

1. (24 points total) Circle the best answer to each of the following questions. Your answers need not be justified, and no partial credit will be awarded.

- A. Which of the following statements about atomic orbitals and electronic structure is false?
- (a) In the He^+ cation, the $3s$, $3p$, and $3d$ orbitals are all degenerate.
 - (b) An As atom in its ground state has three unpaired electrons.
 - (c) In Rb, the $5s$ subshell is lower in energy than the $4d$ subshell because the $4d$ subshell experiences a lower effective nuclear charge.
 - (d) The ground state electron configurations of Ca and Ti^{2+} are different.
 - (e) Statements (a), (b), (c), and (d) are all true.
- B. Which of the following statements about atomic structure is true?
- (a) Thomson's "plum pudding" model was consistent with Rutherford's experiment.
 - (b) The Bohr model predicts accurately the wavelengths of light emitted by helium.
 - (c) The wave function ψ lets us calculate the radius of an electron's orbit in an atom.
 - (d) According to de Broglie, the electron in an atom behaves like a traveling wave.
 - (e) According to Heisenberg, an electron collapsing into the nucleus would be forced to move faster than the speed of light.
- C. Which one of the following series is not listed in decreasing order of radius?
- (a) Fe, Fe^{2+} , Fe^{3+}
 - (b) Ar, Ne, He
 - (c) Ca^{2+} , Sc^{3+} , Ti^{4+}
 - (b) F^- , Ne, Na^+
 - (d) O, O^- , O^{2-}
- D. Which element has the highest second ionization energy?
- (a) Na
 - (b) K
 - (c) Rb
 - (d) Cs
 - (e) Ba
- E. The electron affinity of which of the following species will be positive?
- (a) O^-
 - (b) Li
 - (c) Zn
 - (d) Cl^-
 - (e) He
- F. Which species will have the longest O-O bonds?
- (a) O_2
 - (b) O_2^{2-}
 - (c) O_3
 - (d) Species (a), (b) and (c) will have identical O-O bond lengths
 - (e) We are not given enough information to make a prediction.