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Chemistry $\sim$ Ms. Hart Class: Anions or Cations
200 Things to Know to Pass the Chemistry Regents - Part I
Directions: Review each of the concepts below and answer the questions associated with each number (if applicable).

1. Protons are positively charged (+) with a mass of 1 amu .

Example: Which has the greatest nuclear charge? Cl-35 Ar-40 K-39 Ca-40
2. Neutrons have no charge and a mass of 1 amu .
3. Electrons are small and are negatively charged (-) with a mass of almost o amu..
4. Protons \& neutrons are in an atom's nucleus (nucleons).

Which has the greatest number of nucleons? Sn-119 Sb-122 Te-128 $\quad$ I-127
5. Electrons are found in "clouds" (orbitals) around an atom's nucleus.

Where is most of the mass of an atom found?
Where is most of the size (volume) of an atom found?
6. The mass number is equal to an atom's number of protons and neutrons added together.

What is the mass number of an atom with 18 protons and 22 neutrons?
7. The atomic number is equal to the number of protons in the nucleus of an atom.

Which has the greatest atomic number?

$$
S \quad C l \quad A r \quad K
$$

8. The number of neutrons $=$ mass number - atomic number.

Which correctly represents an atom of neon containing 11 neutrons?
${ }^{11} \mathrm{Ne} \quad{ }^{21} \mathrm{Ne} \quad{ }^{20} \mathrm{Ne} \quad{ }^{22} \mathrm{Ne}$
9. In a neutral atom the number of protons = the number of electrons.
10. Isotopes are atoms with equal numbers of protons, but differ in their neutron numbers.

Two isotopes of the same element will have the same number of neutrons and electrons, neutrons and nucleons, protons and nucleons, protons and electrons
11. Cations are positive ( + ) ions and form when a neutral atom loses electrons.

They are smaller than their parent atom.
Which of the following will form an ion with a smaller radius that that of its atom?
$\mathrm{Cl} \quad \mathrm{N} \quad \mathrm{Br} \quad \mathrm{Ba}$
12. Anions are negative ions and form when a neutral atom gains electrons.

They are larger than their parent atom.
Which electron configuration is correct for a fluoride ion?

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2-7 2-8 2-8-1 2-6
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13. Ernest Rutherford's gold foil experiment showed that an atom is mostly empty space with a small, dense, positively charged nucleus.
14. J.J. Thompson discovered the electron and developed the "plum-pudding" model of the atom.

| +-+- | Positive \& negative |
| :---: | :--- |
| +-+-+ | particles spread throughout |
| -+-+ | entire atom. |

15. Dalton's model of the atom was a solid sphere of matter that was uniform throughout.
16. The Bohr Model of the atom placed electrons in "planet-like" orbits around the nucleus of an atom.
17. The current, wave-mechanical model of the atom has electrons in "clouds" (orbitals) around the nucleus.
18. Electrons can be excited to jump to higher energy levels. They emit energy as light when they fall from higher energy levels back down to lower (ground state) energy levels. Bright line spectra are produced.
19. Elements are pure substances composed of atoms with the same atomic number. They cannot be decomposed. A compound differs from an element in that a compound

$$
\begin{array}{ll}
\text { Has a homogeneous composition } & \text { has one set of properties } \\
\text { Has a heterogeneous composition } & \text { can be decomposed }
\end{array}
$$

20. Binary compounds are substances made up of only two kinds of atoms. "Ternary" compounds contain three (or more) kinds of atoms. Which substance is a binary compound?

Ammonia magnesium potassium nitrate methanol
21. Diatomic molecules are elements that form two atom molecules in their natural form at STP. Which element is a diatomic liquid at STP? Chlorine fluorine bromine iodine
22. Use this diagram to help determine the number of significant figures in a measured value...

## Pacific



If the decimal point is present, start counting digits from the Pacific (left) side, starting with the first non-zero digit.

$$
0.003100 \text { (..... sig. figs.) }
$$

If the decimal point is absent, start counting digits from the Atlantic (right) side, starting with the first non-zero digit.
31,400 (......sig. figs.)
23. When multiplying or dividing measurements, final answer must have as many digits as the measurement with the fewest number of digits.

