Chem15, Fall 2016, SJCC, Test3 Name KEY

Please read all the questions VERY carefully before answering. Ask your instructor if you do not understand. No outside paper is allowed. The last page is a periodeic table with constants. Total points = 50 + (20 * 3 =) 60 = 110

SHORT ANSWER. Please write the set-up equation first, then put the raw data with units before calculating. Write the word or phrase that best completes each statement or answers the question.

1) Phosphorus (P_4) reacts with chlorine gas, Cl_2 to produce PCl_5 according to the following reaction: 1) _____

$$P_4\ (s) + 10\ Cl_2\ (g) \text{------>} 4\ PCl_5\ (s)$$

a) How many grams of PCl_5 is formed from 95.0 g of P_4 (3 pts.).

$95.0\ g\ P_4 \times \frac{1\ mol\ P_4}{123.896\ g\ P_4} \times \frac{4\ mol\ PCl_5}{1\ mol\ P_4} \times \frac{208.239\ g\ PCl_5}{1\ mol\ PCl_5} = 639\ g\ PCl_5$

b) How many grams of PCl_5 is formed from 235.2 g of Cl_2 gas (3 pts.).

$235.2\ g\ Cl_2 \times \frac{1\ mol\ Cl_2}{70.906\ g\ Cl_2} \times \frac{4\ mol\ PCl_5}{10\ mol\ Cl_2} \times \frac{208.239\ g\ PCl_5}{1\ mol\ PCl_5} = 276\ g\ PCl_5$

c) Which is the limiting agent if 95.0 g of P_4 and 235.2 g of Cl_2 gas was used in the rxn. (2 pts.) 235.2 g Cl_2 is the limiting agent because it gave a lower amount of PCl_5.

2) Draw the **complete** ground state electron configuration for (4 pts./each; Total = 8pts.) 2) _____

(a) Potassium (K; Z=19): $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

(b) Cobalt (Co; Z=27) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$

3) Write the name of the element with the **valence** electron configuration given below (3 pts) 3) Bromine

(a) $4s^2 4p^5$ Bromine

4) Using only periodic table, 4) _____

(a) List atomic numbers 15, 16, 33 in order of increasing atomic size (6 pts.)

16 < 15 < 33

(b) List elements Cl, Br, I in order of increasing first ionic ionization energy (6 pts.)

I < Br < Cl

5) Calculate the energy (in joule) of one **mole** of blue light with wavelength = 434 nanometer. 5) _____

Given, E = hγ; c = λγ; N= 6.022×10^{23}/mol; h = 6.626×10^{-34} j.s/photon, Vel of light c = 2.89×10^{8}m/s.; (8 pts.)

$c = \lambda\nu \rightarrow 2.89 \times 10^{8}\ m/s = \left(434\ nm \times \frac{1\ m}{10^{-9}\ nm}\right)\nu$

$\nu = \frac{2.89 \times 10^{8}\ m/s}{\left(434\ nm \times \frac{1\ m}{10^{-9}\ nm}\right)} = 6.66 \times 10^{-4}\ hz \text{ or } 1/s$

$E = h\nu = \frac{(6.626 \times 10^{-34}\ j.s)(6.66 \times 10^{-4}\ 1/s)}{(6.022 \times 10^{23}\ mol)}$

$E = 7.33 \times 10^{-61}\ J/mol$ of blue light

$E = h\nu$; $c = \lambda \cdot \nu$ or $\nu = \frac{c}{\lambda}$

$\therefore E = h \cdot \frac{c}{\lambda}$ for one photon.

So for 1 mole

$E = Nh \cdot \frac{c}{\lambda}$ N = Avogadro #

$= \frac{6.022 \times 10^{23} \times 6.626 \times 10^{-34}\ j.s}{\text{photon}}$

$E = \frac{N \cdot h \cdot c}{\lambda}$

$= \frac{6.022 \times 10^{23}\ photons \times 6.626 \times 10^{-34}\ \frac{j.s}{photon} \times 2.89 \times 10^{8}\ \frac{m}{s} \times \frac{10^{9}\ nm}{1\ m}}{434\ nm}$

$= 2.66 \times 10^{5}\ j/mol$

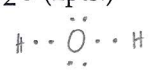
6) A monoatomic ion with a charge of 1- has an electronic configuration of $1S^2 2S^2 2p^6$. 6) _____

(a) Circle the correct answer: It is a CATION/ It is an ANION (3pts.)

