

# PHYSICAL SETTING CHEMISTRY

## Regents Review Practice Tests

**Answers Written By:**

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**Science Teacher – Retired**

### STUDENTS

One of the best ways to raise your Physical Setting/Chemistry Regents Exam grade is to diligently do four previous exams with complete comprehension. When you are done, you will have a working understanding of approximately 350 questions and their supporting concepts. Questions related to these concepts will appear on the exam. This is the purpose of this review book. The trick is to do the exams in earnest; taking your time, checking over our brief but concise explanations until they make sense, and revisiting the ones you answer incorrectly a few days later to check your understanding of the correct answer.

Timing is essential. Don't wait until the last week. We suggest that you start working on these exams early. A good pace to set is 20 to 30 questions a day. Star the ones you need to revisit, underline or highlight important information, and have a good knowledge of what is in the Reference Tables -RT. Many answers are based on information in the Reference Tables.

Chemistry is a commencement level science course, so a good deal of effort is required. Put in the effort, work hard, and your grade will improve.

Good Luck!

# PHYSICAL SETTING REGENTS CHEMISTRY

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## June 2016

## Part A

Answer all questions in this part.

**Directions (1–30):** For *each* statement or question, write in the space provided the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

- Which statement describes the charge of an electron and the charge of a proton?  
(1) An electron and a proton both have a charge of +1.  
(2) An electron and a proton both have a charge of –1.  
(3) An electron has a charge of +1, and a proton has a charge of –1.  
(4) An electron has a charge of –1, and a proton has a charge of +1. 1 \_\_\_\_\_
- Which subatomic particles are found in the nucleus of an atom of beryllium?  
(1) electrons and protons                      (3) neutrons and protons  
(2) electrons and positrons                    (4) neutrons and electrons 2 \_\_\_\_\_
- The elements in Period 4 on the Periodic Table are arranged in order of increasing  
(1) atomic radius    (3) number of valence electrons  
(2) atomic number    (4) number of occupied shells of electrons 3 \_\_\_\_\_
- Which phrase describes two forms of solid carbon, diamond and graphite, at STP?  
(1) the same crystal structure and the same properties  
(2) the same crystal structure and different properties  
(3) different crystal structures and the same properties  
(4) different crystal structures and different properties 4 \_\_\_\_\_
- Which element has six valence electrons in each of its atoms in the ground state?  
(1) Se                      (2) As                      (3) Kr                      (4) Ga 5 \_\_\_\_\_
- What is the chemical name for  $\text{H}_2\text{SO}_3(\text{aq})$ ?  
(1) sulfuric acid                                      (3) hydrosulfuric acid  
(2) sulfurous acid                                    (4) hydrosulfurous acid 6 \_\_\_\_\_

## Part B-1

Answer all questions in this part.

**Directions (31–50):** For *each* statement or question, record in the space provided the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

31. Which notations represent hydrogen isotopes?

- (1)  ${}^1_1\text{H}$  and  ${}^2_1\text{H}$                       (3)  ${}^1_2\text{H}$  and  ${}^1_3\text{H}$   
 (2)  ${}^1_1\text{H}$  and  ${}^4_2\text{H}$                       (4)  ${}^2_1\text{H}$  and  ${}^7_2\text{H}$                       31 \_\_\_\_\_

32. Naturally occurring gallium is a mixture of isotopes that contains 60.11% of Ga-69 (atomic mass = 68.93 u) and 39.89% of Ga-71 (atomic mass = 70.92 u). Which numerical setup can be used to determine the atomic mass of naturally occurring gallium?

