

Pre-A Chemistry, Grade 10

Final Exam - Practice

Multiple Choice:

- What is the total number of valence electrons in a calcium atom in the ground state?
 - 8
 - 2
 - 18
 - 20
- Which subatomic particles are located in the nucleus of an He-4 atom?
 - electrons and neutrons
 - electrons and protons
 - neutrons and protons
 - neutrons, protons, and electrons
- In the late 1800s, experiments using cathode ray tubes led to the discovery of the
 - electron
 - neutron
 - positron
 - proton
- The atomic mass of titanium is 47.88 atomic mass units. This atomic mass represents the
 - total mass of all the protons and neutrons in an atom of Ti
 - total mass of all the protons, neutrons, and electrons in an atom of Ti
 - weighted average mass of the most abundant isotope of Ti
 - weighted average mass of all the naturally occurring isotopes of Ti
- An atom of which element has the largest atomic radius?
 - Fe
 - Mg
 - Si
 - Zn
- Which element requires the *least* amount of energy to remove the most loosely held electron from a gaseous atom in the ground state?
 - bromine
 - calcium
 - sodium
 - silver
- The greatest composition by mass in an atom of $^{17}_8\text{O}$ is due to the total mass of its
 - electrons
 - neutrons
 - positrons
 - protons
- The bond between which two atoms is most polar?
 - Br and Cl
 - Br and F
 - I and Cl
 - I and F
- Given the formula representing a hydrocarbon:

The molecular formula and the empirical formula for this hydrocarbon are

 - C_5H_{10} and CH_2
 - C_5H_{10} and CH_3
 - C_4H_8 and CH_2
 - C_4H_8 and CH_3
- Given the balanced equation representing a reaction:

$$2\text{NaCl}(\ell) \rightarrow 2\text{Na}(\ell) + \text{Cl}_2(\text{g})$$

A 1170.-gram sample of $\text{NaCl}(\ell)$ completely reacts, producing 460. grams of $\text{Na}(\ell)$. What is the total mass of $\text{Cl}_2(\text{g})$ produced?

 - 355 g
 710. g
 1420. g
 1630. g
- Which molecule has a nonpolar covalent bond?
 -
 -
 -
 -

12. A sample of matter must be copper if
- (1) each atom in the sample has 29 protons
 - (2) atoms in the sample react with oxygen
 - (3) the sample melts at 1768 K
 - (4) the sample can conduct electricity

13. In the electron cloud model of the atom, an orbital is defined as the most probable
- (1) charge of an electron
 - (2) conductivity of an electron
 - (3) location of an electron
 - (4) mass of an electron

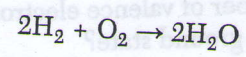
14. The elements on the Periodic Table are arranged in order of increasing
- (1) atomic number
 - (2) mass number
 - (3) number of isotopes
 - (4) number of moles

15. Which statement describes the general trends in electronegativity and metallic properties as the elements in Period 2 are considered in order of increasing atomic number?
- (1) Both electronegativity and metallic properties decrease.
 - (2) Both electronegativity and metallic properties increase.
 - (3) Electronegativity decreases and metallic properties increase.
 - (4) Electronegativity increases and metallic properties decrease.

16. Which atom has the *weakest* attraction for the electrons in a bond with an H atom?
- | | |
|-------------|------------|
| (1) Cl atom | (3) O atom |
| (2) F atom | (4) S atom |

17. Which substance can *not* be broken down by a chemical change?
- | | |
|-------------|-------------|
| (1) ammonia | (3) propane |
| (2) mercury | (4) water |

18. Given the balanced equation representing a reaction:



What is the mass of H_2O produced when 10.0 grams of H_2 reacts completely with 80.0 grams of O_2 ?

- | | |
|------------|------------|
| (1) 70.0 g | (3) 180. g |
| (2) 90.0 g | (4) 800. g |

Given two formulas representing the same compound:

Formula A	Formula B
CH_3	C_2H_6

Which statement describes these formulas?

