Name_____
Please write your name on the back also.

Physiological Chemistry I
Final
Dr. Melissa Kelley
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You have 2 hours to complete this exam. Provide the one best answer for each, following the instructions given in each section of the exam.

Multiple Choice: Select the one best answer for each question. Multiple answers will not be accepted. Each question is worth 2 points.

_____1. Which of the following statements **is not** correct?
A. Half-lives are different for every radioisotope.
B. Nuclei with large numbers of protons are usually unstable.
C. Binding energy is relatively small for radioactive isotopes.
D. Isotopes with odd numbers of protons are usually unstable.

_____2. Which of the following statements **is not** correct?
A. An atom cannot be created, divided, destroyed, or converted to any other type of atom.
B. Short wavelengths of electromagnetic radiation have more energy than long wavelengths.
C. Energy differences between energy levels can be calculated from the wavelengths of the light absorbed or emitted.
D. Electrons can behave like waves, as well as like particles.

_____3. Which of the following is the smallest volume?
A. 1000 mL
B. 8 cm3
C. 1 μL
D. 1×10^{-2} mL

_____4. The electron affinity is
A. the energy required to remove an electron from an isolated atom.
B. the force between two electrons in the same orbital.
C. the force between two ions of opposite charge.
D. the energy released when an isolated atom gains an electron.
E. the attraction of an atom for an electron in a chemical bond.

_____5. Which of the following statements **is not** correct?
A. Adding a catalyst will lower the activation energy.
B. A chemical reaction reaches equilibrium when the forward and reverse reactions are equal.
C. A catalyst does not effect the equilibrium of the reaction.
D. A catalyst will raise the free energy of the reaction.

_____6. Consider the hypothetical reaction: $3A_2 + 2B \rightarrow C + 2D$
How many moles of D can be formed from 5.0 mol of A_2?

A. 1.7 mol B. 3.3 mol C. 6.7 mol
D. 7.5 mol E. 10. mol

_____7. Which one of the following is an example of a pure substance?

A. ethyl alcohol B. sugar water C. salt and pepper
D. milk E. sand

_____8. What type of mixture is represented by a collection of salt and pepper?

A. atoms B. molecules C. solution
D. heterogeneous E. homogeneous

_____9. What is the quantity represented by the mass number minus the atomic number?

A. number of atoms B. number of neutrons C. number of electrons
D. number of protons E. number of particles in the nucleus

_____10. Which of the following elements has the highest ionization energy?

A. Li B. B C. O
D. F E. Ne

_____11. Which of the following statements **is not** correct?

A. Cations tend to be formed from metal atoms, while anions are formed from non-metal atoms.
B. Atoms of the halogen family do not form bonds with any other elements.
C. There are eight valence electrons in a chloride ion.
D. Valence electrons are involved when atoms form bonds.

_____12. According to VSEPR theory, if the valence electrons on a central atom are 3 bond pairs and one nonbonding (lone) pair, the geometry (shape) at this atom will be

A. linear B. bent (angular) C. trigonal planar
D. trigonal pyramidal E. tetrahedral

_____13. In the compound CH_3Cl the bond between carbon and chlorine is

A. intermolecular B. ionic C. nonpolar covalent D. polar covalent

_____14. Calculate the mass in grams of NaCl that is present in 500.0 mL of a 0.900% (W/V) solution.

A. 50.0 g B. 0.500 g C. 5.00 g
D. 45.0 g E. 4.50 g

_____15. How many bonding electrons are in CO_2? (Hint: think about the Lewis structure of CO_2)

A. 1 B. 2 C. 3
D. 4 E. 8

_____16. A double bond between two atoms, A and B

A. is longer than a single bond between the same two atoms
B. has a lower bond energy than a single bond between the same two atoms
C. arises when two electrons are transferred from A to B
D. consists of two electrons shared between A and B
E. consists of four electrons shared between A and B

_____17. What is the pH of a 1.0×10^{-4} *M* solution of KOH?

A. 4.00 B. 6.00 C. 7.00
D. 10.00 E. 14.00

_____18. What Kelvin temperature corresponds to 98.6°F?

A. 310K B. 310.0K C. 31.00K
D. 132.0K E. 199K

_____19. Which of the following statements is not correct?

A. Unstable nuclei can undergo radioactive decay.
B. Alpha particles are smaller and faster than beta particles.
C. Gamma particles are higher in energy than alpha particles.
D. Alpha and beta particles produce a trail of ions throughout the material they penetrate.

