

PHYSICAL SETTING CHEMISTRY

Regents Review Practice Tests

Answers Written By:

William Docekal

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 2018

Part A

Answer all questions in this part.

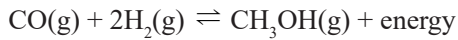
Directions (1–30): For *each* statement or question, write in the space provided the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

- Which statement describes the charge and location of an electron in an atom?
 - An electron has a positive charge and is located outside the nucleus.
 - An electron has a positive charge and is located in the nucleus.
 - An electron has a negative charge and is located outside the nucleus.
 - An electron has a negative charge and is located in the nucleus. 1 _____
- Which statement explains why a xenon atom is electrically neutral?
 - The atom has fewer neutrons than electrons.
 - The atom has more protons than electrons.
 - The atom has the same number of neutrons and electrons.
 - The atom has the same number of protons and electrons. 2 _____
- If two atoms are isotopes of the same element, the atoms must have
 - the same number of protons and the same number of neutrons
 - the same number of protons and a different number of neutrons
 - a different number of protons and the same number of neutrons
 - a different number of protons and a different number of neutrons 3 _____
- Which electrons in a calcium atom in the ground state have the greatest effect on the chemical properties of calcium?
 - the two electrons in the first shell
 - the two electrons in the fourth shell
 - the eight electrons in the second shell
 - the eight electrons in the third shell 4 _____
- The weighted average of the atomic masses of the naturally occurring isotopes of an element is the
 - atomic mass of the element
 - atomic number of the element
 - mass number of each isotope
 - formula mass of each isotope 5 _____
- Which element is classified as a metalloid?
 - Cr
 - Cs
 - Sc
 - Si 6 _____

69. Show a numerical setup for calculating the percent error of Mendeleev's predicted density of Es. [1]

Base your answers to questions 70 through 73 on the information below and your knowledge of chemistry.

Methanol can be manufactured by a reaction that is reversible. In the reaction, carbon monoxide gas and hydrogen gas react using a catalyst. The equation below represents this system at equilibrium.



70. State the class of organic compounds to which the product of the forward reaction belongs. [1] _____

71. Compare the rate of the forward reaction to the rate of the reverse reaction in this equilibrium system. [1]

72. Explain, in terms of collision theory, why increasing the concentration of $\text{H}_2\text{(g)}$ in this system will increase the concentration of $\text{CH}_3\text{OH(g)}$. [1]

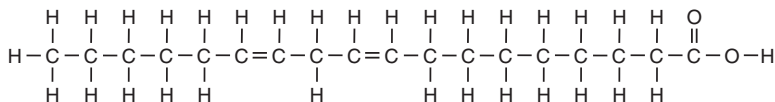
73. State the effect on the rates of both the forward and reverse reactions if no catalyst is used in the system. [1]

Rate of forward reaction: _____

Rate of reverse reaction: _____

Base your answers to questions 74 through 76 on the information below and on your knowledge of chemistry.

Fatty acids, a class of compounds found in living things, are organic acids with long hydrocarbon chains. Linoleic acid, an unsaturated fatty acid, is essential for human skin flexibility and smoothness. The formula below represents a molecule of linoleic acid.



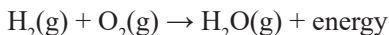
74. Write the molecular formula of linoleic acid. [1] _____

75. Identify the type of chemical bond between the oxygen atom and the hydrogen atom in the linoleic acid molecule. [1] _____

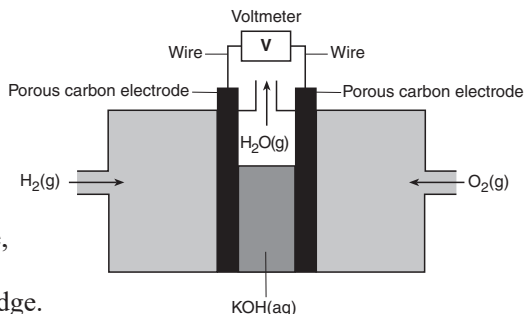
76. On the diagram above, circle the organic acid functional group. [1]

Base your answers to questions 77 through 79 on the information below and on your knowledge of chemistry.

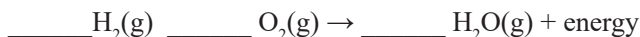
Fuel cells are voltaic cells. In one type of fuel cell, oxygen gas, $\text{O}_2(\text{g})$, reacts with hydrogen gas, $\text{H}_2(\text{g})$, producing water vapor, $\text{H}_2\text{O}(\text{g})$, and electrical energy. The unbalanced equation for this redox reaction is shown below.



