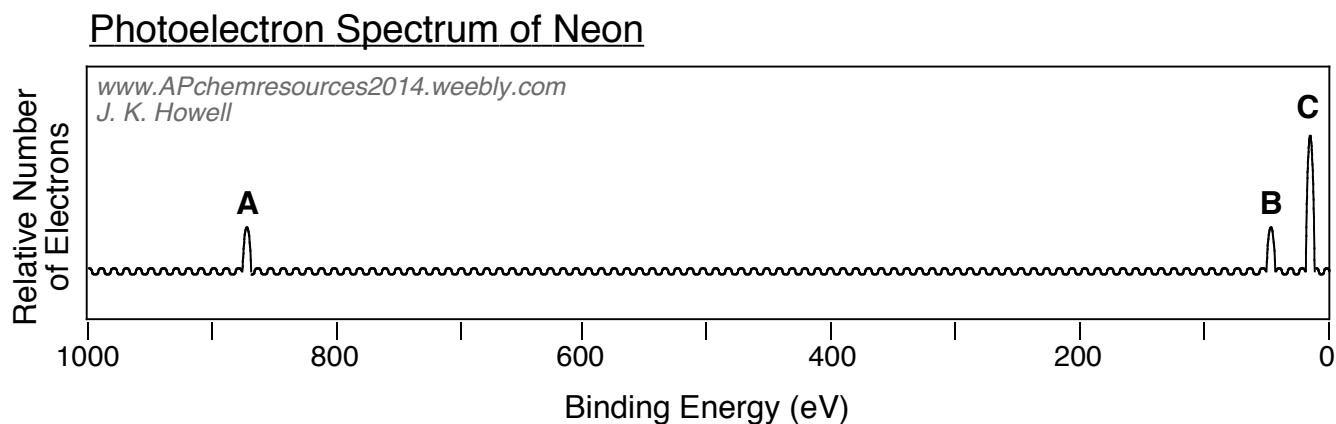


Photoelectron Spectroscopy (PES) Sample Questions

Questions 1-3 refer to the photoelectron spectrum of neon shown below:



1. Peaks A, B, and C represent the binding energies of electrons in which subshells of neon?
 - a. 1s, 2s, 2p
 - b. 2p, 2s, 1s
 - c. 1s, 1s, 1s
 - d. 2s, 2p, 2p
2. Which of the following statements best accounts for peak A being far to the left of peaks B and C:
 - a. the electron configuration of neon is $1s^2 2s^2 2p^6$
 - b. neon has 8 electrons located in its valence shell
 - c. core electrons of an atom experience a much higher effective nuclear charge than valence electrons
 - d. peaks B and C show first ionization energies of electrons in neon, whereas peak A shows the second ionization energy of neon
3. Which of the following statements best accounts for peak C being three times the height of peak B:
 - a. the intensity of the photoelectron signal at a given energy is a measure of the number of electrons in that energy level
 - b. electrons represented by peak B have approximately triple the binding energy than those represented by peak C
 - c. in a photoelectron spectrum, as binding energy increases the relative number of electrons decreases
 - d. the height of peaks in a photoelectron spectrum does not have any relation to the structure of the atom

4. Nitrogen shows 3 peaks in its photoelectron spectrum. These 3 peaks correspond to the binding energies of nitrogen's 1s, 2s and 2p electrons. The relative heights of the 1s, 2s, and 2p peaks in the PES spectrum of nitrogen will be:

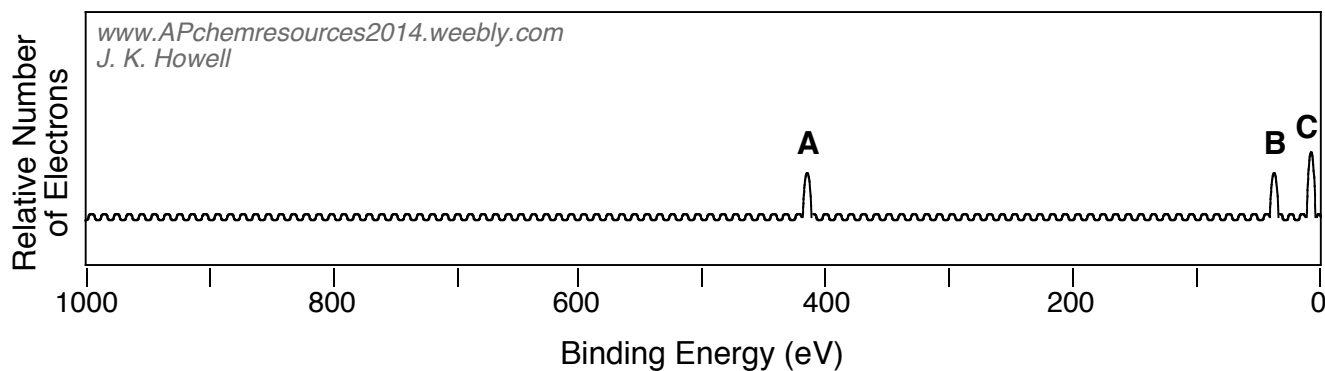
- | | |
|------------|------------|
| a. 1, 1, 1 | c. 1, 1, 2 |
| b. 2, 2, 3 | d. 2, 2, 5 |