- (1) Formulas A and B are both empirical.
- (2) Formulas A and B are both molecular.
- (3) Formula A is empirical, and formula B is molecular.
- (4) Formula A is molecular, and formula B is empirical.

20. The percent composition by mass of nitrogen in NH_4OH (gram-formula mass = 35 grams/mole) is equal to

- | | |
|--------------------------------|--------------------------------|
| (1) $\frac{4}{35} \times 100$ | (3) $\frac{35}{14} \times 100$ |
| (2) $\frac{14}{35} \times 100$ | (4) $\frac{35}{4} \times 100$ |

21. Which Group 15 element exists as diatomic molecules ~~at room temperature~~?

- | | |
|----------------|-------------|
| (1) phosphorus | (3) bismuth |
| (2) nitrogen | (4) arsenic |

22. What is the total number of electrons shared in a double covalent bond?

- | | |
|-------|-------|
| (1) 1 | (3) 3 |
| (2) 2 | (4) 4 |

23. What is the total number of neutrons in an atom of O-18?
 (1) 18 (3) 10
 (2) 16 (4) 8
24. What is the net charge of an ion that has 8 protons, 9 neutrons, and 10 electrons?
 (1) 1+ (3) 1-
 (2) 2+ (4) 2-
25. Which element is malleable and a good conductor of electricity?
 (1) argon (3) iodine
 (2) carbon (4) silver
26. Which element has chemical properties that are most similar to the chemical properties of sodium?
 (1) beryllium (3) lithium
 (2) calcium (4) magnesium
27. If an element, X, can form an oxide that has the formula X_2O_3 , then element X would most likely be located on the Periodic Table in the same group as
 (1) Ba (3) In
 (2) Cd (4) Na
28. When an atom of lithium loses an electron, the atom becomes a
 (1) negative ion with a radius smaller than the radius of the atom
 (2) negative ion with a radius larger than the radius of the atom
 (3) positive ion with a radius smaller than the radius of the atom
 (4) positive ion with a radius larger than the radius of the atom
29. Compared to the atoms of nonmetals in Period 3, the atoms of metals in Period 3 have
 (1) fewer valence electrons
 (2) more valence electrons
 (3) ~~lower~~ lower principal quantum number
 (4) ~~more~~ higher principal quantum number
30. Which elements are malleable and good conductors of electricity?
 (1) iodine and silver (3) tin and silver
 (2) iodine and xenon (4) tin and xenon
31. Which atom in the ground state requires the least amount of energy to remove its valence electron?
 (1) lithium atom (3) rubidium atom
 (2) potassium atom (4) sodium atom
32. What is the chemical formula of iron(III) sulfide?
 (1) FeS (3) FeSO₃
 (2) Fe₂S₃ (4) Fe₂(SO₃)₃
33. What is the percent composition by mass of sulfur in the compound MgSO₄ (molar mass = 120. grams per mole)?
 (1) 20% (3) 46%
 (2) 27% (4) 53%
34. Which process results in a chemical change?
 (1) tearing tin foil
 (2) melting an iron bar
 (3) crushing an aluminum can
 (4) burning magnesium ribbon

35. An orbital is a region of space where there is a high probability of finding

- (1) a proton
- (2) a positron
- (3) a neutron
- (4) an electron

36. Which statement matches a subatomic particle with its charge?

- (1) A neutron has a negative charge.
- (2) A proton has a negative charge.
- (3) A neutron has no charge.
- (4) A proton has no charge.

37. ^{neutral} An atom of any element must contain

- (1) an equal number of protons and neutrons
- (2) an equal number of protons and electrons
- (3) more electrons than neutrons
- (4) more electrons than protons

38. ^{correctly} Which statement compares the masses of two subatomic particles?

- (1) The mass of an electron is greater than the mass of a proton.
- (2) The mass of an electron is greater than the mass of a neutron.
- (3) The mass of a proton is greater than the mass of an electron.
- (4) The mass of a proton is greater than the mass of a neutron.

