You are about to take the third practice SAT Chemistry Subject Test. After answering questions 1–32, which constitute Part A, you’ll be directed to answer questions 101–116, which constitute Part B. Then, begin again at question 33. Questions 33–69 constitute Part C.

When you’re ready to score yourself, refer to the scoring instructions and answer key on pages 323 and 324. Full explanations regarding the correct answers to all questions start on page 327.
## PERIODIC TABLE OF THE ELEMENTS

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### Lanthanide Series

| 58 | Ce | 140.12 |
| 59 | Pr | 140.91 |
| 60 | Nd | 144.24 |
| 61 | Pm | 145.04 |
| 62 | Sm | 150.4 |
| 63 | Eu | 151.97 |
| 64 | Gd | 157.25 |
| 65 | Tb | 158.83 |
| 66 | Dy | 162.50 |
| 67 | Ho | 164.93 |
| 68 | Er | 167.26 |
| 69 | Tm | 168.93 |
| 70 | Yb | 173.04 |
| 71 | Lu | 174.97 |

### Actinium Series

| 90 | Th | 232.04 |
| 91 | Pa | 231.04 |
| 92 | U | 238.03 |
| 93 | Np | 237.05 |
| 94 | Pu | 244.0 |
| 95 | Am | 243.0 |
| 96 | Cm | 247.0 |
| 97 | Bk | 247.0 |
| 98 | Cf | 247.0 |
| 99 | Es | 251.0 |
| 100 | Fm | 257.0 |
| 101 | Md | 258.0 |
| 102 | No | 259.0 |
| 103 | Lr | 260.0 |

### Not Yet Named

| 87 | Fr | 226.02 |
| 88 | Ra | 227.03 |
| 89 | Ac | (261) |

**Note:** The periodic table is provided as a natural representation of the elements and their properties. The table is used for educational purposes and does not correspond to any specific question set in this examination.
CHEMISTRY SUBJECT TEST 3

Note: For all questions involving solutions and/or chemical equations, assume that the system is in pure water unless otherwise stated.

Part A

Directions: Each set of lettered choices below refers to the numbered statements or questions immediately following it. Select the one lettered choice that best fits each statement or answers each question, and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1–5 refer to the following.

(A) Carbon  
(B) Nitrogen  
(C) Oxygen  
(D) Neon  
(E) Argon

1. Is the third most abundant gas in Earth’s atmosphere

2. At standard conditions, has an allotrophic form that is a good electrical conductor

3. Regardless of its electron configuration, it must always be paramagnetic when it’s a single, neutrally charged atom

4. The key element delivered in soil fertilizer

5. Allotrope of this element is the primary absorber of UV solar radiation in Earth’s atmosphere

Questions 6–9 refer to the following.

(A) Chemical pH indicator  
(B) Acid/base buffer  
(C) Anhydrous solution  
(D) Hypotonic solution  
(E) Supersaturated solution

6. A conjugate acid/base pair with differing spectral absorbencies

7. An example of a solution not in equilibrium

8. Term used in reference to an aqueous solution’s osmotic pressure

9. Addition of water to this solution will not change $[H_3O^+]$
Questions 10–14 refer to the following.

(A) Standard voltaic potential  
(B) Entropy  
(C) Enthalpy  
(D) Reaction rate  
(E) Gibbs free energy

10. Increased with the addition of a catalyst

11. Abbreviated as “H”

12. A property that must decrease when a gas condenses into a liquid

13. Is always positive for a spontaneous chemical reaction

14. Is zero for a crystalline solid that is elementally pure at 0ºK

Questions 15–19 refer to the following.

(A) Alkali metals  
(B) Alkaline earth metals  
(C) Noble gases  
(D) Halogens  
(E) Transition metals

15. The most unreactive family of elements

16. Form negative ions in an ionic bond

17. Consist of atoms that have valence electrons in a d subshell

18. Exist as diatomic molecules at room temperature

19. Members possess the lowest first ionization energy in their respective period
CHEMISTRY SUBJECT TEST 3—Continued

Questions 20–24 refer to the following.

(A) N₂
(B) KI
(C) CCl₄
(D) AgNO₃
(E) CaCO₃

20. A product of a neutralization of a strong acid with a strong base

21. A volatile covalent liquid at 25°C and 1 atm

22. Releases a gas with the addition of dilute acid

23. Forms a white precipitate when added to a solution of NaCl

24. Treatment of the dry solid with a mild oxidizing agent produces a purple solid

Questions 25–28 refer to the following.

