

Spring 2012
CHEM 1110.20784
Test 2, Form A

Part 1. Multiple Choice: Clearly indicate the best answer on the scantron form. (60 pts)

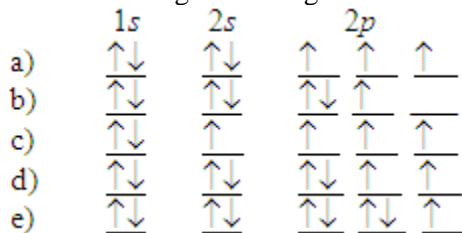
- Which of these choices is the general electron configuration for the outermost electrons of elements in the alkaline earth group?
A) ns^2 B) ns^2np C) ns^1 D) $ns^2np^6(n-1)d^6$ E) ns^2np^4
- Which element has the following ground-state electron configuration? $[\text{Kr}]5s^24d^{10}5p^3$
A) Sb B) Bi C) Sn D) Te E) Pb
- The electron configuration of a cobalt(III) ion is
A) $[\text{Ar}]3d^4$ B) $[\text{Ar}]3d^6$ C) $[\text{Ar}]4s^23d^9$ D) $[\text{Ar}]4s^23d^4$ E) $[\text{Ar}]4s^13d^5$
- Iron(III) oxide is used as a pigment in metal polishing. Which of the following is its formula?
A) Fe_2O B) FeO_3 C) Fe_2O_3 D) FeO E) Fe_2O_5
- Which of these elements exhibits chemical behavior similar to that of potassium?
A) sulfur B) iron C) magnesium D) sodium E) chlorine
- The electron configuration of a ground-state copper atom is
A) $[\text{Ar}]4s^23d^9$ B) $[\text{Ar}]4s^24d^4$ C) $[\text{Ar}]4s^13d^{10}$ D) $[\text{Ar}]4s^24p^63d^3$ E) $[\text{Ar}]3d^9$
- Which of these elements has the highest first ionization energy?
A) Bi B) Cs C) Ga D) K E) As
- The formula for magnesium sulfate is
A) MgSO_4 B) MnSO_3 C) MnS D) MnSO_4 E) MgS
- What is the chemical formula of triphosphorus hexafluoride?
A) P_3F_5 B) P_3F_6 C) P_3Fl_6 D) P_3Fl_5 E) PFl
- The Lewis dot symbol for the S^{2-} ion is
A) $:\ddot{\text{S}}:$ B) $-\ddot{\text{S}}-^{2-}$ C) S^{2-} D) $:\ddot{\text{S}}-$ E) $:\ddot{\text{S}}:^{2-}$
- What is the formula for the ionic compound formed by calcium ions and nitrate ions?
A) $\text{Ca}(\text{NO}_2)_2$ B) Ca_2NO_3 C) $\text{Ca}(\text{NO}_3)_2$ D) CaNO_3 E) Ca_2NO_2
- The compound, P_4S_{10} , is used in the manufacture of safety matches. What is its name?
A) tetraphosphorus decasulfide C) phosphorus sulfide
B) phosphorus decasulfide D) phosphoric sulfide
C) potassium sulfide
- Which ground-state atom has an electron configuration described by the following *orbital diagram*?
$$[\text{Ne}] \quad \uparrow\downarrow \quad \uparrow \quad \uparrow \quad \uparrow$$