- (1)  $\frac{(68.93\text{ u} + 70.92\text{ u})}{2}$                       (3)  $(68.93\text{ u})(0.6011) + (70.92\text{ u})(0.3989)$   
 (2)  $\frac{(68.93\text{ u})(0.6011)}{(70.92\text{ u})(0.3989)}$                       (4)  $(68.93\text{ u})(39.89) + (70.92\text{ u})(60.11)$                       32 \_\_\_\_\_

33. Which list of symbols represents nonmetals, only?

- (1) B, Al, Ga                      (2) Li, Be, B                      (3) C, Si, Ge                      (4) P, S, Cl                      33 \_\_\_\_\_

34. In the formula  $X\text{SO}_4$ , the symbol  $X$  could represent the element

- (1) Al                      (2) Ar                      (3) Mg                      (4) Na                      34 \_\_\_\_\_

35. What is the chemical formula for lead(IV) oxide?

- (1)  $\text{PbO}_2$                       (2)  $\text{PbO}_4$                       (3)  $\text{Pb}_2\text{O}$                       (4)  $\text{Pb}_4\text{O}$                       35 \_\_\_\_\_

36. Which statement describes the general trends in electronegativity and atomic radius as the elements in Period 2 are considered in order from left to right?

- (1) Both electronegativity and atomic radius increase.  
 (2) Both electronegativity and atomic radius decrease.  
 (3) Electronegativity increases and atomic radius decreases.  
 (4) Electronegativity decreases and atomic radius increases.                      36 \_\_\_\_\_

37. What is the percent composition by mass of nitrogen in  $(\text{NH}_4)_2\text{CO}_3$  (gram-formula mass = 96.0 g/mol)?

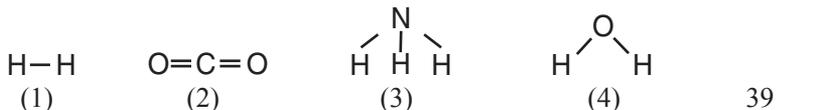
- (1) 14.6%                      (2) 29.2%                      (3) 58.4%                      (4) 87.5%                      37 \_\_\_\_\_

38. Given the balanced equation:  $2\text{KI} + \text{F}_2 \rightarrow 2\text{KF} + \text{I}_2$

Which type of chemical reaction does this equation represent?

- (1) synthesis (3) single replacement  
(2) decomposition (4) double replacement 38 \_\_\_\_\_

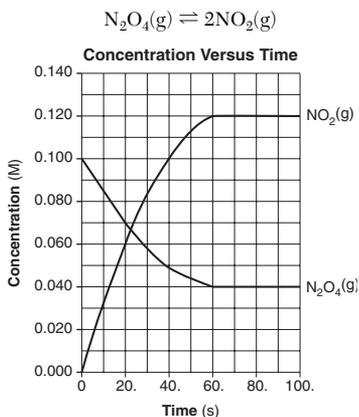
39. Which formula represents a nonpolar molecule containing polar covalent bonds?



40. A reaction reaches equilibrium at  $100^\circ\text{C}$ . The equation and graph representing this reaction are shown.

The graph shows that the reaction is at equilibrium after 60. seconds because the concentrations of both  $\text{NO}_2(\text{g})$  and  $\text{N}_2\text{O}_4(\text{g})$  are

- (1) increasing (3) constant  
(2) decreasing (4) zero



41. Given the balanced equation representing a reaction:



Which statement describes the changes in energy and bonding for the reactant?

- (1) Energy is absorbed as bonds in  $\text{H}_2\text{O}$  are formed.  
(2) Energy is absorbed as bonds in  $\text{H}_2\text{O}$  are broken.  
(3) Energy is released as bonds in  $\text{H}_2\text{O}$  are formed.  
(4) Energy is released as bonds in  $\text{H}_2\text{O}$  are broken. 41 \_\_\_\_\_

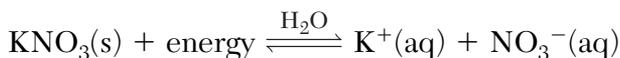
42. At standard pressure, what is the temperature at which a saturated solution of  $\text{NH}_4\text{Cl}$  has a concentration of 60. g  $\text{NH}_4\text{Cl}/100.$  g  $\text{H}_2\text{O}$ ?

- (1)  $66^\circ\text{C}$  (2)  $57^\circ\text{C}$  (3)  $22^\circ\text{C}$  (4)  $17^\circ\text{C}$  42 \_\_\_\_\_

43. Which aqueous solution has the highest boiling point at standard pressure?

- (1) 1.0 M  $\text{KCl}(\text{aq})$  (3) 2.0 M  $\text{KCl}(\text{aq})$   
(2) 1.0 M  $\text{CaCl}_2(\text{aq})$  (4) 2.0 M  $\text{CaCl}_2(\text{aq})$  43 \_\_\_\_\_

44. Given the equation representing a system at equilibrium:



Which change causes the equilibrium to shift?