39. The ~~W~~ ^{emission} line spectrum of sodium is produced when energy is

- (1) absorbed as electrons move from higher to lower electron ~~levels~~ ^{levels}
- (2) absorbed as electrons move from lower to higher electron ~~levels~~ ^{levels}
- (3) released as electrons move from higher to lower electron ~~levels~~ ^{levels}
- (4) released as electrons move from lower to higher electron ~~levels~~ ^{levels}

40. The valence electrons of a germanium atom in the ground state are located in ~~the~~ ^{an} orbital with

- (1) ~~the~~ ⁿ⁼¹
- (2) ~~the~~ ⁿ⁼²
- (3) ~~the~~ ⁿ⁼³
- (4) ~~the~~ ⁿ⁼⁴

41. The elements on the Periodic Table are arranged in order of increasing

- (1) atomic mass
- (2) atomic number
- (3) first ionization energy
- (4) selected oxidation state

42. Which list of elements contains a metal, a metalloid, a nonmetal, and a noble gas?

- (1) Be, Si, Cl, Kr
- (2) C, N, Ne, Ar
- (3) K, Fe, B, F
- (4) Na, Zn, As, Sb

43. The two forms of oxygen, $O_2(g)$ and $O_3(g)$, have

- (1) different molecular structures and identical properties
- (2) different molecular structures and different properties
- (3) identical molecular structures and identical properties
- (4) identical molecular structures and different properties

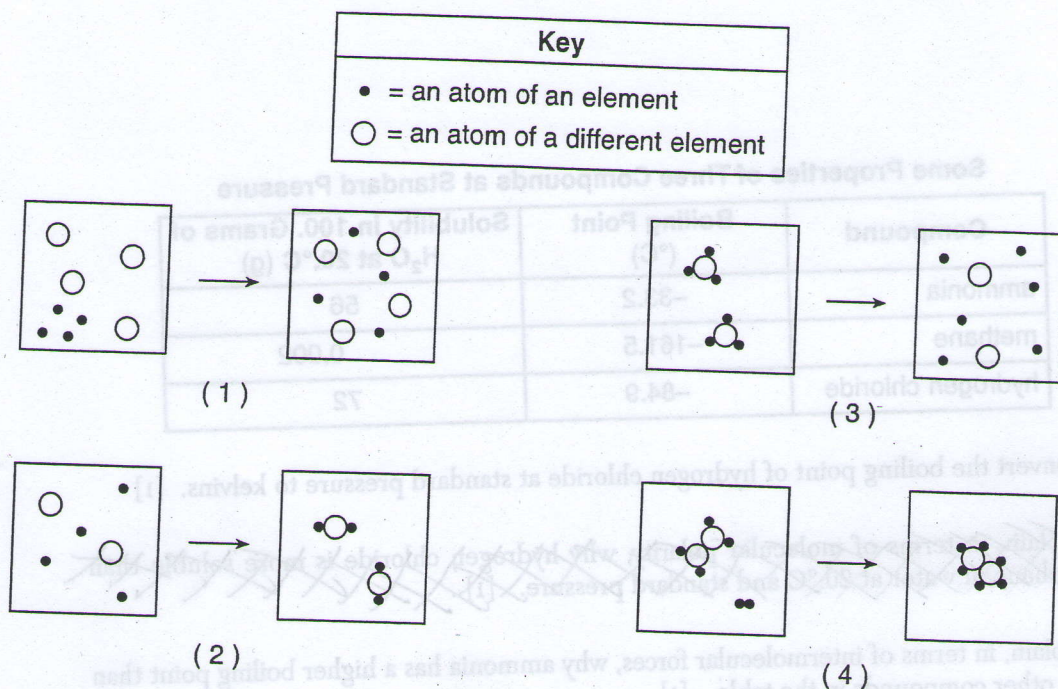
44. The sum of the atomic masses of the atoms in one molecule of $C_3H_6Br_2$ is called the

- (1) ~~molecular~~ ^{molar mass}
- (2) isotopic mass
- (3) percent abundance
- (4) percent composition