When adding or subtracting, use place value.
What is the density of the object measured in lab by the displacement of water according to
The data below:

| Mass of object: | 23.6 g |
| :--- | :---: |
| Volume of water: | 15.0 mL |
| Volume of water + object: | 18.2 mL |

24. Solutions are the best examples of homogeneous mixtures. They have two sets of properties.
25. Heterogeneous mixtures have discernable components and are not uniform throughout.

Air is classified chemically as a(n)
Substance compound element mixture
26. A solute is the substance being dissolved; the solvent is the substance that dissolves the solute. $\mathrm{NaCl}(\mathrm{s})$ is added to water. The solute is $\qquad$ the solvent is $\qquad$ the solution is $\qquad$
27. Isotopes are written in a number of ways: $\mathrm{C}-14$ is also Carbon-14, and is also
$\qquad$
$\qquad$
28. The average atomic mass is the weighted average mass of all the known isotopes of an element.

Find the average atomic mass of lithium if $7.4 \%$ are ${ }^{6}$ Li and $92.6 \%$ are ${ }^{7} \mathrm{Li}$.
29. The distribution of electrons in an atom is its electron configuration.
30. Electron configurations are written in the bottom center of an element's box on the periodic table in your reference tables. The outermost electrons are the valence electrons.


$$
\begin{aligned}
& 2 \text { = \# of electrons in ........... } \\
& 8= \# \text { of electrons in ....... } \\
& 3= \text { \# of electrons in ......... }
\end{aligned}
$$

33. Electron dot model is a way of representing the valence electron of an atom. ' x '
represents the electron-dot symbol of this element $\begin{gathered}C \\ \end{gathered}$
34. The kernel of an atom includes everything in an atom except the atom's valence electrons.

The kernel of this element contains 11 protons and 10 electrons $\begin{array}{llll}O & F & \mathrm{Ne} & \mathrm{Na}\end{array}$
35. Polyatomic ions (Table E) are groups of atoms, covalently bonded together, with an overall charge.

Nitrate: .........., $\quad \mathrm{NH}_{4}^{+}$: ............, sulfite: ............, etc.
Which of the following contains both ionic and covalent bonds?
$\begin{array}{llll}\mathrm{NaOH} & \mathrm{CH}_{3} \mathrm{OH} & \mathrm{NaCl} & \mathrm{Cl}_{2}\end{array}$
36. Coefficients are written in front of the formulas of reactants and products to balance chemical equations. They give the ratios of reactants and products in a balanced chemical equation.
$\qquad$ $+\quad . . . . . . C l_{2} \rightarrow$ $\qquad$ . NaCl
37. Chemical formulas are written so that the charges of cations and anions neutralize (cancel) one another. calcium phosphate: $\mathrm{Ca}^{2+} \mathrm{PO}_{4}{ }^{3-}=$ $\qquad$
38. When naming binary ionic compounds, write the name of the positive ion (cation) first, followed by the name of the negative ion (anion) with the name ending in "-ide."
$\mathrm{CaCl}_{2}$ $\qquad$ $M g S$ $\qquad$
39. When naming compounds containing polyatomic ions, keep the name of the polyatomic ion the same as it is written in Table E.
$\mathrm{NH}_{4} \mathrm{Cl}$.......... Dimercury (I) nitrate $\qquad$
40. Roman numerals are used to show the positive oxidation number of the cation if it has more than one positive oxidation number

FeO : $\qquad$ Nickel (III) sulfate: $\qquad$
41. Physical changes do not form new substances. They merely change the appearance of the original material. (The melting of ice) $\mathrm{H}_{2} \mathrm{O}(\mathrm{s}) \rightarrow \mathrm{H}_{2} \mathrm{O}$ (l)
42. Chemical changes result in the formation of new substances.

Which process is an example of a chemical change?
the melting of ice the electrolysis of water
43. Reactants are on the left side of the reaction arrow and products are on the right.
44. Temperature is a measure of average kinetic.

