
- (d) 18
- (e) 32

Answer: (c)

10. Complete the following table.

<i>Symbol</i>	<i>Atomic Number</i>	<i>Mass Number</i>	<i>Number of Protons</i>	<i>Number of Electrons</i>	<i>Number of Neutrons</i>
^{37}Cl	_____	_____	_____	_____	_____
_____	10	_____	_____	10	12
$^{18}\text{O}^{2-}$	_____	_____	_____	_____	_____

Answer: 17, 37, 17, 17, 20; ^{22}Ne , 22, 10; 8, 18, 8, 10, 10

11. Complete the following table

<u>Symbol</u>	<u>Mass Number</u>	<u>Protons</u>	<u>Neutrons</u>	<u>Electrons</u>
^{19}F	_____	_____	_____	_____
_____	_____	12	13	10

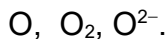
Answer: 19, 9, 10, 9; $^{25}\text{Mg}^{2+}$, 25

12. Complete the table

<u>Symbol</u>	<u>Protons</u>	<u>Neutrons</u>	<u>Electrons</u>
$^{35}\text{Cl}^-$	_____	_____	_____
_____	12	13	10

Answer: 17, 18, 18, $^{25}\text{Mg}^{2+}$

13. Describe the difference on the atomic scale between the following three forms of oxygen:



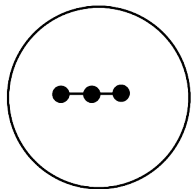
Answer:

O represents an atom of oxygen containing 8 protons and 8 electrons.

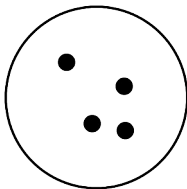
O₂ represents a molecule of oxygen made up of 2 atoms of oxygen bonded together.

O²⁻ represents an anion of oxygen containing 8 protons and 10 electrons.

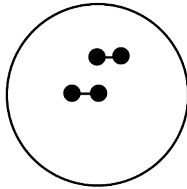
14. Which choice gives the diagrams in the order that best represents 2O₂, 4O, and X₃, respectively?



A



B



C

(a) A B C

(b) C B A

- (c) B C A
- (d) B A C
- (e) None of the above gives the cartoons in the correct order.

Answer: (b)

15. Atoms are isobaric if they have the same mass. Which of the following atoms or ions are isobaric?



- (a) I and II
- (b) II and III
- (c) III and IV
- (d) IV and V
- (e) III, IV and V

Answer: (d)

16. Which of the following correctly describes a Zn^{2+} ion that has a mass number of 65?

- (a) It contains 28 electrons, 30 protons, and 35 neutrons.
- (b) It contains 30 electrons, 30 protons, and 35 neutrons.
- (c) It contains 32 electrons, 30 protons, and 35 neutrons.
- (d) It contains 35 electrons, 35 protons, and 30 neutrons.
- (e) It contains 37 electrons, 35 protons, and 30 neutrons.

Answer: (a)

17. Calculate the number of electrons in a P^{3-} ion if the mass number of phosphorus is 31 and the atomic number of this element is 15.

- (a) 12
- (b) 15
- (c) 18
- (d) 31
- (e) 34

Answer: (c)

18. Which of the following symbols indicates an atom or ion with 12 protons and 10 electrons?

- (a) Mg^{2+}
- (b) C^{4+}
- (c) O^{2-}
- (d) Ne
- (e) none of these

Answer: (a)

19. All of the following have the same number of electrons except:

- (a) K^+
- (b) Ca^{2+}
- (c) Al^{3+}
- (d) S^{2-}
- (e) Cl^-

Answer: (c)

20. What is the symbol for the atom or ion that has 26 protons, 30 neutrons, and 24 electrons?

- (a) $^{56}\text{Cr}^{2+}$
- (b) $^{54}\text{Cr}^{2+}$
- (c) $^{56}\text{Fe}^{2+}$
- (d) $^{54}\text{Fe}^{3+}$
- (e) ^{54}Cr

Answer: (c)

21. How many electrons are present in the $^{77}\text{Se}^{2-}$ ion?

- (a) 32
- (b) 34
- (c) 43
- (d) 77
- (e) none of these

Answer: (e)

22. How many electrons are present in the $^{136}\text{Ba}^{2+}$ ion?

- (a) 56
- (b) 58
- (c) 78
- (d) 134
- (e) none of these

Answer: (e)

23. Calculate the number of electrons on a Ce^{4+} ion if the atomic number of this element is 58 and the mass number of the ion is 140.

- (a) 54
- (b) 58
- (c) 62
- (d) 136
- (e) 140

Answer: (a)

24. Which of the following compounds is composed only of polyatomic ions?

- (a) NH_4NO_3
- (b) CaO
- (c) H_2SO_4
- (d) NO_2
- (e) CO_2

Answer: (a)

Metals, Nonmetals, and Semimetals

25. Which of the following is a nonmetal in the same group as silicon?

- (a) C
- (b) P
- (c) Sn
- (d) Zn
- (e) none of these

Answer: (a)

26. Which of the following is a nonmetal in period 4?

- (a) C
- (b) Ca
- (c) Se
- (d) Sr
- (e) none of these

Answer: (c)

27. Which of the following elements is neither a metal nor a nonmetal?

- (a) Na
- (b) Mg
- (c) Ga
- (d) Si
- (e) P

Answer: (d)

28. Classify the following elements as metals, nonmetals or semi-metals:

S, Sb, Sc, Se, Sg, Si, Sm, Sn, and Sr.