45. What is the total number of electron pairs shared between the two atoms in an O_2 molecule?

- (1) 1
- (2) 2
- (3) 6
- (4) 4

46. Which diagram represents a physical change, only?



47. The table below shows the number of subatomic particles in atom X and in atom Z.

Subatomic Particles in Two Atoms

Atom	Number of Protons	Number of Neutrons	Number of Electrons
X	6	6	6
Z	6	7	6

Atom X and atom Z are isotopes of the element

- | | |
|--------------|---------------|
| (1) aluminum | (3) magnesium |
| (2) carbon | (4) nitrogen |

48. Petroleum can be separated by distillation because the hydrocarbons in petroleum are

- (1) elements with identical boiling points
- (2) elements with different boiling points
- (3) compounds with identical boiling points
- (4) compounds with different boiling points

50. A neutron has a charge of

- | | |
|--------|--------|
| (1) +1 | (3) 0 |
| (2) +2 | (4) -1 |

49. Which element forms an ionic compound when it reacts with lithium?

- | | |
|--------|--------|
| (1) K | (3) Kr |
| (2) Fe | (4) Br |

Free Response:

Some Properties of Three Compounds at Standard Pressure

Compound	Boiling Point (°C)	Solubility in 100. Grams of H ₂ O at 20.°C (g)
ammonia	-33.2	56
methane	-161.5	0.002
hydrogen chloride	-84.9	72

- Convert the boiling point of hydrogen chloride at standard pressure to kelvins. [1]
- ~~Explain, in terms of molecular polarity, why hydrogen chloride is more soluble than methane in water at 20.°C and standard pressure. [1]~~
- Explain, in terms of intermolecular forces, why ammonia has a higher boiling point than the other compounds in the table. [1]

Copper has two naturally occurring isotopes. Information about the two isotopes is shown in the table below.

Naturally Occurring Isotopes of Copper

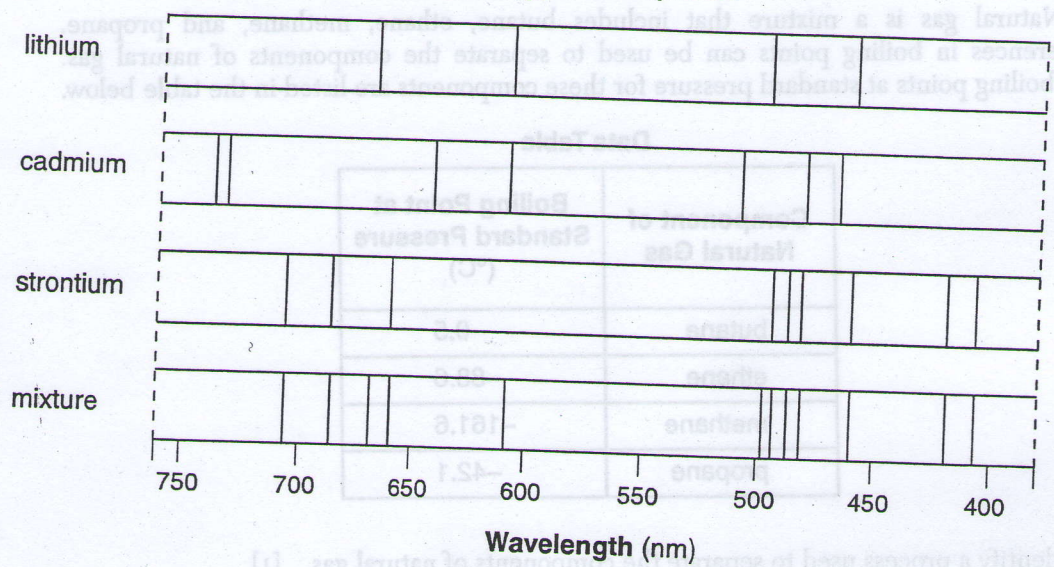
Isotope	Atomic Mass (atomic mass units, u)	Percent Natural Abundance (%)
Cu-63	62.93	69.17
Cu-65	64.93	30.83

- In the space in your answer booklet, show a numerical setup for calculating the atomic mass of copper. [1]

In an experiment, 2.54 grams of copper completely reacts with sulfur, producing 3.18 grams of copper(I) sulfide.