(A) Gamma decay
(B) Nuclear fusion
(C) Alpha decay
(D) Positron emission
(E) Nuclear fission

25. Is the principle reaction responsible for the energy output of the sun

26. Is a nuclear process that results in no change in the mass number and atomic number of a nuclide

27. Responsible for most helium found on Earth

28. The nuclear process that transmutes uranium-238 into thorium-234

Questions 29–32 refer to the following.

(A) 0.1 M MgCl₂
(B) 0.1 M HClO₄
(C) 0.1 M NH₃·OH
(D) 0.1 M KOH
(E) 0.1 M LiNO₃

29. Has a pH of 13

30. The solution with the lowest freezing point temperature

31. The solution with the highest boiling point temperature

32. Indicates a red flame when ionized with a Bunsen burner
CHEMISTRY SUBJECT TEST 3—Continued

PLEASE GO TO THE SPECIAL SECTION LABELED CHEMISTRY AT THE LOWER RIGHT-HAND CORNER OF THE ANSWER SHEET YOU ARE WORKING ON AND ANSWER QUESTIONS 101–116 ACCORDING TO THE FOLLOWING DIRECTIONS.

Part B

Directions: Each question below consists of two statements, I in the left-hand column and II in the right-hand column. For each question, determine whether statement I is true or false and whether statement II is true or false, and fill in the corresponding T or F ovals on your answer sheet. Fill in oval CE only if statement II is a correct explanation of statement I.

EXAMPLES:

<table>
<thead>
<tr>
<th>I</th>
<th>BECAUSE</th>
<th>II</th>
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<td>EX 1. $\text{H}_2\text{SO}_4$ is a strong acid</td>
<td>BECAUSE</td>
<td>$\text{H}_2\text{SO}_4$ contains sulfur.</td>
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<td>EX 2. An atom of oxygen is electrically neutral</td>
<td>BECAUSE</td>
<td>an oxygen atom contains an equal number of protons and electrons.</td>
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SAMPLE ANSWERS

<table>
<thead>
<tr>
<th>EX 1</th>
<th>EX 2</th>
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</tr>
<tr>
<td>T</td>
<td>T</td>
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101. Transition metal compounds are often colored

102. Chemical reactions slow down with lower temperature

103. Exothermic reactions absorb heat

104. The solubility of gases in liquids does not depend upon pressure

105. MgO has a high melting point

106. The ground state electron configuration orbitals of elemental Cu is $[\text{Ar}]4s^13d^{10}$

107. Isotopes of a particular element have nearly identical chemical behavior

108. In an electrochemical cell, the electrode that is the site of reduction is called the anode

BECAUSE they frequently possess partially filled $d$ orbitals.

BECAUSE the energy barrier for the formation of products decreases with decreasing temperature.

BECAUSE breaking covalent bonds always requires energy.

BECAUSE the vapor pressure of a substance is independent of external pressure.

BECAUSE highly charged ions result in strong ionic forces and high lattice energies.

BECAUSE completely half-filled and filled $d$ bestow special electronic stabilization.

BECAUSE they have identical electron configurations.

BECAUSE oxidation always occurs at the cathode.
109. The addition of acid to a solution buffered to pH 7 slightly lowers the pH BECAUSE the addition of acids to any neutral solution always lowers the pH.

110. Saltwater boils at a higher temperature than pure water BECAUSE the presence of salt increases the vapor pressure of water.

111. BF₃ has a tetrahedral geometry BECAUSE the central B atom does not have a complete stable octet.

112. Hydrogen peroxide, H₂O₂, is a good oxidizing agent BECAUSE the hydrogen in H₂O₂ has a +1 oxidation number.

113. Hydrogen gas (H₂) is considered a perfectly ideal gas BECAUSE hydrogen atoms interact with each other via hydrogen bonds.

114. Electrolysis of water requires the input of energy BECAUSE the products formed, H₂ and O₂, possess more chemical potential energy than H₂O.

115. By mass, oxygen is the most abundant element in the human body BECAUSE it is principally found as O₂ in the bloodstream.