5. If the binding energy of an electron is between 0 - 10 eV, it can be assumed that the electron originated in:

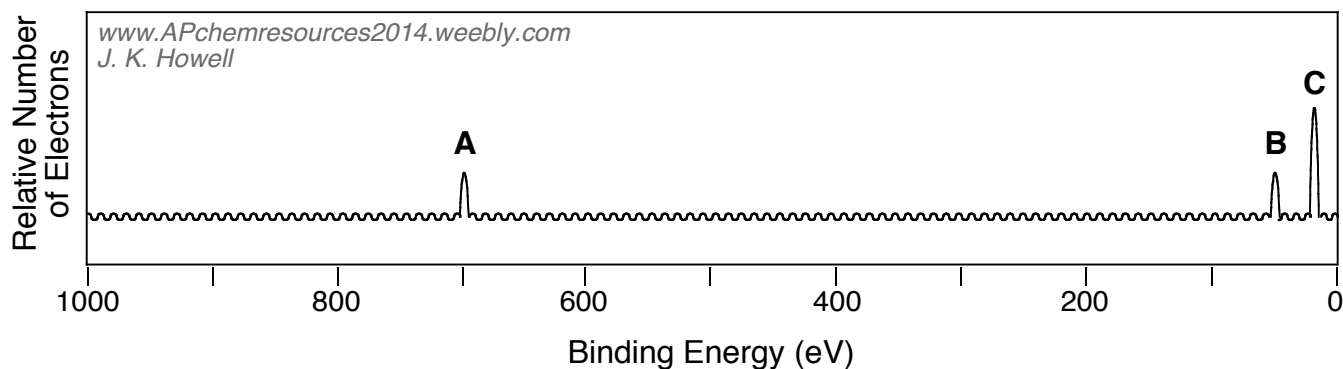
- | | |
|-----------------|----------------------|
| a. an s orbital | c. a core orbital |
| b. a p orbital | d. a valence orbital |

6. Shown below are the photoelectron spectra of nitrogen (atomic number 7) and fluorine (atomic number 9).

Photoelectron Spectrum of Nitrogen



Photoelectron Spectrum of Fluorine

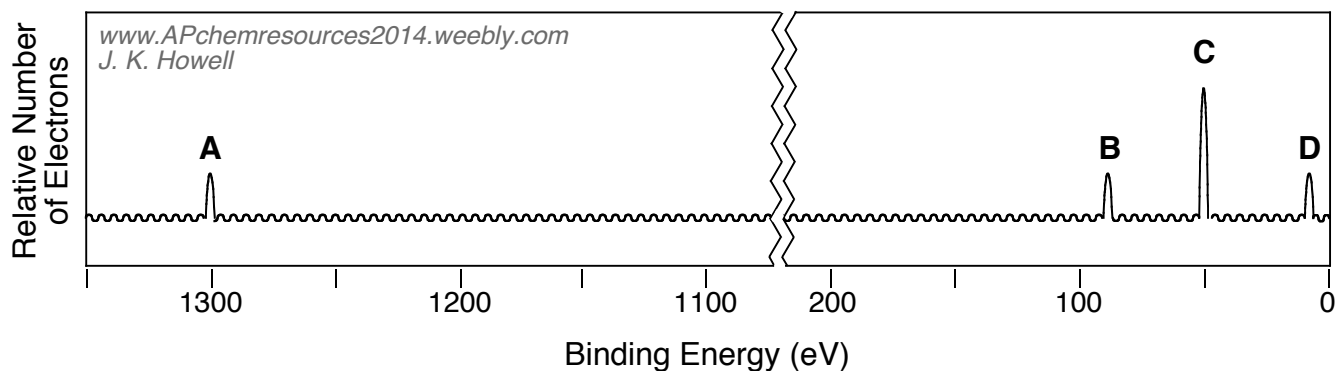


Given the data in the two spectra, what do you expect the binding energy of the 1s electrons in oxygen (atomic number 8) to be?