Answer:

Nonmetals: S, Se

Semi-metals: Sb, Si

Metals: Sc, Sg, Sm, Sn, Sr

The Mass of an Atom

The following two questions use the data listed below.

<u>Isotope</u>	<u>Abundance</u>	<u>Mass (amu)</u>
^{16}O	99.76%	15.9949
^{17}O	0.04%	16.9991
^{18}O	0.20%	17.9992

29. If you were able to select a single atom of oxygen from a naturally occurring sample, what would its mass most likely be?

- (a) 15.9949 amu
- (b) 16.9991 amu
- (c) 17.9992 amu
- (d) 15.9993 amu
- (e) none of these

Answer: (a)

30. If you were able to select 1000 individual atoms of oxygen from a naturally occurring sample, what would be the **average** mass of the atoms?

- (a) 15.9949 amu
- (b) 16.9991 amu
- (c) 17.9992 amu
- (d) 15.9993 amu
- (e) none of these

Answer (d)

The following two questions use the data listed below.

Isotope	% Natural Abundance	Mass (amu)
²⁰ Ne	90.51	19.99244
²¹ Ne	0.27	20.99384
²² Ne	9.22	21.99138

31. If you select a **single** random atom of Ne from a naturally occurring sample, its mass is most likely to be

- (a) 19.99244 amu
- (b) 20.99384 amu
- (c) 21.99138 amu
- (d) 20.179 amu
- (e) 20.000 amu

Answer: (a)

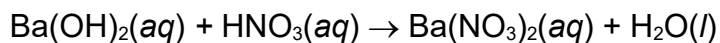
32. If you select **100** random atoms of Ne from a naturally occurring sample, their **total** mass is most likely to be

- (a) 1999.244 amu
- (b) 2099.384 amu
- (c) 2199.138 amu
- (d) 2017.9 amu
- (e) 2000.0 amu

Answer: (d)

Balancing Chemical Equations

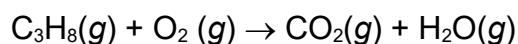
33. What will be the coefficient for HNO₃ when the following equation is balanced?



- (a) 1
- (b) 2
- (c) 3
- (d) 5
- (e) none of these

Answer: (b)

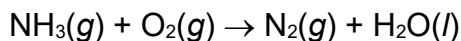
34. What will be the coefficient for oxygen when the following equation is balanced?



- (a) 1
- (b) 2
- (c) 3
- (d) 5
- (e) none of these

Answer: (d)

35. What will be the coefficient for NH_3 when the following reaction is balanced?



- (a) 1
- (b) 3
- (c) 4
- (d) 5
- (e) none of these

Answer: (c)

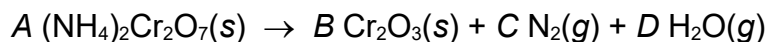
36. Balance the following equations:

- (I) $\text{Na}_2\text{SO}_4(s) + \text{C}(s) \rightarrow \text{Na}_2\text{S}(aq) + \text{CO}_2(g)$
- (II) $\text{Mg}_3\text{N}_2(s) + \text{H}_2\text{O}(l) \rightarrow \text{Mg(OH)}_2(aq) + \text{NH}_3(g)$

Answer:

- (I) $\text{Na}_2\text{SO}_4(s) + 2 \text{C}(s) \rightarrow \text{Na}_2\text{S}(s) + 2 \text{CO}_2(g)$
- (II) $\text{Mg}_3\text{N}_2(s) + 6 \text{H}_2\text{O}(l) \rightarrow 3 \text{Mg(OH)}_2(aq) + 2 \text{NH}_3(g)$

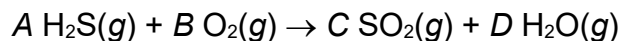
37. The balanced equation for the decomposition of ammonium dichromate has which of the following sets of coefficients?



- (a) $A = 2, B = 2, C = 2, D = 4$
- (b) $A = 1, B = 1, C = 1, D = 4$
- (c) $A = 1, B = 1, C = 1, D = 2$
- (d) $A = 1, B = 1, C = 2, D = 2$
- (e) $A = B = C = D = 1$

Answer: (b)

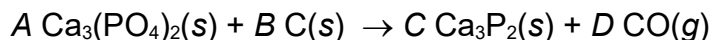
38. Calculate the sum of the coefficients in the balanced chemical equation for the following reaction:



- (a) 6
- (b) 8
- (c) 9
- (d) 11
- (e) 17

Answer: (c)

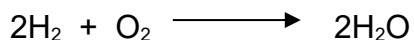
39. What is the sum of the coefficients when the following chemical equation is balanced?



- (a) 6
- (b) 12
- (c) 18
- (d) 20
- (e) none of the above

Answer: (c)

40. Which illustration best represents the following equation?



- (a)  +  $\longrightarrow$ 
- (b)  +  +  $\longrightarrow$  +  +  + 
- (c)  +  +  $\longrightarrow$  + 
- (d)  +  +  +  $\longrightarrow$  + 
- (e)  +  +  $\longrightarrow$  +  +  + 

Answer: (c)