- (1) increasing pressure                      (3) adding a noble gas  
 (2) increasing temperature                (4) adding a catalyst                      44 \_\_\_\_\_

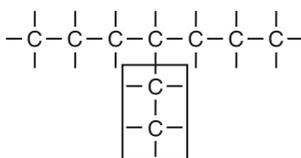
45. Which hydrocarbon is saturated?

- (1)  $\text{C}_2\text{H}_2$               (2)  $\text{C}_3\text{H}_4$               (3)  $\text{C}_4\text{H}_6$               (4)  $\text{C}_4\text{H}_{10}$               45 \_\_\_\_\_

46. Which volume of 0.600 M  $\text{H}_2\text{SO}_4(\text{aq})$  exactly neutralizes 100. milliliters of 0.300 M  $\text{Ba}(\text{OH})_2(\text{aq})$ ?

- (1) 25.0 mL            (2) 50.0 mL            (3) 100. mL            (4) 200. mL            46 \_\_\_\_\_

47. Given the formula for an organic compound:



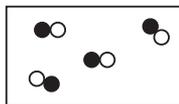
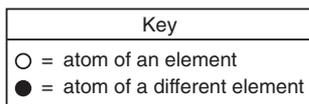
What is the name given to the group in the box?

- (1) butyl              (3) methyl  
 (2) ethyl              (4) propyl                      47 \_\_\_\_\_

48. Given the particle diagram:

Which type of matter is represented by the particle diagram?

- (1) an element  
 (2) a compound  
 (3) a homogeneous mixture  
 (4) a heterogeneous mixture



48 \_\_\_\_\_

49. Which substance is an electrolyte?

- (1)  $\text{O}_2$               (2) Xe              (3)  $\text{C}_3\text{H}_8$               (4)  $\text{KNO}_3$               49 \_\_\_\_\_

50. Which type of organic reaction produces both water and carbon dioxide?

- (1) addition    (2) combustion    (3) esterification    (4) fermentation    50 \_\_\_\_\_

## Part B-2

Answer all questions in this part.

**Directions (51–65):** Record your answers in the spaces provided. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

51. Draw a Lewis electron-dot diagram for a chloride ion,  $\text{Cl}^-$ . [1]

Base your answers to questions 52 and 53 on the information below and on your knowledge of chemistry.

At STP,  $\text{Cl}_2$  is a gas and  $\text{I}_2$  is a solid. When hydrogen reacts with chlorine, the compound hydrogen chloride is formed. When hydrogen reacts with iodine, the compound hydrogen iodide is formed.

52. Balance the equation below for the reaction between hydrogen and chlorine, using the smallest whole-number coefficients. [1]



53. Explain, in terms of intermolecular forces, why iodine is a solid at STP but chlorine is a gas at STP. [1]

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Base your answers to questions 54 and 55 on the information below and on your knowledge of chemistry.

Some properties of the element sodium are listed below.

- is a soft, silver-colored metal
- melts at a temperature of 371 K
- oxidizes easily in the presence of air
- forms compounds with nonmetallic elements in nature
- forms sodium chloride in the presence of chlorine gas

54. Identify *one* chemical property of sodium from this list. [1]

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55. Convert the melting point of sodium to degrees Celsius. [1] \_\_\_\_\_ °C

Base your answers to questions 56 through 58 on the information below and on your knowledge of chemistry.

At standard pressure, water has unusual properties that are due to both its molecular structure and intermolecular forces. For example, although most liquids contract when they freeze, water expands, making ice less dense than liquid water. Water has a much higher boiling point than most other molecular compounds having a similar gram-formula mass.