- | | |
|----------------|------------------|
| a. 0 - 50 eV | c. 400 - 700 eV |
| b. 50 - 400 eV | d. 700 - 1000 eV |

7. The photoelectron spectrum below shows the binding energies for all electrons in neutral element Z:

Photoelectron Spectrum of Element Z

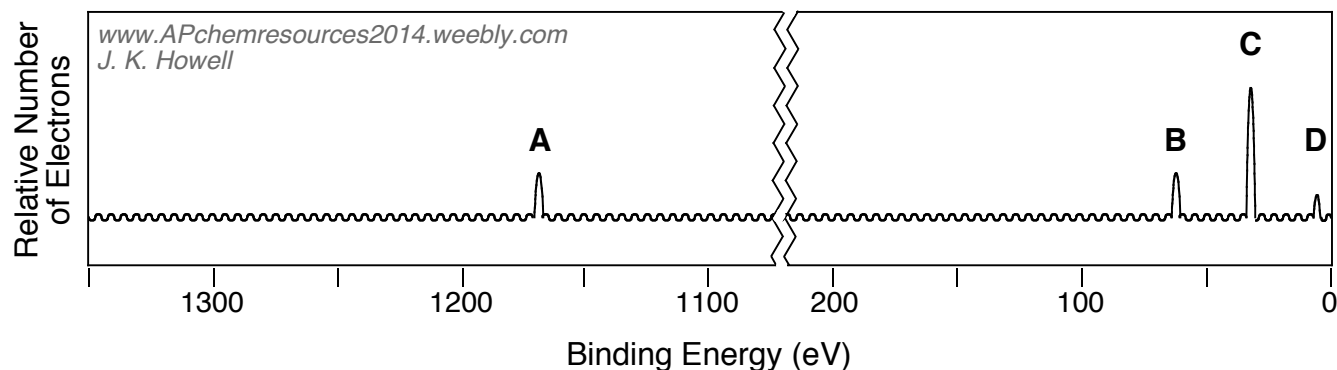


What is the identity of element Z?

- a. boron
- b. carbon
- c. neon
- d. magnesium

Questions 8-11 refer to the complete photoelectron spectrum of sodium shown below:

Photoelectron Spectrum of Sodium



8. Identify the peak (A-D) in the photoelectron spectrum of sodium that represents the binding energy of electrons in the 2s orbital.

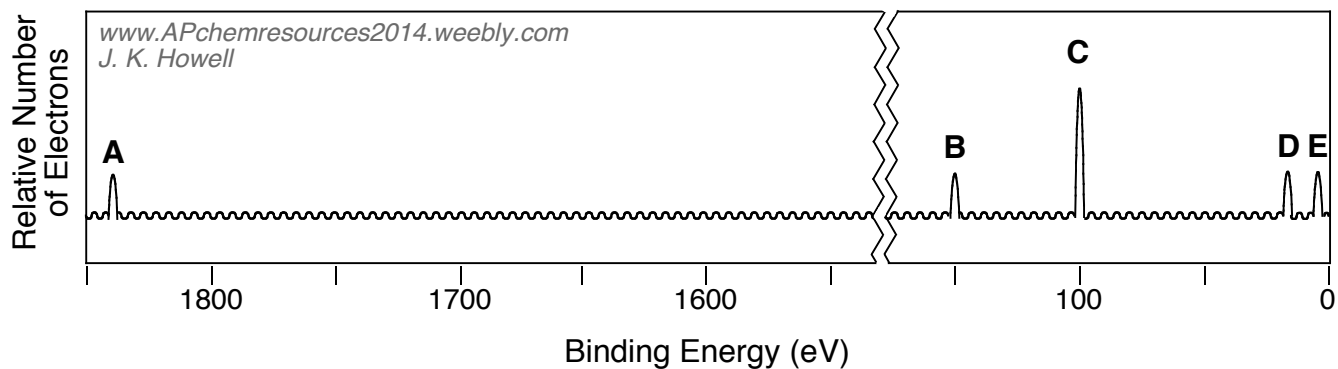
9. Identify the peak (A-D) in the photoelectron spectrum that gives the binding energy of sodium's valence electrons.

10. Which peak (A-D) in the photoelectron spectrum of sodium shows electrons closest to the nucleus?

11. Which peak (A-D) in the photoelectron spectrum of sodium represents an orbital containing 6 electrons?

Questions 12 - 15 refer to the complete photoelectron spectrum of neutral element Q shown below:

Photoelectron Spectrum of Element Q



12. The electrons that feel the strongest effective nuclear charge are given by which peak?
- A
 - B
 - E
 - all electrons in this spectrum experience the same effective nuclear charge
13. Which peaks in the photoelectron spectrum represent valence electrons of element Q?
- A only
 - B and C
 - D and E
 - E only
14. Which peaks in the photoelectron spectrum of Q are given by the binding energy of p orbital electrons?
- C only
 - D only
 - C and E
 - B, C, and D
15. What is the identity of element Q?
- carbon
 - oxygen
 - magnesium
 - silicon

Answers:

- | | | |
|------|-------|-------|
| 1. a | 6. c | 11. c |
| 2. c | 7. d | 12. a |
| 3. a | 8. b | 13. c |
| 4. b | 9. d | 14. c |
| 5. d | 10. a | 15. d |