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AP Chemistry Summer Work

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Atomic Theory and Models of the Atom

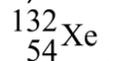
1) Consider the following selected postulates of Dalton's atomic theory:

- (i) Each element is composed of extremely small particles called atoms.
- (ii) Atoms are indivisible.
- (iii) Atoms of a given element are identical.
- (iv) Atoms of different elements are different and have different properties.

Which of the postulates is(are) no longer considered valid?

- A) (i) and (ii)
- B) (ii) only
- C) (ii) and (iii)
- D) (iii) only
- E) (iii) and (iv)

2) There are _____ electrons, _____ protons, and _____ neutrons in an atom of



- A) 132, 132, 54
- B) 54, 54, 132
- C) 78, 78, 54
- D) 54, 54, 78
- E) 78, 78, 132

3) Which pair of atoms constitutes a pair of isotopes of the same element?

- A) ${}_{6}^{14}\text{X}$ ${}_{7}^{14}\text{X}$
- B) ${}_{6}^{14}\text{X}$ ${}_{6}^{12}\text{X}$
- C) ${}_{9}^{17}\text{X}$ ${}_{8}^{17}\text{X}$
- D) ${}_{10}^{19}\text{X}$ ${}_{9}^{19}\text{X}$
- E) ${}_{10}^{20}\text{X}$ ${}_{11}^{21}\text{X}$

4) The element X has three naturally occurring isotopes. The masses (amu) and % abundances of the isotopes are given in the table below. The average atomic mass of the element is _____ amu.

	Isotope	Abundance	Mass
A) 219.7	${}^{221}\text{X}$	74.22	220.9
B) 220.4	${}^{220}\text{X}$	12.78	220.0
C) 220.42	${}^{218}\text{X}$	13.00	218.1
D) 218.5			
E) 221.0			

5) Silver has two naturally occurring isotopes with the following isotopic masses:

$^{107}_{47}\text{Ar}$	$^{107}_{47}\text{Ar}$
106.90509	108.9047

The average atomic mass of silver is 107.8682 amu. The fractional abundance of the lighter of the two isotopes is _____.

- A) 0.24221
- B) 0.48168
- C) 0.51835
- D) 0.75783
- E) 0.90474

6. Which of the following conclusions can be drawn from J. J. Thomson's plum pudding model?

- (A) Atoms contain electrons.
- (B) Practically all the mass of an atom is contained in its nucleus.
- (C) Atoms contain protons, neutrons, and electrons.
- (D) Atoms have a positively charged nucleus surrounded by an electron cloud.
- (E) No two electrons in one atom can have the same four quantum numbers.

Questions 7-9: Use the following answer choices.

- (A) Wave nature of matter
- (B) Spectral lines
- (C) Quantum numbers
- (D) Bohr Model

7. Explained spectral lines by postulating that electrons were only able to exist in discrete orbits of differing energies around the atom.

8. Describes the location of an electron series of possible quantum states that are allowed - some of which are favored energetically for certain electrons over others.

9. Caused by electrons emitting energy as they transitioned from one specific orbit to another.

10. Which of the following is a correct interpretation of the results of Rutherford's experiments in which gold atoms were bombarded with alpha particles?

- A) Atoms have equal numbers of positive and negative charges.
- B) Electrons in atoms are arranged in shells.
- C) Neutrons are at the center of an atom.
- D) Neutrons and protons in atoms have nearly equal mass.
- E) The positive charge of an atom is concentrated in a small region.

11) The energy of a photon of light is _____ proportional to its frequency and _____ proportional to its wavelength.

- A) directly, directly
- B) inversely, inversely
- C) inversely, directly
- D) directly, inversely
- E) indirectly, not

12) What is the wavelength of light (nm) that has a frequency of $3.22 \times 10^{14} \text{ s}^{-1}$?

- A) 932
- B) 649
- C) 9.66×10^{22}
- D) 9.32×10^{-7}
- E) 1.07×10^6

13) The energy of a photon that has a wavelength of 9.0 m is _____ J.