Which sample has the highest average kinetic energy?

$$
\mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \text { at } \mathrm{o}^{\circ} \mathrm{C} \quad \mathrm{H}_{2} \mathrm{O}(\mathrm{~s}) \text { at } 0^{\circ} \mathrm{C} \quad \mathrm{CO}_{2}(\mathrm{~g}) \text { at } S T P \quad \mathrm{Mg}(\mathrm{~s}) \text { at } 298 \mathrm{~K}
$$

58. Solids have a definite shape and volume.

In what region of the graph below would you only find molecules with definite shape and volume?
59. Liquids have closely-spaced particles that easily slide past one another; they have no definite shape, but have a definite volume.
60. Gases have widely-spaced particles that are in random motion (collide with container to create pressure).
61. Gases are easily compressed and have no definite shape or volume.

In what region of the graph below would you only find a sample with no definite shape or volume?
62. Be able to read and interpret heating/cooling curves as pictured below.

During which interval on the graph are solid and liquid in equilibrium?

63. Substances that sublime turn from a solid directly into a gas.

They have very weak attractive forces. (examples include $\mathrm{CO}_{2} \& \mathrm{I}_{2}$ )
64. As they evaporate, liquids become gases, which create vapor pressure. (Reference Table H).

As temperature increases, vapor pressure increases.
This liquid on Reference Table H has the weakest attractive forces:
Propanone ethanol water acetic acid
65. "STP" means "Standard Temperature and Pressure." Reference Table B

These conditions define $S T P \quad P=$.....atm $\quad T=\ldots . . K$
66. Degrees Kelvin $=\mathrm{C}+273$

Room temperature $=25^{\circ} \mathrm{C}=\ldots . . . . \mathrm{K}$ Boiling point of helium $=4 \mathrm{~K}=$ $\qquad$ ${ }^{\circ} \mathrm{C}$
67. Heat is a transfer of energy from a material at higher temperature to one at lower temperature.

When an ice pack is applied to a bruised arm, $\qquad$ transfers from $\qquad$ to $\qquad$
68. Use this formula to calculate heat absorbed/released by substances.
$\mathrm{q}=\mathrm{mcDt}$
$\mathrm{q}=$ heat absorbed or released (Joules)
$\mathrm{m}=$ mass of substance in grams
$\mathrm{c}=$ specific heat capacity of substance $(\mathrm{J} / \mathrm{gC}) . .$. for water it's $4.18 \mathrm{~J} / \mathrm{g} \mathrm{C}$.
$\mathrm{Dt}=$ temperature change in degrees Celsius
What is the total number of joules of heat energy absorbed by 12 grams of water when it is heated from $30^{\circ} \mathrm{C}$ to $40^{\circ} \mathrm{C}$ ?
69. The heat absorbed or released when 1 gram of a substance changes between the solid and liquid phases is the substance's heat offusion. (Reference Table B: $334 \mathrm{~J} / \mathrm{g}$ for water)

How many joules are required to melt $15 \mathrm{~g} \mathrm{H} \mathrm{H}_{2} \mathrm{O}$ (s)?
70. The heat absorbed or released when 1 gram of a substance changes between the liquid and gaseous phases
is the substance's heat of vaporization. (Reference Table B: $2260 \mathrm{~J} / \mathrm{g}$ for water)
How many joules are required to boil $120 \mathrm{~g} \mathrm{H}_{2} \mathrm{O}$ (l)?
71. Always use Kelvins for temperature when using the combined gas law.

$$
\underline{\mathrm{P}}_{1} \underline{\mathrm{~V}}_{\underline{1}}=\underline{\mathrm{P}}_{2} \underline{\mathrm{~V}}_{\underline{2}} \underline{\mathrm{~T}}_{2}
$$

Set up the equation to calculate the volume of 50. mL of methane gas collected at STP when the pressure rises to 2.4 atm and the temperature drops to 240 K .
72. As the pressure exerted on a gas increases, the volume decreases proportionally.
$25 L$ of a gas is held at 1.2 atm pressure. Find the new volume if pressure drops to 0.80 atm at constant temperature.
73. As the pressure on a gas increases, temperature increases.

A sample of gas exerts a pressure of $220 . \mathrm{kPa}$ at 373 K . Find the pressure at 373 K at constant volume.
74. As the temperature of a gas increases, volume increases.

