

TEST 2 (of 3)

Show all of your work. Students should make use of the conversion factor method throughout, use significant figures and express their answers in scientific notation.

1. (a) In 1897 _____ used magnetic and electric fields to measure the ratio of the cathode ray particle's mass to its charge.

(b) Complete the following table of conclusions from the Cathode Ray Tube experiment:

OBSERVATION	CONCLUSION
1. Ray bends in a magnetic field	
2. Ray bends towards positive plate in electric field	
3. Ray is identical for cathodes made from any metal	

(c) Which sub-atomic particle was discovered?

2. (a) Write down the molar mass of aluminum in g/mol.

(b) Calculate the mass in grams of one atom of aluminum metal.
(Avogadro's number = 6.022×10^{23} atoms/mole).

3. (a) Draw Bohr diagrams for a nitrogen atom and a nitrogen ion.

(b) Does an atom of N gain or lose electrons when forming an ion?

(c) When N forms an ion, the ion is isoelectric to which of the noble gases?

(d) Write down the Lewis dot structure for the nitrogen ion.

4. Gallium has two naturally occurring isotopes, ^{69}Ga (isotopic mass 68.9256 amu, abundance 60.11 %) and ^{71}Ga (isotopic mass 70.9247 amu, abundance 39.89 %). Calculate the atomic mass of gallium.

(SHOW ALL YOUR WORK)

5. The compound 'ammonium nitrate' consists of two different polyatomic ions.

(a) What are the formulas and electric charges of these ions?

(b) What is the molar mass of this compound?

6. (a) Give the name, atomic symbol, and group number of the element with the following atomic number (Z value), classify as metal, metalloid, or non-metal:
- (i) $Z = 33$, (ii) $Z = 16$,
- (iii) $Z = 2$, (iv) $Z = 3$,
- (v) $Z = 78$
- (b) What class of elements lies along the “staircase” line in the periodic table?
7. Correct the name to match the formula of the following compounds:
- (a) calcium (II) chloride, CaCl_2 (b) copper (II) oxide, Cu_2O ,
- (c) hydrogen chloride acid, $\text{HCl}_{(\text{aq})}$ (d) nitrogen tetroxide, N_2O_5
8. Give the name and formula for the acid derived from each of the following anions:
- (a) NO_3^- , (b) F^- ,
- (c) sulfate, (d) phosphate (PO_4^{3-})
9. Give the names for the formulas or the formulas for the names:
- (a) Lead (IV) bromide, (b) $\text{Fe}(\text{NO}_3)_2$,
- (c) Mn_2O_3 , (d) copper (II) chloride dihydrate
10. Determine the oxidation number of arsenic in the following species:
- (a) Arsenate ion, AsO_4^{3-} (b) Arsenite ion, AsO_2^-
- (c) Elemental arsenic, As (d) As_2H_4

Answer **ONE** of the following two questions:

BONUS 1:

Nitrous oxide (N_2O) is a potent greenhouse gas. It enters the atmosphere from fertilizer breakdown, car exhausts, and many other sources. Some studies have shown that the isotope ratios of ^{15}N to ^{14}N and of ^{18}O to ^{16}O in N_2O depend on the source. Thus, measuring the relative abundance of molecular masses in a sample of N_2O can help determine the source.

(a) What different molecular masses are possible for N_2O ?

(b) The percent abundance of ^{14}N is 99.6 %, and that of ^{16}O is 99.8 %. Which molecular mass of N_2O is least common, and which is most common?

BONUS 2: Use the following information to answer the question.

The **atomic mass** of an element is the average atomic mass of all the chemical element's isotopes, weighted by isotopic abundance.

Isotopes are forms of an element whose nuclei have the same atomic number—the number of protons in the nucleus—but different atomic masses because they contain different numbers of neutrons.

Question: How can iodine ($Z = 53$) have a higher atomic number yet a lower atomic mass than tellurium ($Z = 52$)?