_____20. A sample of oxygen occupies 1.00 L. If the temperature remains constant, and the pressure on the oxygen is tripled, what is the new volume?

A. 3.00 L B. 1.50 L C. 0.667 L
D. 0.500 L E. 0.333 L

_____21. A human blood sample contains 0.5 mg/mL of a drug. The following concentrations were measured in the human sample:

0.49 mg/mL 0.48 mg/mL 0.51 mg/mL 0.52 mg/mL

Which of the following statements describes the data?

A. The data is precise.
B. The data is accurate.
C. The data is inaccurate and imprecise.
D. The data is accurate and precise.
E. None of the above.

_____22. In the molecule AX_2, the central atom A has two lone pairs of electrons in addition to the two bond pairs in the A—X bonds. What is the shape of this molecule?

A. linear B. bent (angular) C. trigonal planar
D. trigonal pyramidal E. tetrahedral

_____23. Choose the best classification of the reaction represented by the following equation:

$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$

A. combustion B. acid-base C. precipitation
D. decomposition E. combination

_____24. Which of the following statements **is not** correct?

A. The solubility of solids in water increases with increasing temperature.
B. The smaller the difference between polarity of the solute and solvent the more soluble the solute.
C. The solubility of gases in liquids increases with decreasing temperature.
D. The solubility of gases decreases with increasing pressure.

_____25. Of the following gases, which will behave most like an ideal gas?

A. H_2 B. HF C. NH_3
D. CH_3Cl E. CO

____26. The reaction below is at equilibrium. Use LeChatelier's principle to predict the effect of adding more hydrogen gas to the equilibrium reaction mixture.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

A. The equilibrium position will remain unchanged.
B. The equilibrium position will shift to the right.
C. The equilibrium position will shift to the left.
D. The equilibrium constant will increase.
E. All of the nitrogen gas will be used up.

Short Answer

27. (5 points) Name the following compounds:

_____a. N_2O_5

_____b. Na_3PO_4.

_____c. $AgNO_3$

_____d. $BaSO_4$

_____e. $MgCO_3$

28. (5 points) Write the formula for the following compounds:

_____a. Sulfur trioxide

_____b. Magnesium hypochlorite

_____c. Aluminium sulfate

_____d. Calcium phosphate

_____e. Sodium bicarbonate

29. (8 points) **Fill in the following table for all missing spaces. In spaces where there is a line through that space, you do not need to provide an answer**.

Element Name	Element Symbol	# Protons	# Neutrons	# Electrons	Atomic Mass Number	Atomic Number	Valence Electrons
			22		40		
	P^{3-}				31	15	
	Zn^{2+}	30					_____

30. (10 points) Draw the Lewis structure for the following compound:

$CH_3CH_2NH_2$

31. (10 points) In the space provided below, clearly write the total electron configuration for the following:

Zn^{2+}

P^{3-}

32. (12 points) Balance the following chemical equations: All coefficients including the number one must be shown in the blank provided to receive maximum credit. **ANY BLANK NOT FILLED IN WILL BE MARKED WRONG**

a) _____$Al\ (s)$ + _____$O_2\ (g) \rightarrow$ _____Al_2O_3

b) _____$N_2O_5\ (g) \rightarrow$ _____$NO_2\ (g)$ + _____$O_2\ (g)$

33. (9 points) Predict whether the following compounds will be ionic, non-polar covalent, or polar covalent. If the compound is covalent predict its VSEPR geometry.