116. LiOH is considered a strong base BECAUSE it undergoes neutralization reactions with acids.

RETURN TO THE SECTION OF YOUR ANSWER SHEET YOU STARTED FOR CHEMISTRY AND ANSWER QUESTIONS 33–69.
CHEMISTRY SUBJECT TEST 3—Continued

Part C

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

33. Choose the answer below that accurately describes the correct molecular shape for the molecule XeOF₄.
   (A) Tetrahedral
   (B) Trigonal pyramidal
   (C) Trigonal bipyramidal
   (D) Square pyramidal
   (E) Flat

34. For the radioactive atom ⁹⁹Tc, what is the correct number of protons and neutrons?
   (A) 43 protons and 56 neutrons
   (B) 43 protons and 99 neutrons
   (C) 56 protons and 43 neutrons
   (D) 56 protons and 99 neutrons
   (E) Cannot be determined

35. Which one of the following acids is NOT strong?
   (A) HCl
   (B) HBr
   (C) HNO₃
   (D) H₃PO₄
   (E) H₂SO₄

36. Identify the equation used to determine the amount of heat required to melt 10 grams of ice.
   (A) \( Q = mc \Delta T \)
   (B) \( Q = n \Delta H \)
   (C) \( KE = \frac{1}{2}mv^2 \)
   (D) \( PE = mgh \)
   (E) \( PV = nRT \)

37. Identify the correct ground state electron configuration for Cr.
   (A) \([Ar] 3s^23d^4\)
   (B) \([Ar] 3s^23d^6\)
   (C) \([Ar] 4s^23d^6\)
   (D) \([Ar] 4s^23d^4\)
   (E) \([Ar] 4s^13d^5\)

38. What is the hydroxide concentration for a solution with a pH of 10 at 25°C?
   (A) \(10^{-14} M\)
   (B) \(10^{-16} M\)
   (C) \(10^{-7} M\)
   (D) \(10^{-4} M\)
   (E) \(10^{-1} M\)

39. Five hundred milliliters of solution of 0.1 M NaBr has how many milligrams of bromine?
   (A) 200 mg
   (B) 400 mg
   (C) 2,000 mg
   (D) 4,000 mg
   (E) 20,000 mg

40. According to the ideal gas law, what is the approximate volume that will be occupied by 0.5 mole of an ideal gas at 30°C and 3 atm pressure (gas constant \(R = 0.0821 \text{ L-atm/mol-K}\))?
   (A) Less than 1 L
   (B) 5 L
   (C) 10 L
   (D) 15 L
   (E) More than 20 L
CHEMISTRY SUBJECT TEST 3—Continued

41. Given that \( \Delta G = \Delta H - T \Delta S \), how is the spontaneity of an endothermic reaction expected to change with decreasing \( T \)?
   (A) Becomes less spontaneous
   (B) Becomes more spontaneous
   (C) Does not change
   (D) Decreases at first but then increases
   (E) Insufficient information to make a conclusion

42. Identify the element with the greatest first ionization energy.
   (A) Ce
   (B) C
   (C) Cl
   (D) Ca
   (E) Cs

43. Identify the molecule/ion with the greatest potential to act as a Lewis acid.
   (A) \( ^{14} \text{CH}_3 \)
   (B) \( ^{14} \text{CN} \)
   (C) \( ^{14} \text{NH}_3 \)
   (D) \( ^{14} \text{BF}_4^- \)
   (E) \( ^{14} \text{CO}_2 \)

46. Identify which of the following statements is FALSE.
   (A) The vapor pressure of a liquid decreases with increasing atmospheric pressure.
   (B) The value of an equilibrium constant is dependent on temperature.
   (C) The rate of a spontaneous reaction cannot be determined solely by its Gibbs free energy.
   (D) During a phase transition, the temperature of a substance must be constant.
   (E) The addition of a catalyst to a reaction at equilibrium has no net effect on the system.

47. Which of the following compounds would be expected to have the greatest lattice binding energy?
   (A) \( \text{LiNO}_3 \)
   (B) \( \text{LiF} \)
   (C) \( \text{KI} \)
   (D) \( \text{NH}_3 \text{Br} \)
   (E) \( \text{CsNO}_3 \)

48. The daughter nucleus formed when \(^{18}\text{F}\) undergoes positron emission is
   (A) \(^{14}\text{N}\)
   (B) \(^{14}\text{O}\)
   (C) \(^{14}\text{O}\)
   (D) \(^{14}\text{F}\)
   (E) \(^{28}\text{Ne}\)

49. Which of the following reactions produces a yellow precipitate?
   (A) \( \text{NaOH} (aq) + \text{HCl} (aq) \rightarrow \text{NaCl} (s) + \text{H}_2\text{O} \)
   (B) \( \text{NaOH} (aq) + \text{BaCl} (aq) \rightarrow \text{BaOH} (s) + \text{NaCl} (aq) \)
   (C) \( \text{Pb(NO}_3)_2 (aq) + 2\text{KI} (aq) \rightarrow 2\text{KNO}_3 (aq) + \text{PbI}_2 (s) \)
   (D) \( \text{CuO}(s) + \text{Mg}(s) \rightarrow \text{Cu}(s) + \text{MgO} (s) \)
   (E) \( 4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 \)