- A) 2.2×10^{-26}
- B) 4.5×10^{25}
- C) 6.0×10^{-23}
- D) 2.7×10^9
- E) 4.5×10^{-25}

Periodic Table

- 14) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?
- A) O, S
 - B) C, N
 - C) K, Ca
 - D) H, He
 - E) Si, P
- 15) An element that appears in the lower left corner of the periodic table is _____.
- A) either a metal or metalloid
 - B) definitely a metal
 - C) either a metalloid or a non-metal
 - D) definitely a non-metal
 - E) definitely a metalloid
- 16) The elements in groups 1, 17, and 18 are called, _____, respectively.
- A) alkaline earth metals, halogens, and chalcogens
 - B) alkali metals, chalcogens, and halogens
 - C) alkali metals, halogens, and noble gases
 - D) alkaline earth metals, transition metals, and halogens
 - E) halogens, transition metals, and alkali metals
- 17) Which one of the following is most likely to lose electrons when forming an ion?
- A) F
 - B) P
 - C) Rh
 - D) S
 - E) N
- 18) When a metal and a nonmetal react, the _____ tends to lose electrons and the _____ tends to gain electrons.
- A) metal, metal
 - B) nonmetal, nonmetal
 - C) metal, nonmetal
 - D) nonmetal, metal
 - E) None of the above, these elements share electrons.
- 19) _____ typically form ions with a 2+ charge.
- A) Alkaline earth metals
 - B) Halogens
 - C) Chalcogens
 - D) Alkali metals
 - E) Transition metals

Chemical Names/Formulas

20) What is the ratio of hydrogen to oxygen atoms in the mineral cacoxenite, $\text{Fe}_4(\text{PO}_4)_3(\text{OH})_3 \cdot 12\text{H}_2\text{O}$?

- A) 27:19
- B) 15:27
- C) 15:24
- D) 1:1
- E) 27:25

21) Which of the following compounds would you expect to be ionic?

- A) SF_6
- B) H_2O
- C) H_2O_2
- D) NH_3
- E) CaO

22) The charge on the iron ion in the salt Fe_2O_3 is _____.

- A) +1
- B) +2
- C) +3
- D) -5
- E) -6

23) What is the formula of the compound formed between strontium ions and nitrogen ions?

- A) SrN
- B) Sr_3N_2
- C) Sr_2N_3
- D) SrN_2
- E) SrN_3

24) Which species below is the nitride ion?

- A) Na^+
- B) NO_3^-
- C) NO_2^-
- D) NH_4^+
- E) N^{3-}

25) Which one of the following compounds is chromium(III) oxide?

- A) Cr_2O_3
- B) CrO_3
- C) Cr_3O_2
- D) Cr_3O
- E) Cr_2O_4

26) What is the correct formula for ammonium sulfide?

- A) NH_4SO_3
- B) $(\text{NH}_4)_2\text{SO}_3$
- C) $(\text{NH}_4)_2\text{S}$
- D) NH_3S
- E) N_2S_3

27) Which formula/name pair is incorrect

- A) FeSO_4 iron(II) sulfate
- B) $\text{Fe}_2(\text{SO}_3)_3$ iron(III) sulfite
- C) FeS iron(II) sulfide
- D) FeSO_3 iron(II) sulfite
- E) $\text{Fe}_2(\text{SO}_4)_3$ iron(III) sulfide

28) The formula for the compound formed between aluminum ions and phosphate ions is

- A) $\text{Al}_3(\text{PO}_4)_3$
- B) AlPO_4
- C) $\text{Al}(\text{PO}_4)_3$
- D) $\text{Al}_2(\text{PO}_4)_3$
- E) AlP

29) Barium reacts with a polyatomic ion to form a compound with the general formula $\text{Ba}_3(\text{X})_2$. What would be the most likely formula for the compound formed between sodium and the polyatomic ion X?

- A) NaX
- B) Na_2X
- C) Na_2X_2
- D) Na_3X
- E) Na_3X_2

30) Which one of the following is TRUE concerning the simplest unit of MgCl_2 ?

- A) 1 Mg atom and 1 Cl_2 molecule
- B) 1 MgCl_2 molecule
- C) 1 Mg atom and 2 chlorine atoms
- D) 1 positive ion and 2 negative ions
- E) 1 positive and 1 negative ion

Mole Concept

31) The molar mass of $(\text{NH}_4)_3\text{PO}_4$ is

- A) 116.03 g/mol
- B) 121.07 g/mol
- C) 149.09 g/mol
- D) 155.42 g/mol
- E) 242.01 g/mol

32) One mole of _____ contains the largest number of atoms.

