

Answers to SNC 2DI Exam Review: Chemistry Unit

1. Understand the meaning of the following terms. Be able to recognize their definitions:

Protons	Chemical Family or Group	Ionic compound	Double displacement reaction
Neutrons	Chemical Period	Covalent bond	Precipitate
Electrons	Group Number	Covalent Compound	Rate of reaction
Atomic number	Valence electrons	Law of Conservation of Mass	Temperature
Mass number	Stable Octet	Reactants	Acid (and its pH range)
Isotopes	Ion	Products	Base (and its pH range)
Metal	Anion and cation	Synthesis reaction	Neutralization reaction
Non-metal	Chemical formula	Decomposition reaction	Sulfuric acid (battery acid)
Metalloid	Ionic bond	Single displacement reaction	Hydrochloric acid (stomach acid)

2. Compare the sub-atomic particles:

- protons are found in the **nucleus**, have a charge of **1+** and a mass of **1 amu (atomic mass unit)**.
- neutrons are found in the **nucleus**, have a charge of **0 (are neutral)** and a mass of **1 amu**.
- electrons are found in the **space around the nucleus**, have a charge of **1-** and a mass of **almost 0**.

3. What does each of the following terms tell us about an atom?

- atomic number:** tells us the number of protons in the nucleus of the atom. This determines the atom's identity.
- mass number:** tells us the number of protons and neutrons in the nucleus of the atom. This determines the mass of an atom.
- Group number:** tells us the number of valence electrons in a neutral atom. This determines the atom's physical and chemical properties.
- neutral atom:** is an atom that contains equal numbers of protons and electrons.

4. Complete the chart for the following atoms and ions:

Name of Element	Symbol for Element	Atomic Number	Number of Protons	Number of Electrons	Number of Neutrons	Mass Number	Total Electric Charge
Phosphorus	P	15	15	18	15	30	3 -
Manganese	Mn	25	25	23	29	54	2 +
Magnesium	Mg	12	12	12	14	26	0
Fluorine	F	9	9	10	10	19	1-
Argon	Ar	18	18	18	21	39	0
Manganese	Mn	25	25	21	30	55	4 +
Scandium	Sc	21	21	18	23	44	3 +
Chlorine	Cl	17	17	18	19	36	1 -
Phosphorus	P	15	15	12	16	31	3 +

5. Identify any isotopes in the chart in question 4:

Manganese and phosphorus both show isotopes. Isotopes are atoms with the same number of protons but different numbers of neutrons. Isotopes can also be defined as atoms with the same atomic number but different mass numbers.

6. Complete the following chart to compare metals and non-metals:

Property	Metal	Non-metal
Where is it on the Periodic Table?	left side of staircase line	right side of staircase line
Usual colour	usually silver coloured (except copper and gold)	many colours or colourless
State at room conditions	usually solid (except mercury)	can be solid, liquid or gas
Lustre of the solid (shiny or dull)?	shiny	dull
Malleable or brittle?	malleable (can be flattened)	brittle (shatters when hit)
Does it conduct electricity?	good conductor	non-conductor
Number of valence electrons	1, 2 or 3	(4), 5, 6, 7 or 8
Does it lose or gain valence electrons?	loses valence electrons	gains valence electrons (except Noble gases)
Does it form positive or negative ions?	forms positive ions (cations)	forms negative ions (anions)

7. Complete the following chart:

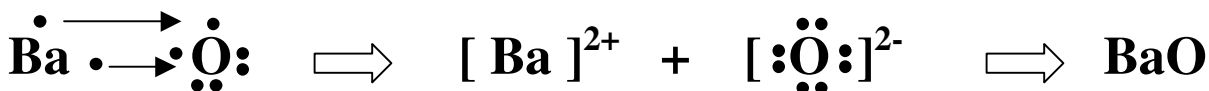
	calcium	bromine	cesium	magnesium	argon	fluorine
Period	4	4	6	3	3	2
Group Number	IIA (2)	VIIB (17)	IA (1)	IIA (2)	VIII (18)	VIIB (17)
# of Valence Electrons	2	7	1	2	8	7