a) BCl_3

b) NH_3

c) CH_4

d) Li_2SO_3

e) $SiCl_4$

34. (10 points) Complete the products and balance the following equation. All coefficients including the number one must be shown to receive maximum credit. **ANY COEFFICIENTS NOT SHOWN WILL BE MARKED WRONG. Next to each product predict the solubility by writing (aq) or (s) next to each product.**

a) $Al(NO_3)_3 + NaOH \rightarrow$

b) $CaCl_2 + Na_2CO_3 \rightarrow$

35. (10 points) Write a rate expression for the reaction:

$$2NaCl\ (aq) + Pb(NO_3)_2(aq) \rightleftharpoons PbCl_2\ (s) + 2\ NaNO_3\ (aq)$$

b) Write an equilibrium constant for the reaction listed above.

36. (2 points) Circle the appropriate word in each of the pairs: In an endothermic reaction, the products are initially formed (hotter/colder) than the reactants, and in returning to the temperature of the surroundings, the system (gains/loses) heat from/to the surroundings.

37. (8 points) Shown below is an oxidation/reduction reaction.

$$Zn\ (s) + 2\ HCl \rightarrow ZnCl_2 + H_2$$

Answer the following questions:

Identify the compound which was oxidized._____
Identify the compound which was reduced._____
Identify the oxidizing agent._____
Identify the reducing agent._____

Perform the following calculations: Credit will only be given if you show all of your work including equations and units. All of your final answers should contain the correct number of significant figures.

38. (7 points) This year for Christmas a physiological chemistry student receives a lump of coal in their stocking. A piece of coal weighs 1.75 lbs. The molar mass of coal is 12.00 g/mol. How many molecules of coal did the student receive? [Useful information 1 lb=454 g]

39. (6 points) Codeine (a narcotic which can be lethal if overdosed) is supplied as a solution containing 1.25 mg/mL. A patient weighs 160.0 pounds and needs to receive 0.50 mg. How many milliliters of drug do you administer?

40. (10 points) A chemistry elf working in Santa's research laboratory has a stock solution of 800.0 mL of 12.0 M HCl. The elf needs 4.3 M HCl. How many liters of water should the elf add to the stock solution.

b) How many grams of HCl are in the diluted sample?

41. (7 points) Rudolph is busy this year helping Santa deliver goodies to all of the good chemistry boys and girls. Rudolph is capable of traveling 1670.0 km/hr. How far will Rudolph travel in miles in 24 hours? Your answer should be expressed in scientific notation. Useful information: 1 kilometer = 0.621 miles

42. (12 points) Santa and Mrs. Clause decide to celebrate the end of a busy Christmas season with some champagne. Champagne is made through the following chemical process in which glucose is fermented to ethanol and carbon dioxide. The chemical reaction is shown below:

$C_6H_{12}O_6 \rightarrow$	$2\ C_2H_5OH$	+	$2\ CO_2$
Glucose	ethanol		carbon dioxide

If you start with 280.0 g of glucose, how much pressure is exerted from a 825.0 mL bottle of champagne at 25.0 $^{?}$C. Useful information: molar mass of glucose is 180.0 g/mol. R=0.0821 L atm/K mol.

43. (7 points) Reindeer feed is completely combusted in a bomb calorimeter. The calorimeter contains 1.8×10^5g of water. The initial temperature is 37 $^?$C and the final temperature is 57 $^?$C. What is the fuel value of the reindeer feed in nutritional Calories?

44. (10 points) Santa has consumed all the cookies and milk left for him by good chemistry girls and boys and has had increased stress through the holiday season. All of which have contributed to an excess of stomach acid (HCl). How many milliliters of an antacid solution containing 1.5×10^{-4} M NaOH would be necessary to neutralize a stomach acid sample containing 30.0 mL of 3.0×10^{-3}M HCl?

HAVE A GREAT CHRISTMAS VACATION!!