- A) S_8
- B) C_{10}H_8
- C) $\text{Al}_2(\text{SO}_4)_3$
- D) Na_3PO_4
- E) Cl_2

33) A 30.5 gram sample of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) contains _____ mol of glucose.

- A) 0.424
- B) 0.169
- C) 5.90
- D) 2.36
- E) 0.136

34) How many moles of oxygen are in 1.08 moles of $\text{Ca}(\text{NO}_3)_2$?

- A) 7.55 moles
- B) 1.43 moles
- C) 6.48 moles
- D) 33.8 moles
- E) 1.16×10^{23} moles

35) How many grams of calcium nitrate, $\text{Ca}(\text{NO}_3)_2$, contains 24 grams of oxygen atoms?

- A) 164 grams
- B) 96 grams
- C) 62 grams
- D) 50. grams
- E) 41 grams

36) How many molecules of CH_4 are in 48.2 g of this compound?

- A) 5.00×10^{24}
- B) 3.00
- C) 2.90×10^{25}
- D) 1.81×10^{24}
- E) 4.00

37) What number of moles of O_2 is needed to produce 14.2 grams of P_4O_{10} from P in a synthesis reaction where 1 mol of P_4O_{10} is produced for every 5 mol O_2 that reacts?

(Molecular weight $\text{P}_4\text{O}_{10} = 284$)

- A) 0.0500 mole
- B) 0.0625 mole
- C) 0.125 mole
- D) 0.250 mole
- E) 0.500 mole

38) Which of the following gas samples contains the greatest mass of gas molecules?

- A) 1.0 liter of He at STP
- B) 1.0 liter of Xe at STP
- C) 1.0 liter of H_2 at STP
- D) All three are the same.

39) The molarity of an aqueous solution containing 75.3 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in 35.5 mL of solution is _____.

- A) 1.85
- B) 2.12
- C) 0.197
- D) 3.52
- E) 11.8

40) How many milliliters of 0.123 M NaOH solution contain 25.0 g of NaOH (molar mass = 40.00 g/mol)?

- A) 50.80 mL
- B) 625 mL
- C) 5080 mL
- D) 7.69 mL

41) What is the total concentration of ions in a 0.0360 M solution of Na_2CO_3 ?

- A) 0.0900 M
- B) 0.108 M
- C) 0.0120 M
- D) 0.0720 M

Short Answer

1. Give three physical methods used by chemists to separate mixtures and identify the type of mixture best suited for each process.

2. Write the names of the following compounds:

- a) FeSO_4 _____
- b) $\text{NaC}_2\text{H}_3\text{O}_2$ _____
- c) KNO_2 _____
- d) $\text{Ca}(\text{OH})_2$ _____
- e) NiCO_3 _____

3. Write the chemical formulas for the following compounds or ions.

a) nitrate ion _____

b) aluminum oxide _____

c) ammonium ion _____

d) perchloric acid _____

e) copper(II) bromide _____

4. The percent yield is a ratio of the _____ yield to the _____ yield, multiplied by 100%.

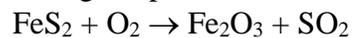
5. Balance the following equation: $C_3H_5(NO_3)_3 \rightarrow N_2 + CO_2 + H_2O + O_2$

6. Balance the following equation: $KI + HNO_3 \rightarrow KNO_3 + NO + I_2 + H_2O$

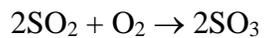
7. The hormone epinephrine is released in the human body during stress and increases the body's metabolic rate. Epinephrine, like many biochemical compounds, is composed of carbon, hydrogen, oxygen, and nitrogen. The percentage composition of the hormone is 59.0% C, 7.15% H, 26.2% O, and 7.65% N. Determine the empirical formula.

8. One of the major commercial uses of sulfuric acid is in the production of phosphoric acid and calcium sulfate. The phosphoric acid is used for fertilizer. The reaction is $\text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{SO}_4 \rightarrow 3\text{CaSO}_4 + 2\text{H}_3\text{PO}_4$. What mass of concentrated H_2SO_4 (98% by mass) must be used to react completely with 100.00 g of calcium phosphate?

9. In a metallurgical process the mineral pyrite, FeS_2 , is roasted in air:



The SO_2 is then converted into H_2SO_4 in the following reactions:



Assuming the mineral is 24.0% FeS_2 and the remainder is inert, what mass of H_2SO_4 is produced if 155 g of the mineral is used?