15 mL of oxygen gas is collected at $0^{\circ} \mathrm{C}$. Find the volume at $50^{\circ} \mathrm{C}$ at constant pressure.
75. Real gas particles have volume and are attracted to one another.They don"t always behave like ideal gases.

Lighter gases (with weaker attractive forces) are often most ideal.
Which of the following is the most ideal gas?
$\mathrm{He} \quad \mathrm{Ne} \quad \mathrm{Ar} \quad \mathrm{Kr}$
76. Real gases behave more like ideal gases at low pressures and high temperatures.
77. Mixtures may be separated by several physical means:

Distillation separates mixtures with different boiling points. Fractional distillation is a common method to separate and collect Hydrocarbons Ionic solids Metals Precipitates

Filtration separates mixtures of solids and liquids. What would collect in filter paper if a mixture of $\mathrm{NaCl}(\mathrm{aq})$ and $\mathrm{CaCO}_{3}(\mathrm{~s})$ were poured through?

Chromatography can also be used to separate mixtures of liquids and mixtures of gases.
78. The Periodic Law states that the properties of elements are periodic functions of their atomic numbers.

Elements are arranged on the modern periodic table in order of increasing
79. Periods are horizontal rows on the Periodic Table.

In which energy level are the valence electrons of the elements in Period 3 found?
8o. Groups are vertical columns on the Periodic Table.
Which group on the periodic table contains a solid, liquid, and gas(es)?
81. Metals are found left of the "staircase" on the Periodic Table and at the bottom, nonmetals are above it and at the top, and metalloids border it.

Which of the following Group 14 elements has the greatest metallic character?
Carbon silicon germanium tin
82. Complete and memorize this chart.

| Metals | Malleable <br> and ductile | All solids <br> except <br> $\ldots . . . .$. | Lustrous | Good <br> conductors <br>  <br> electricity | $\ldots \ldots .$. <br> ionization <br> energy and <br> electroneg. | Tend to form <br> $\ldots . .$. ions |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Nonmetals | Brittle <br> when solid | Mostly <br> gases at <br> STP | Dull | Good <br> insulators | $\ldots . . .$. <br> ionization <br> energy and <br> electroneg. | Tend to form <br> $\ldots .$. ions |

83. Noble gases (Group 18) are unreactive and stable due to the fact that their valence level of electrons is completely filled.
84. Ionization energy increases as you go up and to the right on the Periodic Table. Which element among the diagrams below has the lowest ionization energy?
85. Atomic radii decrease left to right across a period due to increasing nuclear charge. Which period 3 element among the diagrams below has the largest radius?
86. Atomic radii increase as you go down a group due to increased electron energy levels. Which alkali metal among the diagrams below has the largest radius?
87. Electronegativity is a measure of an element's attraction for electrons.

Which of the following atoms has the greatest tendency to attract electrons? calcium carbon copper chlorine
88. Electronegativity increases as you go up and to the right on the Periodic Table. Which element among the diagrams below has the greatest electronegativity?
89. The elements in Group 1 are the alkali metals; those in Group 2 are the alkaline earth metals. Which atom below represents the alkali metal of period 2?
90. The elements in Group 17 are the halogens.

Which element among the diagrams below is a halogen?
91. The elements in Group 18 are the noble gases.

Which element among the diagrams below is a noble gas?

92. Use Table $\boldsymbol{S}$ to compare and look up the properties of specific elements.

The freezing point of phosphorus is $\qquad$ .${ }^{\circ} \mathrm{C}$
93. Energy is absorbed when a chemical bond breaks. Energy is released when a chemical bond forms.

The greater the energy, the more stable the bond that forms.
Which of the following, according to Reference Table I, is the most stable compound?

Ethane ethane ethyne hydrogen iodide
94. The last digit of an element's group number is equal to its number of valence electrons.

Which contains the greatest number of valence electrons?
Ca
Ge
Se
Kr
95. Draw one dot for each valence electron when drawing an element's or ion's Lewis electron dot diagram.