GO ON TO THE NEXT PAGE
50. In the electrochemical cell described by the cell diagram above, what reaction occurs at the anode?
(A) \( \text{Zn} \rightarrow \text{Zn}^{2+} + 2e \)
(B) \( \text{Zn}^{2+} + 2e \rightarrow \text{Zn} \)
(C) \( \text{Cl}_2 + 2e \rightarrow 2\text{Cl}^- \)
(D) \( 2\text{Cl}^- \rightarrow \text{Cl}_2 + 2e \)
(E) \( \text{Zn} + \text{Cl}_2 \rightarrow \text{ZnCl}_2 \)

51. Given the reaction \( A \rightarrow B + C \), where \( \Delta H_{\text{re}} \) is negative, what effect would increasing the temperature (at constant pressure) have on the system at equilibrium?
(A) No change
(B) Cannot be determined
(C) Shift to the right
(D) Shift to the left for \( K < 1 \) and to the right for \( K > 1 \)
(E) Shift to the left

52. An unknown acid solution was presumed to be either HCl or H\(_2\)SO\(_4\). Which one of the following salt solutions would produce a precipitate when added to H\(_2\)SO\(_4\) but not when added to HCl?
(A) Li\(_2\)CO\(_3\)
(B) NH\(_4\)NO\(_3\)
(C) Cs\(_2\)SO\(_4\)
(D) Ba(NO\(_3\))\(_2\)
(E) AgNO\(_3\)

\[ \text{Ca}_3(\text{PO}_4)_2(s) \rightleftharpoons 3 \text{Ca}^{2+}(aq) + 2 \text{PO}_4^{3-}(aq) \]

53. What is the equilibrium expression for the dissolution of Ca\(_3\)(PO\(_4\))\(_2\) where the above is true?
(A) \( K_p = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2 \)
(B) \( K_p = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2 \)
(C) \( K_p = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2/[\text{Ca}_3(\text{PO}_4)_2] \)
(D) \( K_p = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2/[\text{Ca}_3(\text{PO}_4)_2] \)
(E) \( K_p = [\text{Ca}^{2+}]^3[\text{PO}_4^{3-}]^2/[\text{Ca}_3(\text{PO}_4)_2] \)

54. Which of the following represents a conjugate acid/base pair?
(A) Na\(^+\)/Cl\(^-\)
(B) HCl/H\(^+\)
(C) H\(_2\)CO\(_3\)/CO\(_3^{2-}\)
(D) NH\(_4\)/NH\(_3^+\)
(E) K\(^+\)/OH\(^-\)

55. An unknown solution having a pH of 3.5 was titrated with 0.1 M NaOH. Analysis of the resulting titration curve showed a single equivalence point at pH 7. Therefore, which of the following could be the unknown solute in the initial solution?
(A) HF
(B) HCl
(C) LiOH
(D) NH\(_3\)
(E) H\(_2\)SO\(_4\)

56. Acid/base titration experiments could be used to determine all of the following directly EXCEPT
(A) the acid concentration of an acidic solution
(B) the alkalinity of a basic solution
(C) the \( pK_a \) of an unknown weak acid
(D) whether an unknown acid is monoprotic or polyprotic
(E) the molecular weight of an unknown acid or base

57. What is the correct term for the phase change from gas directly to solid?
(A) Deposition
(B) Sublimation
(C) Liquefaction
(D) Fusion
(E) Vaporization
58. What is the correct name for a straight-chained organic compound with the molecular formula C_3H_8?
   (A) Methane
   (B) Ethane
   (C) Methylthene
   (D) Propane
   (E) Isopropene

59. If the pH of a solution is changed from 1 to 3 with the addition of an antacid, what percentage of [H^+] was neutralized?
   (A) 2%
   (B) 10%
   (C) 20%
   (D) 90%
   (E) 99%

60. Which of the following statements is the most accurate with regard to the significance of Avogadro’s number, 6.02 \times 10^{23}?
   (A) It is the conversion factor between grams and atomic mass units.
   (B) It is a universal physical constant just as the speed of light.
   (C) It is the number of particles that is required to fill a 1-liter container.
   (D) It is the inverse diameter of an H atom.
   (E) It is the number of electrons in the universe.
CHEMISTRY SUBJECT TEST 3—Continued

Questions 61–64 refer to the following data at standard conditions.