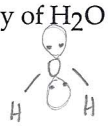
(b) Write the name and the symbol of the noble gas it is isoelectronic with(3 pts.) Neon, [Ne]

(c) What is the symbol of the ion ? (3 pts.) F^-

7) (a) Draw the Lewis structure of H_2O (2pts.) 7) _____



(b) **Draw** and **name** the electronic geometry of H_2O (4 pts.)



tetrahedral

8) Magnesium reacts with Oxygen gas forming Magnesium oxidein the following balanced equation: 2 Mg (s) + O_2 (g) -> 2 MgO (s) 8) _____

What mass of O_2 (g) is needed to completely react with 15.00 g of Mg? (6 pts.)

$15.00\ g\ Mg \times \frac{1\ mol\ Mg}{24.305\ g\ Mg} \times \frac{1\ mol\ O_2}{2\ mol\ Mg} \times \frac{31.999\ g\ O_2}{1\ mol\ O_2} = 9.874\ g\ O_2$ is needed.

MULTIPLE CHOICE. On the scantron, fill up the circle with the same number as the question number. Choose the one alternative that best completes the statement or answers the question (3 pts each).

9) How many eggs are needed to make 1 dozen waffles, assuming you have enough of all other ingredients? 9) C

Given: 2 cups flour + 3 eggs + 1 tbs oil →4 waffles

2 : 3 : 1 : 4

×3

6 : 9 : 3 : 12

A) 48
B) 12
C) 9
D) 16
E) not enough information

10) What is the theoretical yield of a reaction if 25.0 grams of product were actually produced from a reaction that has a 88% yield? 10) A

$\frac{AY}{TY} \times 100 \rightarrow \frac{25.0g}{TY} = 0.88$

$TY = \frac{25.0g}{0.88} = 28.4\ g$

A) 28.4
B) 352
C) 22.0
D) 3.52
E) none of the above

11) Which among the following statements is TRUE? 11) B

✗ A) Red light has a shorter wavelength than violet light.
✓ B) The wavelength of light is inversely related to its energy.
✗ C) As the energy increases, the frequency of radiation decreases.
✗ D) As the wavelength increases, the frequency also increases.
E) none of the above

12) Which color of the visible spectrum has the shortest wavelength (400 nm)? 12) E

A) green B) red C) yellow D) orange E) violet

13) Which color of the visible spectrum has photons with the most energy? 13) A

A) violet B) red C) yellow D) orange E) green

14) Which form of electromagnetic radiation has the highest frequency? 14) A

A) Gamma Rays
B) Microwaves
C) Infrared Radiation
D) Radio Waves
E) X-rays

15) Which statement below does NOT follow the Bohr Model? 15) A

✗ A) The energy emitted from a relaxing electron can have any wavelength.
✓ B) When an atom emits light, electrons fall from a higher orbit into a lower orbit.
✓ C) When energy is absorbed by atoms, the electrons are promoted to higher-energy orbits.
✓ D) Electrons exist in specific, quantized orbits.
E) none of the above

16) How many subshells are there in the n = 2 principal shell? 16) A

A) 2
B) 4
C) 1
D) 3
E) not enough information

17) Which one of the following is the correct orbital diagram for nitrogen? 17) C

A) ⇅ ⇅ ↓ ↓ ↑
B) ⇅ ⇓ ↓ ↑ ↑
C) ⇅ ⇅ ↑ ↑ ↑
D) ⇅ ⇓ ↑ ↑ ↑
E) none of the above

18) The "d" subshell can hold a maximum of _____ electrons. 18) C

A) 5
B) 6
C) 10
D) 2
E) none of the above

19) How many electrons are unpaired in the orbitals of carbon? 19) C

A) 6
B) 12
C) 2
D) 4
E) none of the above

$1s^2 2s^2 2p^2$

20) How many valence electrons are in a chlorine atom? 20) D

A) 17
B) 1
C) 10
D) 7
E) none of the above

21) What is the element in which at least one electron is in the d-orbital? 21) A

A) Sc
B) K
C) Ar
D) Ca
E) none of the above

22) The size of an atom generally increases 22) A

A) down a group and from right to left across a period.
B) down a group and from left to right across a period.
C) up a group and from left to right across a period.
D) up a group and diagonally across the Periodic Table.
E) up a group and from right to left across a period.

23) Which of the following elements has the highest ionization energy? 23) D

A) Ba B) Cl C) Ca D) Ne E) Al

TRUE/FALSE. On the scantron, fill up circle "A" for a true answer and "B" for wrong answer (3 pts each).

24) A photon of red light contains the same amount of energy as a photon of blue light. 24) B

25) Wavelength of visible light determines color. 25) A

26) The possible values for the principal quantum numbers are: n = 0, 1, 2, 3, 4. 26) B

27) The double bond is shorter and stronger than a single bond. 27) A

28) When calculating the number of electrons for the Lewis structure of a polyatomic ion, subtract one electron for each negative charge. 28) B