A diagram of the fuel cell is shown. During operation of the fuel cell, hydrogen gas is pumped into one compartment and oxygen gas is pumped into the other compartment. Each compartment has an inner wall that is a porous carbon electrode through which ions flow. Aqueous potassium hydroxide, $\text{KOH}(\text{aq})$, and the porous electrodes serve as the salt bridge.



77. Balance the equation below for the reaction in this fuel cell, using the smallest whole-number coefficients. [1]



78. Determine the change in oxidation number for oxygen in this operating fuel cell. [1] From _____ to _____

79. State the number of moles of electrons that are gained when 5.0 moles of electrons are lost in this reaction. [1] _____ mol

Base your answers to questions 80 through 82 on the information below and on your knowledge of chemistry.

Data for HCl(aq) Solutions

In a laboratory investigation, a student compares the concentration and pH value of each of four different solutions of hydrochloric acid, HCl(aq), as shown in the table.

Solution	Concentration of HCl(aq) (M)	pH Value
W	1.0	0
X	0.10	1
Y	0.010	2
Z	0.0010	3

80. State the number of significant figures used to express the concentration of solution Z. [1] _____

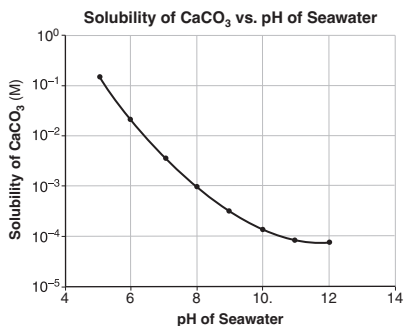
81. Determine the concentration of an HCl(aq) solution that has a pH value of 4. [1] _____ M

82. Determine the volume of 0.25 M NaOH(aq) that would exactly neutralize 75.0 milliliters of solution X. [1] _____ mL

Base your answers to questions 83 through 85 on the information below and on your knowledge of chemistry.

Carbon dioxide is slightly soluble in seawater. As carbon dioxide levels in the atmosphere increase, more CO₂ dissolves in seawater, making the seawater more acidic because carbonic acid, H₂CO₃(aq), is formed.

Seawater also contains aqueous calcium carbonate, CaCO₃(aq), which is used by some marine organisms to make their hard exoskeletons. As the acidity of the sea water changes, the solubility of CaCO₃ also changes, as shown in the graph.



83. State the trend in the solubility of CaCO₃ as seawater becomes more acidic. [1] _____

84. State the color of bromcresol green in a sample of seawater in which the CaCO₃ solubility is 10⁻² M. [1] _____

85. A sample of seawater has a pH of 8. Determine the new pH of the sample if the hydrogen ion concentration is increased by a factor of 100. [1] _____

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*.

Base your answers to questions 51 and 52 on the information below and on your knowledge of chemistry.

The element technetium, Tc, has several isotopes. The bright-line spectrum of technetium has been observed in the spectra of some stars.

51. Compare the energy of an electron in the first shell of a technetium atom to the energy of an electron in the third shell of the same atom. [1]

52. State, in terms of protons and neutrons, why the various nuclides of technetium are isotopes of each other. [1]

Base your answers to questions 53 and 54 on the information below and on your knowledge of chemistry.

A sample of a gas in a sealed, rigid cylinder with a movable piston has a volume of 0.250 liter at STP.