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<th>Appearance</th>
<th>Reactions with dilute HCl</th>
<th>Reaction with dilute HNO₃</th>
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</thead>
<tbody>
<tr>
<td>Unknown metal #1</td>
<td>Dull gray solid with white oxide coating</td>
<td>Dissolved with bubbles of clear gas</td>
<td>Dissolved with bubbles of clear gas</td>
</tr>
<tr>
<td>Unknown metal #2</td>
<td>Solid; lustrous, smooth silver-gray surface</td>
<td>No reaction</td>
<td>Dissolved with bubbles of orange gas</td>
</tr>
</tbody>
</table>

61. Unknown metal #1 could be
   (A) mercury
   (B) copper
   (C) zinc
   (D) iron
   (E) silver

62. Unknown metal #2 could be
   (A) carbon
   (B) copper
   (C) zinc
   (D) sodium
   (E) silver

63. The addition of dilute HCl to unknown metal #1 produced a transparent gas. What is the likely identity of this gas?
   (A) Cl₂
   (B) H₂
   (C) O₂
   (D) CO₂
   (E) NO₂

64. The addition of dilute HNO₃ to unknown metal #2 produced an orange gas. What is the likely identity of this gas?
   (A) Cl₂
   (B) H₂
   (C) O₂
   (D) CO₂
   (E) NO₂

65. Which of the following solutions is the product of the neutralization reaction between 10 ml 0.2 M KOH and 10 ml 0.2 M HI?
   (A) 0.1 M KI
   (B) 0.1 M KI
   (C) 0.2 M KI
   (D) 0.4 M KI
   (E) 0.4 M HOH

66. Which of the following is true regarding an Ne atom with a mass number of 20 and an O²⁻ ion with a mass number of 16?
   (A) They contain the same number of protons.
   (B) They contain the same number of neutrons.
   (C) They contain the same number of protons plus neutrons.
   (D) They are isoelectronic.
   (E) They are isomers.

67. Which of the following statements is NOT correct regarding chemical catalysts?
   (A) They are not consumed during the chemical reaction.
   (B) They cannot make nonspontaneous reactions occur.
   (C) They do not have to be the same phase as the reactant molecules.
   (D) They shift equilibrated reactions to the product’s side.
   (E) Enzymes are biological catalysts.

GO ON TO THE NEXT PAGE
68. Most elements are solids at 25°C and 1 atm pressure, the exception being the 11 elements that are gases and 2 that are liquids. What 2 elements are liquids?
(A) Hg and Br
(B) Hg and I
(C) Ag and Kr
(D) Au and Kr
(E) Pt and Co

69. A student conducted an experiment and obtained three values during three repetitive trials: 1.65, 1.68, 1.71. Later, the student discovered that the true value was 2.37. In contrast to the real value, the experimental results should be characterized as
(A) not accurate and not precise
(B) accurate but not precise
(C) not accurate but precise
(D) accurate and precise
(E) accurate, precise, but unreliable

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IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS TEST ONLY.
DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.
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HOW TO SCORE THE PRINCETON REVIEW
PRACTICE SAT CHEMISTRY SUBJECT TEST

When you take the real exam, the proctors will collect your test booklet and bubble sheet and send your answer sheet to New Jersey, where a computer looks at the pattern of filled-in ovals on your answer sheet and gives you a score. We couldn't include even a small computer with this book, so we are providing this more primitive way of scoring your exam.

Determining Your Score

STEP 1 Using the answer key on the next page, determine how many questions you got right and how many you got wrong on the test. Remember: Questions that you do not answer don't count as either right or wrong answers.

STEP 2 List the number of right answers here. (A) _______

STEP 3 List the number of wrong answers here. Now divide that number by 4. (Use a calculator if you're feeling particularly lazy.) (B) _______ ÷ 4 = (C) _________

STEP 4 Subtract the number of wrong answers divided by 4 from the number of correct answers. Round this score to the nearest whole number. This is your raw score. (A) _______ - (C) _______ = _______

STEP 5 To determine your real score, take the number from Step 4 above, and look it up in the left column of the Score Conversion Table on page 325; the corresponding score on the right is your score on the exam.
## ANSWERS TO THE PRINCETON REVIEW PRACTICE SAT CHEMISTRY SUBJECT TEST 3

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