- Determine the total mass of sulfur consumed. [1]
- Write the chemical formula of the compound produced. [1]

Line Spectra



7. Explain, in terms of *both* electrons and energy, how the bright-line spectrum of an element is produced. [1]
8. Identify *all* the elements in the mixture. [1]
9. State the total number of valence electrons in a cadmium atom in the ground state.

In the early 1800s, John Dalton proposed an atomic theory that was based on experimental observations made by several scientists. Three concepts of Dalton's atomic theory are stated below.

- Statement A: Atoms are indivisible and cannot be destroyed or broken down into smaller parts.
- Statement B: Atoms of one element cannot be changed into atoms of another element.
- Statement C: All atoms of one element have the same mass.

10. Explain, in terms of particles, why statement A is no longer accepted. [1]
11. Explain, in terms of particles in the atoms of an element, why statement C is *false*.

Natural gas is a mixture that includes butane, ethane, methane, and propane. Differences in boiling points can be used to separate the components of natural gas. The boiling points at standard pressure for these components are listed in the table below.

Data Table

Component of Natural Gas	Boiling Point at Standard Pressure (°C)
butane	-0.5
ethane	-88.6
methane	-161.6
propane	-42.1

12. Identify a process used to separate the components of natural gas. [1]
13. List the *four* components of natural gas in order of increasing strength of intermolecular forces. [1]

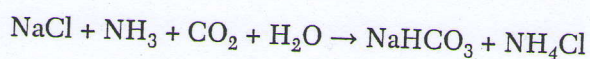
A student prepared two mixtures, each in a labeled beaker. Enough water at 20.°C was used to make 100 milliliters of each mixture.

Information about Two Mixtures at 20.°C

	Mixture 1	Mixture 2
Composition	NaCl in H ₂ O	Fe filings in H ₂ O
Student Observations	<ul style="list-style-type: none"> colorless liquid no visible solid on bottom of beaker 	<ul style="list-style-type: none"> colorless liquid black solid on bottom of beaker
Other Data	<ul style="list-style-type: none"> mass of NaCl(s) dissolved = 2.9 g 	<ul style="list-style-type: none"> mass of Fe(s) = 15.9 g density of Fe(s) = 7.87 g/cm³

14. Classify *each* mixture using the term “homogeneous” or the term “heterogeneous.” [1]
15. Determine the volume of the Fe filings used to produce mixture 2. [1]
16. Describe a procedure to physically remove the water from mixture 1. [1]

In 1864, the Solvay process was developed to make soda ash. One step in the process is represented by the balanced equation below.



17. Write the chemical formula for *one* compound in the equation that contains *both* ionic bonds and covalent bonds. [1]
18. Explain, in terms of electronegativity difference, why the bond between hydrogen and oxygen in a water molecule is more polar than the bond between hydrogen and nitrogen in an ammonia molecule. [1]
19. In the space *in your answer booklet*, draw a Lewis electron-dot diagram for the reactant containing nitrogen in the equation. [1]

Ionic Radii of Some Group 2 Elements

Symbol	Atomic Number	Ionic Radius (pm)
Be	4	44
Mg	12	66
Ca	20	99
Ba	56	134

20. On the grid *in your answer booklet*, mark an appropriate scale on the axis labeled "Ionic Radius (pm)." [1]
21. On the same grid, plot the data from the data table. Circle and connect the points. [1]
22. Estimate the ionic radius of strontium. [1]
23. State the trend in ionic radius as the elements in Group 2 are considered in order of increasing atomic number. [1]
24. Explain, in terms of electrons, why the ionic radius of a Group 2 element is smaller than its atomic radius. [1]