53. Show a numerical setup for calculating the volume of this sample of gas at 298 K and 1.00 atm. [1]

54. State a change in pressure that will cause the gas in the cylinder to behave more like an ideal gas. [1]

ANSWERS AND EXPLANATIONS

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Part A

- 3 Electrons, fast moving negatively charged particles, are found outside the nucleus. The most probable location of the electrons are in orbitals that are located at different energy levels from the nucleus. This modern model is called the atomic orbital model.
- 4 In the ground state, atoms have the same number of electrons as protons, making them electrically neutral.
- 2 Atoms of the same element will always have the same atomic number (number of protons). It is the atomic number that identifies the element. Atoms of the same element may have different mass numbers ($p + n$) due to having different numbers of neutrons within the nucleus. Atoms that have the same number of protons but different numbers of neutrons are isotopes of each other.
- 2 An element's chemical properties are dictated by its valence electrons, always located in the last shell. It is the valence electron(s) that are transferred or shared in chemical reactions. Calcium, in the ground state, has an electron configuration of 2-8-8-2. The two valence electrons, located in the fourth shell, are involved in calcium chemical reactions and produces its properties.
- 1 The atomic mass of any element is defined as the weighted average mass of all the naturally occurring isotopes of that element. Isotopes of an element have the same atomic number (# of protons) but different numbers of neutrons, resulting in different masses for each isotope.
- 4 Metalloids, also known as semimetals, are elements that exhibit properties of metals and nonmetals. They are positioned adjacent to the dark zig-zag line found on the Periodic Table. Si is located in Group 14 adjacent to this dark line, making it a metalloid.
- 1 When iron oxidizes, Fe chemically reacts with O producing iron oxide (FeO). This ability to react with oxygen and form a new compound represents a chemical property of iron. The other 3 choices are physical properties of iron.
- 2 Carbon has the ability to join with itself and to produce different crystal structures. Diamond and graphite are composed of only carbon atoms, but are arranged in a different crystal lattice or structure. This arrangement produces completely different properties as exhibited by the hardness of diamond and the softness of graphite. Different forms of the same element are called allotropes.

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Answer Key

48. 1 Open to Table M. Methyl orange will undergo a change of color from red to yellow in a pH range of 3.1- 4.4. Above this range, this indicator will remain yellow.
49. 3 The pH scale indicates the concentration of the hydronium ions $[(\text{H}_3\text{O}^+)]$, see Table E] in a solution. This scale is based on the logarithmic scale. A decrease of 1 pH unit (becoming more acidic) represents a 10-fold increase in hydronium ion concentration. A decrease of 2 pH units represents $100x$ ($10 \times 10 = 10^2$) increase in the concentration of hydronium ions.
50. 1 Nuclear reactions release, by far, more energy per mole of reactant than any chemical reaction. In a nuclear reaction, a small amount of mass is converted to a large amount of energy according to Einstein's equation, $E = mc^2$.

Part B-2

51. Answer: 3

Explanation: Li-7 is an isotope of lithium, where 7 represents its atomic mass (P + N). Open to the Periodic Table. Lithium's atomic number (number of protons) is 3. In neutral atoms, electrons equal protons.

52. Acceptable responses include, but are not limited to:

The energy of an electron in the first shell is less than the energy of an electron in the second shell.

or The second shell electron has greater energy.

Explanation: The farther electrons are from the nucleus of an atom, the greater the energy they possess.

53. Acceptable responses include, but are not limited to:

$$(6.015 \text{ u})(0.0759) + (7.016 \text{ u})(0.9241)$$

$$\text{or} \quad \frac{(7.59)(6.015) + (92.41)(7.016)}{100}$$

$$\text{or} \quad (7.59\%)(6.015) + (92.41\%)(7.016)$$

Explanation: The atomic mass of an element is the weighted average mass of the naturally occurring isotopes of that element. This is obtained by taking the sum of the products of the percentages and mass of each isotope. The above examples are the mathematical set-ups to obtain the correct average atomic mass of the isotopes of lithium.

54. Acceptable responses include, but are not limited to:

From left to right in Period 3, the atomic radius generally decreases.

or The atomic radius decreases from Na to Cl across Period 3.

or Radii decrease

Explanation: The graph shows this decreasing trend for the atomic radii from Na to Cl.

PHYSICAL SETTING CHEMISTRY
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Table A
Standard Temperature and Pressure

Name	Value	Unit
Standard Pressure	101.3 kPa 1 atm	kilopascal atmosphere
Standard Temperature	273 K 0°C	kelvin degree Celsius

Table B
Physical Constants for Water

Heat of Fusion	334 J/g
Heat of Vaporization	2260 J/g
Specific Heat Capacity of H ₂ O(ℓ)	4.18 J/g•K

Table C
Selected Prefixes

Factor	Prefix	Symbol
10 ³	kilo-	k
10 ⁻¹	deci-	d
10 ⁻²	centi-	c
10 ⁻³	milli-	m
10 ⁻⁶	micro-	μ
10 ⁻⁹	nano-	n
10 ⁻¹²	pico-	p

Table D
Selected Units

Symbol	Name	Quantity
m	meter	length
g	gram	mass
Pa	pascal	pressure
K	kelvin	temperature
mol	mole	amount of substance
J	joule	energy, work, quantity of heat
s	second	time
min	minute	time
h	hour	time
d	day	time
y	year	time
L	liter	volume
ppm	parts per million	concentration
M	molarity	solution concentration
u	atomic mass unit	atomic mass