56. Explain why  $\text{H}_2\text{O}(\text{s})$  floats on  $\text{H}_2\text{O}(\ell)$  when both are at  $0^\circ\text{C}$ . [1]

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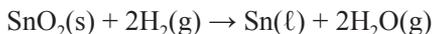
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57. State the type of intermolecular force responsible for the unusual boiling point of  $\text{H}_2\text{O}(\ell)$  at standard pressure. [1] \_\_\_\_\_

58. Determine the total amount of heat, in joules, required to completely vaporize a 50.0-gram sample of  $\text{H}_2\text{O}(\ell)$  at its boiling point at standard pressure. [1] \_\_\_\_\_ J

Base your answers to questions 59 and 60 on the information below and on your knowledge of chemistry.

At 1023 K and 1 atm, a 3.00-gram sample of  $\text{SnO}_2(\text{s})$  (gram-formula mass = 151 g/mol) reacts with hydrogen gas to produce tin and water, as shown in the balanced equation below.



59. Show a numerical setup for calculating the number of moles of  $\text{SnO}_2(\text{s})$  in the 3.00-gram sample. [1]

60. Determine the number of moles of  $\text{Sn}(\ell)$  produced when 4.0 moles of  $\text{H}_2(\text{g})$  is completely consumed. [1]

**PHYSICAL SETTING**

**CHEMISTRY**

**ANSWERS**

**AND**

**EXPLANATIONS**

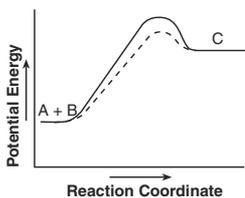
A Chemistry Reference Table can be found in the back of this booklet.

**June 2016**  
**Part A**

1. 4 Electrons are negatively charged particles ( $-1$ ) located in energy levels outside the nucleus of the atom. Protons are positively charged particles ( $+1$ ) located in the nucleus.
2. 3 All atoms, except ordinary hydrogen, consist of a central nucleus composed of protons and neutrons. The nucleus of ordinary hydrogen consists of a single proton. As shown in the Periodic Table, beryllium (Be) has an atomic mass of 9 and an atomic number of 4. Its nucleus would contain 4 protons and 5 neutrons.
3. 2 Open to the Periodic Table and locate the elements in Period 4. Starting with K, as you move to the right arriving at Kr, the atomic number (number of protons) increases. This is true with all Periods. Choice 1 is incorrect as shown in Table S – The Properties of Selected Elements. This chart shows that in Period 4 the atomic radius, for the most part, decreases moving left to the right.
4. 4 Carbon has the ability to bond with itself producing different crystal structures. Diamond and graphite are composed of only carbon atoms, but are arranged in a different crystal lattice or structure. This produces completely different properties of these two minerals as exhibited by the hardness of diamond and the softness of graphite. Different forms of the same element are called allotropes.
5. 1 The outermost energy level (last number in the electron configuration) is the valence level, and the electrons in this energy level are the valence electrons in the ground state. Using the Periodic Table, Se has 6 valence electrons, Kr has 8, As has 5, and Ga has 3 valence electrons.
6. 2 Table K – Common Acids shows this answer.
7. 1 Open to Table F – Solubility Guidelines for Aqueous Solutions. In the Ions that Form Soluble Compounds, ammonium ( $\text{NH}_4^+$ ) is listed, thus  $(\text{NH}_4)_3\text{PO}_4$  would be soluble.  $\text{Ag}_2\text{SO}_4$  is insoluble because the  $\text{Ag}^+$  ion is in the Exceptions column for being soluble when joined with sulfate ( $\text{SO}_4^{2-}$ ).  $\text{Cu}(\text{OH})_2$  and  $\text{CaCO}_3$  contain the  $\text{OH}^-$  and  $\text{CO}_3^{2-}$  ions, respectively, making them insoluble.
8. 2 Metals have the property of malleability, which is being able to be pounded or rolled into thin sheets. Metal atoms in a metallic crystal are held together by metallic bonds. This bonding produces positive ions surrounded by electrons that are able to move freely from one atom to another.