$3s \qquad \qquad \qquad 3p$

A) nitrogen B) vanadium C) sulfur D) phosphorus E) arsenic

14. A magnesium ion, Mg^{2+} , has
 A) 24 protons and 22 electrons. D) 24 protons and 26 electrons.
 B) 12 protons and 10 electrons. E) 12 protons and 13 electrons.
 C) 12 protons and 14 electrons.
15. Which of these pairs consists of *isoelectronic* species?
 A) Cl^- and S B) Na^+ and K^+ C) Mn^{2+} and Ar D) K^+ and Cl^- E) Zn^{2+} and Cu^{2+}
16. Which of the following is a correct set of quantum numbers for an electron in a 5f orbital?
 A) $n = 4, l = 3, m_l = 0$ D) $n = 5, l = 4, m_l = 3$.
 B) $n = 5, l = 3, m_l = +1$ E) $n = 5, l = 2, m_l = +3$
 C) $n = 4, l = 2, m_l = +1$
17. Consider the element with the electron configuration $[\text{Kr}] 5s^2 4d^7$. This element is
 A) a noble gas. B) a halogen. C) a transition metal. D) a nonmetal. E) an actinide element.
18. What is the correct electron configuration for germanium (Ge) atom?
 A) None of the answers is correct D) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^2$
 B) $1s^2 2s^2 2p^6 3s^2 3p^2$ E) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$
 C) $1s^2 2s^2 3s^2 3p^5$
19. Which of the elements listed below has the greatest atomic radius?
 A) S B) B C) Si D) Al E) P
20. A possible set of quantum numbers for the last electron added to complete an atom of germanium in its ground state is
- | | <i>n</i> | <i>l</i> | <i>m_l</i> | <i>m_s</i> |
|----|----------|----------|----------------------|----------------------|
| A) | 4 | 0 | 0 | +1/2 |
| B) | 3 | 0 | +1 | -1/2 |
| C) | 4 | 1 | -1 | +1/2 |
| D) | 3 | 1 | +1 | -1/2 |
| E) | 4 | 2 | +2 | -1/2 |
21. What is the wavelength of light having a frequency of $4.8 \times 10^{14} \text{ s}^{-1}$ ($c = 3.0 \times 10^8 \text{ m/s}$)?
 A) $6.3 \times 10^{-7} \text{ nm}$ B) 0.0016 nm C) 1600 m D) 630 nm E) 1600 nm
22. What is the formula for lead (II) oxide?
 A) PbO_4 B) PbO C) PbO_2 D) Pb_2O_3 E) Pb_2O
23. Potassium permanganate is a strong oxidizer that reacts explosively with easily oxidized materials. What is its formula?
 A) $\text{K}(\text{MnO}_4)_2$ B) $\text{K}_2\text{Mn}_2\text{O}_7$ C) KMnO_4 D) K_2MnO_4 E) KMnO_3
24. A radio wave has a frequency of $8.6 \times 10^8 \text{ Hz}$. What is the energy of one photon of this radiation ($h = 6.63 \times 10^{-34} \text{ J s}$)?
 A) $2.3 \times 10^{-34} \text{ J}$ B) $> 10^{-15} \text{ J}$ C) $1.7 \times 10^{-16} \text{ J}$ D) $7.7 \times 10^{-43} \text{ J}$ E) $5.7 \times 10^{-25} \text{ J}$
25. How does atomic radius increase or decrease horizontally or vertically across the periodic table?
 A) Atomic radius increases diagonally across the periodic table
 B) Atomic radius decreases moving from left to right across a period and increases from top to bottom.
 C) Atomic radius increases moving left to right across a period and decreases from top to bottom.
 D) None of the answers is correct
 E) Atomic radius is sporadic unless moving you are moving across a period.

26. The orbital diagram for a ground-state nitrogen atom is



27. Which one of the following sets of quantum numbers can correctly represent a $3p$ orbital?

- | | | | | |
|-----------|-----------|-----------|------------|-----------|
| A) | B) | C) | D) | E) |
| $n = 3$ | $n = 1$ | $n = 3$ | $n = 3$ | $n = 3$ |
| $l = 1$ | $l = 3$ | $l = 2$ | $l = 1$ | $l = 0$ |
| $m_l = 2$ | $m_l = 3$ | $m_l = 1$ | $m_l = -1$ | $m_l = 1$ |

28. "No two electrons in an atom can have the same four quantum numbers" is a statement of

- | | |
|---------------------------|-----------------------------------|
| A) Hund's rule. | D) Dalton's atomic theory. |
| B) de Broglie's relation. | E) the Pauli exclusion principle. |
| C) Bohr's equation. | |

29. Which of these compounds is most likely to be covalent?

- A) SrCl_2 B) CaO C) MgI_2 D) CS_2 E) Rb_2S

30. What is defined as the number of waves that pass through a particular point in one second?

- A) amplitude. B) magnitude. C) frequency. D) light. E) wavelength.

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Part 2. Calculations: Clearly show all work on the blank space on the scantron answer sheet for full credit. (40 pts)

1. (15 pts) Calcium borate hexahydrate is commonly used in the production of Portland cement.
 - a. Calculate the molar mass of $\text{Ca}(\text{BO}_2)_2 \cdot 6\text{H}_2\text{O}$.

 - b. What is the percent composition of oxygen?

2. (10 pts) Phosphorus pentachloride, a white solid that has a pungent, unpleasant odor, is used as a catalyst for certain organic reactions. Calculate the number of molecules of PCl_5 in 38.7 g of phosphorus pentachloride. (MM of $\text{PCl}_5 = 208.24 \text{ g/mol}$)

3. (10 pts) Carbon tetrabromide is used as an ingredient in fire resistant chemicals because it is nonflammable. Calculate the mass in grams of 8.35×10^{22} molecules of CBr_4 . (MM of $\text{CBr}_4 = 331.63 \text{ g/mol}$)

4. (5 pts) What is the molecular formula of a molecule that has a molar mass of 150.13 g/mol and an empirical formula of CH_2O ?