



Chem!stry

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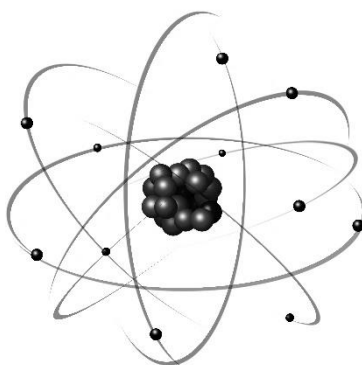
Class:

Date: / /

Notes on Atomic Structure – Macroconcept: Models

Learning Outcomes:

- By the end of the unit, students should understand the concept of *atom*.
- Students will demonstrate their understanding of atomic structure by being able to...
 - (a) State the relative charges and approximate relative masses of a proton, a neutron and an electron.
 - (b) Describe, with the aid of diagrams, the structure of an atom as containing protons and neutrons (nucleons) in the nucleus and electrons arranged in shells (energy levels).
 - (c) Define proton (atomic) number and nucleon (mass) number.
 - (d) Interpret and use symbols such as $^{12}_6\text{C}$.
 - (e) Define the term isotope.
 - (f) Deduce the numbers of protons, neutrons and electrons in atoms and ions given proton and nucleon numbers.
 - (g) Draw the electronic configurations of the first twenty elements (hydrogen to calcium).
 - (h) Understand that atoms with noble gas electronic configurations are inert.
 - (i) Understand that atoms of metallic elements react by losing their valence electrons to form positively charged ions (cations) with a noble gas electronic configuration.
 - (j) Understand that atoms of non-metallic elements react by gaining electrons into their valence shell to form negatively charged ions (anions) with a noble gas electronic configuration.
 - (k) Understand generalisations about models and how models are used by scientists to visualise and understand complex ideas.



1. What is the definition of *atom*?

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2. Atoms are extremely small. Even with the use of modern technology, it is not possible to observe the detailed structure of an individual atom. On what evidence do scientists base their understanding of atomic structure?

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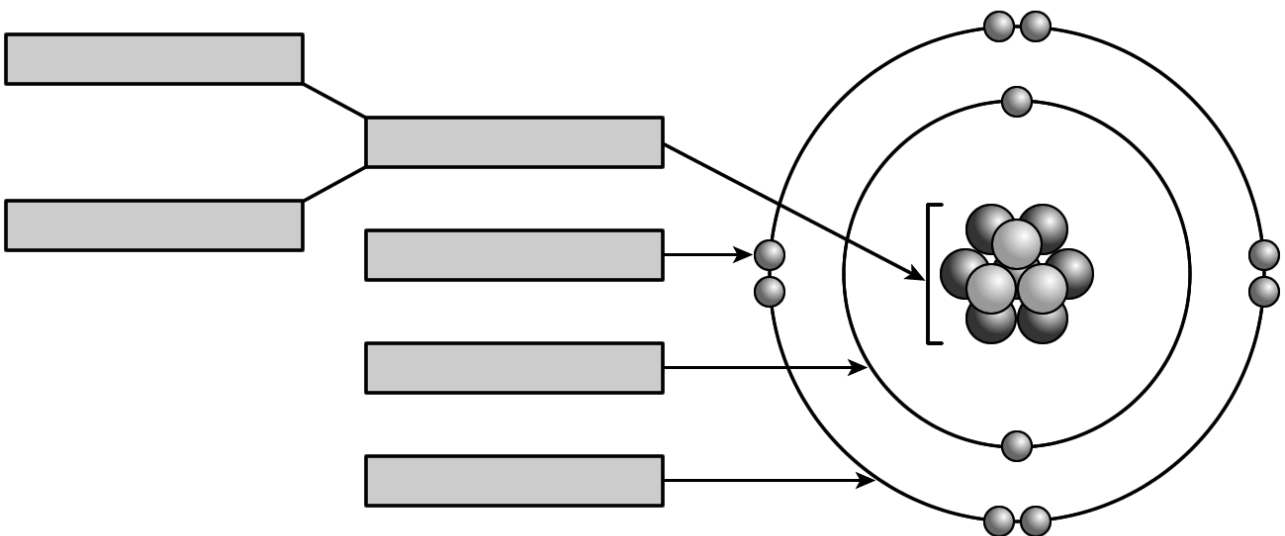
3. Modern understanding of atomic structure is a conceptual *model*. Ideas about atomic structure may change as new evidence is discovered. What are some generalisations about *models*?

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4. At the centre of every atom is a small dense This is composed of two sub-atomic particles known as (which carry a charge of +1) and (which carry a charge of 0)*. A third sub-atomic particle known as an (which carries a charge of -1) orbits around the centre of the atom in energy levels that are often referred to as The inner shell (closest to the centre) can hold a maximum number of while the second and third shells can hold a maximum number of each.

*Note: There is one exception. The nucleus of a hydrogen atom does not contain any neutrons.

5. Label the diagram shown below to summarise the fundamental structure of an atom.



6. Complete the table shown below to summarise the fundamental properties of protons, neutrons and electrons.

Name of Sub Atomic Particle	Particle's Location in Atom	Particle's Charge	Particle's Relative Mass
Proton			
Neutron			
Electron			

7. Explain why atoms are electrically neutral.

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8. (a) Define the term *atomic number*.

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- (b) Define the term *mass (nucleon) number*.

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- (c) How are the number of neutrons in an atom calculated?

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9. How many protons, neutrons and electrons do the atoms of the following elements contain?