9. 2 Electronegativity is a measure of the relative attraction an atom has for electrons in a chemical bond. The higher the electronegativity value, the greater the attraction. Open to Table S – Properties of Selected Elements and in the Electronegativity column, oxygen has the highest electronegativity value (3.4) of the given choices.
10. 4 In redox reactions, oxidation and reduction occur simultaneously. Oxidation occurs when an atom loses one or more electrons, causing the oxidation number to increase. In reduction, an atom gains one or more electrons, resulting in a decrease in the oxidation number. Example: In the reaction  $\text{Fe(s)} + \text{S(s)} \rightarrow \text{FeS}$ , Fe is undergoing oxidation by losing  $2e^-$  ( $\text{Fe}^0 \rightarrow \text{Fe}^{2+} + 2e^-$ ), and S is undergoing reduction by gaining these  $2e^-$  ( $\text{S}^0 + 2e^- \rightarrow \text{S}^{2-}$ ).
11. 3 Open to Table S — Properties of Selected Elements. In the Boiling Point column, nitrogen (N) has a boiling point of 77 K. At STP (273 K — see Table A) nitrogen is a gas. If nitrogen was cooled to 72 K, being below its boiling point, it would be a liquid, and its density has increased.
12. 2 At STP, the temperature is 273 K (see Table A). A substance that has a boiling point lower than 273 K would be in its gaseous phase at this temperature. Table S – Properties of Selected Elements shows the boiling point of sulfur (S) is 718 K, xenon (Xe) is 165 K, potassium (K) is 337 K and phosphorus (P) is 554 K. Of these choices, at 273 K only xenon would be a gas.
13. 1 Increasing the surface area of a solid by crushing, grinding, or cutting it into smaller pieces, results in a faster rate of reaction. If the concentration of  $\text{HCl(aq)}$  increases, there will be more of these particles in solution. With more particles, there will be an increase in the frequency of collisions between the reactant (Fe) and the acid ( $\text{HCl(aq)}$ ), resulting in an increase in the rate of reaction.
14. 1 Due to the different boiling points of ethanol and water, a mixture of these substances can be separated out by distillation. Each liquid component boils off separately when its boiling point is reached. The substance with the lowest boiling point boils out first, and when condensed, the liquid is collected.
15. 2 An ideal gas is one that conforms exactly to the assumptions of the kinetic theory. In this theory, it states that gas particles display no attraction for one another and are in constant random motion. This is best accomplished by having the gas under low pressure and high temperature. These two conditions would cause the gas molecules to have the greatest separation and greatest motion, producing the least attraction to one another – conditions needed for an ideal gas.

16. 4 The collision theory states that particles must collide in order for a chemical change to take place. When the reactant particles collide with enough energy and with the proper orientation, a chemical reaction may take place. Those collisions that do results in a chemical change are called effective collisions.
17. 3 Avogadro's Law states that equal volumes of gases at the same temperature and pressure have equal numbers of particles, even though their masses may not be the same. Therefore, at STP (Table A), 3.0 L of  $\text{H}_2(\text{g})$  contains the same number of molecules as 3.0 L of  $\text{CH}_4(\text{g})$ .
18. 4 A catalyst is a substance that increases the speed at which a reaction takes place or equilibrium is reached. The catalyst accomplishes this by lowering the activation energy needed for the forward and reverse reaction. In the graph below, the solid line represents the changes in potential energy that occur during the given reaction  $\text{A} + \text{B} \rightarrow \text{C}$ . The dotted line represents the pathway of the same reaction when a catalyst is added. Notice that a different reaction pathway occurs with the peak of the potential energy graph (the top of the curve) being lowered. Thus the activation energy is decreased, without changing the positions of the potential energy of the reactants and product.



19. 3 A phase change occurs at constant temperature. Therefore, when water boils, the average kinetic energy, measured by temperature, does not change. The potential energy of the water molecules increases due to vaporization ( $\ell \rightarrow \text{g}$ ), an endothermic process (energy is absorbed) causing the potential energy of the molecules to increase.
20. 2 Entropy is a measure of the disorder or randomness in a system. The higher the temperature, the greater the disorder or randomness of motion of the particles. As a substance changes from solid to liquid to gas, the entropy increases.
21. 3 Carbon has the ability to form bonds not only with other atoms but also indefinitely with other carbon atoms. The hydrocarbon series shown in the Structural Formula column in Table Q consists of chains of carbon atoms. The organic molecule benzene ( $\text{C}_6\text{H}_6$ ) has a ring structure shape. Diamond, made from pure carbon, is a network solid containing very strong covalent bonds.