

ACS Practice Test 1

Acids & Bases:

- All are examples of Lewis acid–base reactions *except*
 - $\text{Cu}^{2+}(\text{aq}) + 4\text{NH}_3(\text{aq}) \rightleftharpoons [\text{Cu}(\text{NH}_3)_4]^{2+}(\text{aq})$
 - $\text{HCl}(\text{g}) + \text{NH}_3(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$
 - $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{H}_2\text{O}(\text{l})$
 - $2\text{Na}(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NaCl}(\text{s})$
- According to the Lewis definition, an acid is a species
 - having a hydrogen ion.
 - donating a pair of electrons.
 - accepting a pair of electrons.
 - accepting a hydrogen ion.
- All are potential Lewis bases *except*
 - NH_3
 - H_2O
 - CH_4
 - CN^-
- Which hydrated metal ion is most acidic under conditions of equal molar concentration in water?
 - Al^{3+}
 - Ba^{2+}
 - K^+
 - Zn^{2+}
 - Ag^+
- Which element in Group 5A forms the most basic oxide?
 - N
 - P
 - As
 - Sb
 - Bi

Atomic Structure:

- In what respect does an atom of magnesium differ from a magnesium ion (Mg^{2+})?
 - The ion has a more stable electronic arrangement than the atom.
 - The positive charge on the nucleus of the ion is two units greater than the nuclear charge on the atom.
 - The ion has two more protons than the atom.
 - The ion will react more readily with free Cl_2 .
 - The ion has two more planetary electrons than the atom.
- A certain atom has the symbol ${}^{148}_{73}\text{P}x$. What does this symbol tell about an atom of the element?
 - It has 148 electrons.
 - It has a valence of 4.
 - It has 221 protons in the nucleus.
 - It has 75 neutrons in the nucleus.
 - Its atomic mass is 73 u.
- The atomic mass of an element is 32.07 u and its atomic number is 16. The number of protons contained in the nucleus of an atom of this element is
 - 16
 - 31
 - 32
 - 48
- The atomic mass of an element is 32.07 u and its atomic number is 16. The element forms a simple ion. The ion will most likely have a charge of
 - 1–
 - 2–
 - 3+
 - 1+

10. The nucleus of which atom contains seven neutrons?

Atom A	$n = 1$	$n = 2$	$n = 3$
$M = 24, Z = 12$	$2e$	$8e$	$2e$

Atom B	$n = 1$	$n = 2$	$n = 3$
$M = 15, Z = 7$	$2e$	$5e$	

Atom C	$n = 1$	$n = 2$	$n = 3$
$M = 17, Z = 10$	$2e$	$8e$	

Atom D	$n = 1$	$n = 2$	$n = 3$
$M = 7, Z = 3$	$2e$	$1e$	

Atom E	$n = 1$	$n = 2$	$n = 3$
$M = 34, Z = 17$	$2e$	$8e$	$7e$

(A) A (B) B (C) C (D) D (E) E

Bonding:

11. In which pair of compounds should the first member be more covalent than the second member?

(A) $\text{TiCl}_2, \text{TiCl}_3$ (B) $\text{SnI}_4, \text{SnF}_4$ (C) LiF, BF_3 (D) $\text{SnF}_4, \text{CF}_4$

12. Which is the most complete and best description of a covalent bond?

(A) a system of two nuclei with a pair of electrons located exactly midway between both nuclei

(B) the attractive force between two atoms of opposite charge

(C) a donor bond in which one atom donates an unshared pair to the other

(D) a system of two nuclei where each atom donates one electron to the other atom, thus forming a bond

13. Which pair of elements is most likely to react to form a covalently bonded species?

(A) P and O (B) Ca and O (C) K and S (D) Zn and C

14. Which chloride should exhibit the most covalent type of bond?

(A) NaCl (B) KCl (C) CaCl_2 (D) BaCl_2 (E) BeCl_2

15. The compound of which two elements is most likely to involve covalent bonding?

Electronegativities of Unknown Elements			
Q	0.9	X	3.0
R	1.0	Z	4.0
T	2.8		

(A) Q and Z (B) R and T (C) T and X (D) R and X (E) R and Z

Electrochemistry:

16. Chromium metal can be plated from an acidic solution of CrO_3 .



How many grams of chromium will be plated by the passage of 19,300 C (coulombs)?

(A) 10.4 (B) 5.19 (C) 1.73 (D) 0.20

17. What time is required to plate 2.08 g of copper at a constant current flow of 1.26 A?

Atomic Molar Mass	
Cu	63.5 g mol ⁻¹



- (A) 41.8 min (B) 83.6 min (C) 128 min (D) 4820 min

18. Nickel is a transition element and has a variable valence. Using a nickel salt, 2 *F* (faradays) plate out 39.2 g of nickel. What ions are in the solution of this salt?

Atomic Molar Mass	
Ni	58.7 g mol ⁻¹

- (A) Ni⁺ (B) Ni²⁺ (C) Ni³⁺ (D) Ni^{2/3+}

19. A given amount of electric charge deposits 2.159 g of silver from an Ag⁺ solution. What mass of copper from a Cu²⁺ solution will be deposited by the same quantity of electric charge?

Atomic Molar Masses	
Ag	107.9 g mol ⁻¹
Cu	63.5 g mol ⁻¹

- (A) 0.635 g (B) 1.97 g (C) 2.54 g (D) 127 g

20. If each of these ions were reduced to metal with one coulomb, which would yield the greatest mass?

- (A) Cu²⁺(aq) (B) Ag⁺(aq) (C) Hg²⁺(aq) (D) Cu⁺(aq)

Equilibrium:

21. Which is a proper description of chemical equilibrium?

- (A) The frequencies of reactant and of product collisions are identical.
 (B) The concentrations of products and reactants are identical.
 (C) The velocities of product and reactant molecules are identical.
 (D) Reactant molecules are forming products as fast as product molecules are reacting to form reactants.
 (E) The numbers of moles of reactants and products are equal.

22. When equilibrium has been reached in the reaction $\text{AE} + \text{CD} \rightleftharpoons \text{CE} + \text{AD} + x \text{ kJ}$ in which all substances are in solution,

- (A) adding AE will increase the concentration of CE but not of AD.
 (B) adding CD will increase the concentration of both AE and AD.
 (C) heating will increase the concentration of both AE and CE.
 (D) escape of some AD by volatilization will increase the concentration of CE.
 (E) doubling the pressure will increase the concentration of CE.

23. Given the reaction $2\text{X}(\text{g}) + \text{Y}(\text{g}) \rightleftharpoons 2\text{Z}(\text{g})$ $\Delta H = -335 \text{ kJ}$ which combination of pressure and temperature gives the highest yield of Z at equilibrium?

- (A) 1000 atm and 500 °C (B) 500 atm and 500 °C
 (C) 1000 atm and 100 °C (D) 500 atm and 100 °C
 (E) catalyst, 500 atm and 100 °C