Which dot model would contain the fewest dots as valence electrons?
Ca $\quad$ Ge $\quad \mathrm{Se} \quad \mathrm{Kr}$
96. Metallic bonds can be thought of as a crystalline lattice of kernels surrounded by a "sea" of mobile valence electrons.

Metallic bonding occurs between atoms of
sulfur sodium fluoride sodium carbon
97. Atoms are most stable when they have 8 valence electrons (an octet) and tend to form ions to obtain such a configuration of electrons.

Which of the following atoms forms a stable ion that does not have an octet structure?
Li
F
Na
Cl
98. Covalent bonds form when two atoms share a pair of electrons.

How many covalent bonds are found in a nitrogen $\left(N_{2}\right)$ molecule?
99. Ionic bonds form when one atom transfers an electron to another atom when forming a bond with it.

Which substance exhibits ionic bonding rather than covalent bonding?
$\begin{array}{lllll}\mathrm{CO}_{2} & \mathrm{~N}_{2} \mathrm{O}_{4} & \mathrm{SiO}_{2} & \mathrm{CaBr}_{2} & \mathrm{C}_{6} \mathrm{H}_{12} \mathrm{O}_{6}\end{array}$
100. Dot models may be used to represent the formation of ions or covalent molecules.
. Given the equation:
$\therefore \ddot{\mathrm{F}}+1 \mathrm{e}^{-} \longrightarrow[\because \stackrel{\rightharpoonup}{\mathrm{F}}:]$
This equation represents the formation of a
fluoride ion, which is smaller in radius than a fluorine atom
fluoride ion, which is larger in radius than a fluorine atom
fluorine atom, which is smaller in radius than a fluoride ion
fluorine atom, which is larger is radius than a fluoride ion
101. Nonpolar covalent bonds form when two atoms of the same element bond together.
102. Polar covalent bonds form when the electronegativity difference between two bonding atoms is between 0.6 and 1.7 .

Which of the following combinations would form a polar covalent bond?
$H$ and $H \quad$ Na and $N$ and $N \quad$ Na and Br
103. Ionic bonds form when the electronegativity difference between two bonding atoms is greater than 1.7.
104. Substances containing mostly covalent bonds are called molecular substances.

They are attracted to each other by weak van der Waals or stronger hydrogen attractions
Which of the following is a molecular substance?
Lithium chloride carbon monoxide sodium nitrate aluminum
oxide
105. Van der Waals attractive forces are the attractive force between nonpolar molecules.

Nonpolar molecules are molecules that have structural symmetry.
106. Van der Waals attractions become stronger with increasing molar mass.

Which of the following samples has the greatest forces of attraction?

$$
\begin{array}{cccc}
\mathrm{F}_{2} & C l_{2} & B r_{2} & I_{2}
\end{array}
$$

107. Polar molecules have stronger forces of attraction. The lack structural symmetry.

Which of the following is a polar molecule?

| $\mathrm{CO}_{2}$ | $\mathrm{H}_{2} \mathrm{O}$ | $\mathrm{C}_{4} \mathrm{H}_{10}$ | $\mathrm{~N}_{2}$ |
| :--- | :--- | :--- | :--- |

108. Hydrogen bonds are attractive forces that form when hydrogen bonds to the elements $\mathrm{N}, \mathrm{O}$, or F and gives the compound unexpectedly high melting and boiling points.

The strongest forces of attraction occur between molecules of
HCl
HBr
HF
HI
109. Substances containing mostly ionic bonds are called ionic compounds.

They are made of metal and nonmetallic ions. They are held together by electrostatic (ionic) forces.
110. Complete and memorize this table.

| Substance Type | Properties |
| :---: | :---: |
| Ionic | Hard <br> (Low/high) melting and boiling points <br> Conduct electricity when molten or aqueous |
| Covalent (Molecular) | Soft <br> (Low/high) melting and boiling points <br> Do not conduct electricity (insulators) |

111. Remember: substances tend to be soluble in solvents with similar molecular properties.
"Like dissolves like"
Pentane does not dissolve in water because pentane is $\qquad$ and water is $\qquad$
112. As temperature increases, solubility increases for most solids.

For which solid does increasing temperature have the least effect on solubility? Potassium nitrate ammonium chloride potassium chlorate sodium chloride

