

Answer each question in the space required. Show all work.

1. Which electrons on an atom or ion are considered *valence electrons*? (Give a brief answer!)

2. Determine how many *valence electrons* are found in each of the following elements and ions.

- | | | |
|-------------|---------------------------|--------------------------|
| a. C _____ | f. Ca^{2+} _____ | k. P _____ |
| b. F _____ | g. O _____ | l. Cl^- _____ |
| c. Na _____ | h. Cl _____ | m. S^{2-} _____ |
| d. He _____ | i. Ne _____ | n. N^{3-} _____ |
| e. S _____ | j. N _____ | o. Na^+ _____ |

3. Name each of the following elemental species, then write the *full electron configuration* for the ground state of each species:

- | | | |
|---------------------|-------|-------|
| a. N | _____ | _____ |
| b. P | _____ | _____ |
| c. Cl^- | _____ | _____ |
| d. Ru^{2+} | _____ | _____ |
| e. Ga | _____ | _____ |

4. Name each of the following elemental species, then write the *shorthand (abbreviated) electron configuration* for the ground state of each species:

- | | | |
|---------------------|-------|-------|
| a. Al^{3+} | _____ | _____ |
| b. Sm | _____ | _____ |
| c. C | _____ | _____ |
| d. I^- | _____ | _____ |
| e. V^{5+} | _____ | _____ |

5. P^{3-} , S^{2-} , Mn^{7+} , Sc^{3+} , and Ti^{4+} are *isoelectronic* ions. Write the ground state electron configuration for each of these ions. Which **one** of them would you expect to have the **smallest** radius? Justify your answer (be brief!).

6. Assume M is a metal that forms $2+$ ions, M^{2+} . Which element does M represents for each of the following M^{2+} ion electron configurations.

a. $[Ar]3d^7$: _____

c. $[Kr]4d^4$: _____

b. $[Ar]3d^6$: _____

d. $[Kr]4d^3$: _____

7. Consider each of the following sets of quantum numbers (n , ℓ , m_ℓ , s). Decide if each set is valid or not valid. For valid sets, identify the orbital the set describes (*i.e.* $2p$). For sets that are not valid, give an explanation as to why the set is not valid.

a. $n = 2$, $\ell = 1$, $m_\ell = 0$, $s = 1/2$

b. $n = 0$, $\ell = 0$, $m_\ell = 0$, $s = 1/2$

c. $n = 3$, $\ell = 2$, $m_\ell = -2$, $s = -1/2$

d. $n = 3$, $\ell = -2$, $m_\ell = 3$, $s = 1/2$

e. $n = 4$, $\ell = 3$, $m_\ell = 2$, $s = -1$

8. Determine the element for each of the following orbital populations. Write the atomic symbol.

a.

$1s$	$2s$	$2p$	$3s$	$3p$	$4s$	$3d$
$(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow\downarrow)(\uparrow\downarrow)(\uparrow)$	$()$	$() () ()$	$()$	$() () () () ()$

b.

$1s$	$2s$	$2p$	$3s$	$3p$	$4s$	$3d$
$(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow\downarrow)(\uparrow\downarrow)(\uparrow\downarrow)$	(\uparrow)	$() () ()$	$()$	$() () () () ()$

c.

$1s$	$2s$	$2p$	$3s$	$3p$	$4s$	$3d$
$(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow\downarrow)(\uparrow\downarrow)(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow)(\uparrow)()$	$()$	$() () () () ()$

d.

$1s$	$2s$	$2p$	$3s$	$3p$	$4s$	$3d$
$(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow\downarrow)(\uparrow\downarrow)(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow\downarrow)(\uparrow\downarrow)(\uparrow\downarrow)$	$(\uparrow\downarrow)$	$(\uparrow\downarrow)(\uparrow)(\uparrow)(\uparrow)(\uparrow)$