(a) ${}^7_3\text{Li}$ protons = neutrons = electrons =

(b) ${}^{19}_9\text{F}$ protons = neutrons = electrons =

(c) ${}^{23}_{11}\text{Na}$ protons = neutrons = electrons =

10. (a) What is the relationship between an element's position in the Periodic Table and the number of *electron shells* in an atom of that chemical element?

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- (b) What is the relationship between an element's position in the Periodic Table and the number of electrons in the *valence shell* of an atom of that chemical element?

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- (c) What is the relationship between an element's position in the Periodic Table and the total number of electrons contained within a single atom of that element?

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11. Based upon its electronic configuration, how can you determine whether an atom belongs to a metallic element or a non-metallic element?

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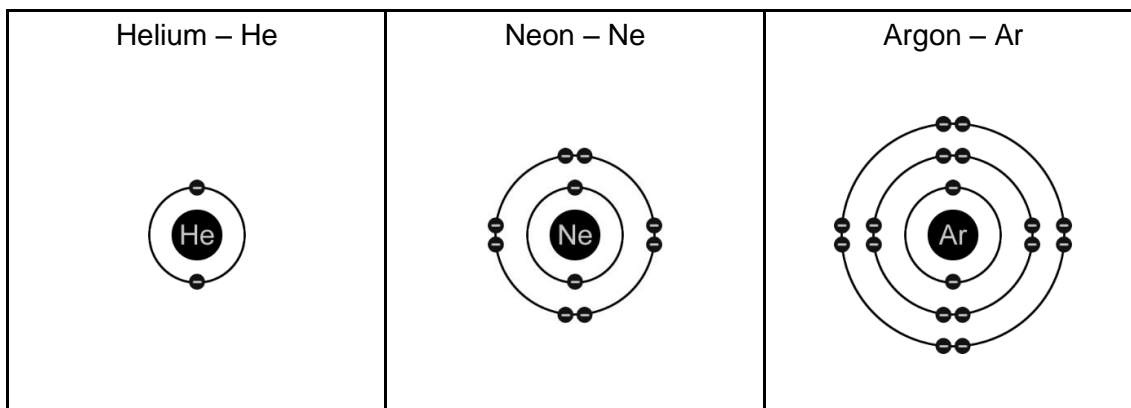
12. In the space provided below, draw the full electronic configuration of (a) an atom of oxygen (b) an atom of aluminium.

<p>(a) Electronic configuration of a single oxygen atom.</p>	<p>(a) Electronic configuration of a single aluminium atom.</p>
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13. Define the term *isotope*.

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14. The electronic configurations of helium, neon and argon are given below.



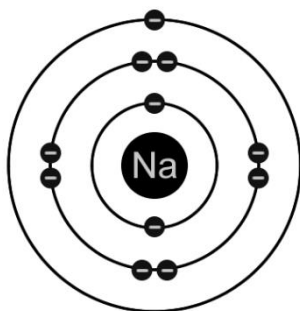
(a) What is unique about the electronic configurations of helium, neon and argon?

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(b) How do the unique electronic configurations of helium, neon and argon affect their reactivity?

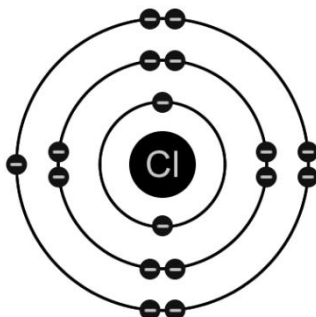
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15. The diagram below shows the full electronic configuration of a sodium atom.



With the aid of a diagram, explain how a sodium atom reacts to obtain a noble gas electronic configuration.

16. The diagram below shows the full electronic configuration of a chlorine atom.



With the aid of a diagram, explain how a chlorine atom reacts to obtain a noble gas electronic configuration.

- Scan the QR code below for the answers to this assignment.



http://www.chemist.sg/chemical_bonding/notes_atomic_structure/notes_atomic_structure_ans.pdf

Periodic Table

The Periodic Table of the Elements

I		II		Group										III	IV	V	VI	VII	0																																																																									
7 Li lithium 3	9 Be beryllium 4	23 Na sodium 11	24 Mg magnesium 12	39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54	133 Cs caesium 55	137 Ba barium 56	178 Hf hafnium 72	179 Ta tantalum 73	181 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	210 Po polonium 84	210 At astatine 85	210 Rn radon 86																																																						
11 B boron 5	12 C carbon 6	13 Al aluminium 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54	55 Cs caesium 55	56 Ba barium 56	57 La lanthanum 57	58 Ce cerium 58	59 Pr praseodymium 59	60 Nd neodymium 60	61 Pm promethium 61	62 Sm samarium 62	63 Eu europium 63	64 Gd gadolinium 64	65 Tb terbium 65	66 Dy dysprosium 66	67 Ho holmium 67	68 Er erbium 68	69 Tm thulium 69	70 Yb ytterbium 70	71 Lu lutetium 71	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86	87 Fr francium 87	88 Ra radium 88	89 Ac actinium 89	90 Th thorium 90	91 Pa protactinium 91	92 U uranium 92	93 Np neptunium 93	94 Pu plutonium 94	95 Am americium 95	96 Cm curium 96	97 Bk berkelium 97	98 Cf californium 98	99 Es einsteinium 99	100 Fm fermium 100	101 Md mendelevium 101	102 No nobelium 102	103 Lr lawrencium 103
1 H hydrogen 1																				2 He helium 2																																																																								

*58-71 Lanthanoid series
†90-103 Actinoid series

Key $\begin{matrix} a \\ X \\ b \end{matrix}$
 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number