8. Complete the following chart, assuming that hydrogen is a non-metal.

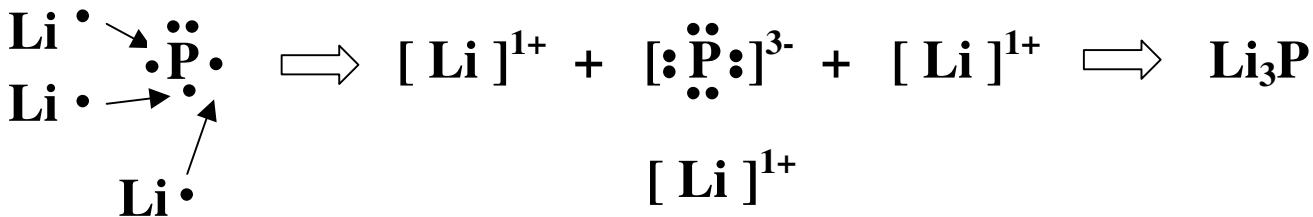
Chemical Formula	Ionic or Covalent Compound?	Number Of Each Type Of Atom Or Ion Present
C ₂ H ₂ F ₄	covalent	2 (C) + 2 (H) + 4 (F)
NO ₂	covalent	1 (N) + 2 (O)
Ba(NO ₃) ₂	ionic	1 (Ba) + 2 (N) + 6 (O)
C ₆ H ₁₂ O ₆	covalent	6 (C) + 12 (H) + 6 (O)
Ca(HCO ₃) ₂	ionic	1 (Ca) + 2 (H) + 2 (C) + 6 (O)
PBr ₃	covalent	1 (P) + 3 (Br)
Sn ₃ (PO ₄) ₄	ionic	3 (Sn) + 4 (P) + 16 (O)

9. Use electron dot diagrams to show the formation of the *ionic* compound between the following pairs of atoms. Show all three steps.

a) barium and oxygen

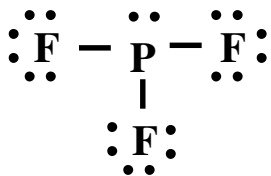


b) lithium and phosphorus



10. Use electron dot diagrams to show the formation of the following *covalent* compounds. Show the bonded electron pairs as “sticks” and include all unshared electron pair.

a) PF₃



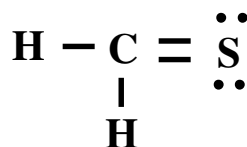
c) H₂O



b) CO₂



d) CH₂S



11. Complete the following chart to compare the properties of ionic and covalent compounds:

Property	Ionic	Covalent
Made from what type of elements?	metal + non-metal(s)	only non-metals
Are electrons shared or transferred?	electrons transferred from the metal to the non-metal to form ions	electrons are shared between non-metal atoms. No ions are formed
State at room conditions	all are solid	can be gas, liquid or solid
Melting point	high melting points	low melting points
Do they usually have an odour?	usually odourless	often have odours
Do they dissolve in water?	usually dissolve in water	often do not dissolve in water
Do they conduct electricity in solution?	conduct electricity in solution	do not conduct in solution

12. Name the following ionic compounds (remember to use Roman Numerals where necessary):

Ca ₃ P ₂	calcium phosphide	Na ₂ (CO ₃)	sodium carbonate
Fe ₂ O ₃	iron (III) oxide	PbCl ₄	lead (IV) chloride
BaS	barium sulfide	Mg(NO ₃) ₂	magnesium nitrate
Co ₂ (SO ₄) ₃	cobalt (III) sulfate	CrBr ₃	chromium (III) bromide
NH ₄ (HCO ₃)	ammonium hydrogen carbonate	Al(OH) ₃	aluminum hydroxide
Ni(PO ₄)	nickel (III) phosphate	MnF ₂	manganese (II) fluoride

13. Write the chemical formulas for the following ionic compounds:

iron (II) sulfide	FeS	zinc carbonate	ZnCO ₃
tin (IV) nitride	Sn ₃ N ₄	manganese (II) bromide	MnBr ₂
cobalt (III) nitrate	Co(NO ₃) ₃	nickel (III) hydroxide	Ni(OH) ₃
lead (IV) oxide	PbO ₂	ammonium phosphate	(NH ₄) ₃ PO ₄
potassium sulfate	K ₂ SO ₄	silver iodide	AgI
aluminum phosphide	AlP	mercury (II) carbide	Hg ₂ C

14. Use the prefix system to name the following covalent (molecular) compounds:

CS ₂ carbon disulfide	SF ₆ sulfur hexafluoride
P ₂ O ₃ diphosphorus trioxide	PI ₃ phosphorus triiodide
NH ₃ nitrogen trihydride	CCl ₄ carbon tetrachloride
SO sulfur monoxide	Cl ₂ O ₅ dichlorine pentoxide

15. Write the chemical formulas for the following covalent compounds:

dihydrogen monoxide H ₂ O	bromine pentafluoride BrF ₅
dicarbon tetrabromide C ₂ Br ₄	nitrogen triiodide NI ₃
sulfur dioxide SO ₂	dinitrogen tetroxide N ₂ O ₄
diphosphorus pentoxide P ₂ O ₅	xenon hexafluoride XeF ₆

16. Balance the following chemical reactions. Classify each reaction as a synthesis, decomposition, single displacement or double displacement reaction.

Type of Reaction

- | | |
|--|---------------------|
| a) 4 Cu + O ₂ → 2 Cu ₂ O | synthesis |
| b) XeF ₆ + 3 H ₂ O → XeO ₃ + 6 HF | double displacement |
| c) 2 Al + 6 HCl → 3 H ₂ + 2 AlCl ₃ | single displacement |
| d) 2 PCl ₃ + 3 H ₂ S → P ₂ S ₃ + 6 HCl | double displacement |
| e) 2 PH ₃ → 3 H ₂ + 2 P | decomposition |
| f) 16 Cu + S ₈ → 8 Cu ₂ S | synthesis |
| g) 2 SnO → 2 Sn + O ₂ | decomposition |
| h) 3 Cu(NO ₃) ₂ + 2 Fe → 2 Fe(NO ₃) ₃ + 3 Cu | single displacement |

17. How do you recognize each type of reaction?

- synthesis has only one **product** (on the right hand side of the equation)
- decomposition has only one **reactant** (on the left hand side of the equation)
- in **single** displacement, one element takes the place another element in a compound
- in **double** displacement, the atoms (ions) from both compounds “change partners”

18. Write the Law of Conservation of Mass. How is it related to balancing chemical equations?

The Law of Conservation of Mass states that the total mass of the products of a reaction is equal to the total mass of the reactants. This relationship indicates that during a chemical reaction, atoms are neither created nor destroyed, they are just rearranged. We must have the same number of each type of atom on both sides of a chemical reaction, so chemical reactions must be balanced to make this true.

19. Will the following increase (↑) or decrease (↓) the rate of a chemical reaction?

- increasing the temperature of the reactants: ↑
- decreasing the surface area of reactants: ↓
- adding water to a reactant to decrease its concentration: ↓
- adding more reactant to make it more concentrated: ↑
- cooling the reactants: ↓
- increasing surface area of reactants: ↑

20. Describe three (3) ways that you could make a “chunk” of aluminum react more SLOWLY with acid.
- keep the piece of aluminum as one big chunk
 - add water to the acid to decrease the concentration of the acid
 - cool the acid and/or the piece of aluminum
 - you could paint the aluminum with some kind of unreactive paint

21. Compare the properties of acids and bases:

Property	Acids	Bases
pH range	0 – 6.5 (7.0)	(7.0) 7.5 – 14
does it react with metal? gas produced?	reacts to produce hydrogen gas	does not react
colour with bromothymol blue	yellow/orange	blue
colour with red or blue litmus	red	blue
colour with phenolphthalein	colourless	pink

22. Write the general equation that occurs when you mix an acid and a base together. What is this called?

When acids and bases are mixed, they under-go a double displacement reaction to form water and a salt. This is called a neutralization reaction because the products of the reaction are neutral (the acidic and basic properties of the reactants are gone).

in general: acid + base → water + a salt

eg. $\text{HCl} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaCl}$

23. Refer to the information in the chart to the right to answer these questions:

- the strongest acid is **apple juice**
- the strongest base is **liquid bleach**
- the weakest acid is **folic acid**
- the weakest base is **soap**
- a neutral substance is **distilled water**
- which is stronger: hair remover or soap? **hair remover** by how much? **1000x**
- which is stronger, apple juice or folic acid? **apple juice** by how much? **100x**

Substance	pH
Red wine	3.8
Hair remover	11
Apple juice	3.0
Soap	8.0
Distilled water	7.0
Folic acid	5.0
Liquid bleach	12.4