

Electron configurations, PES and periodic trends

AP Chemistry · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers configurations, PES, Coulomb's law and periodic trends. It has 8 questions worth 20 marks. A calculator is allowed and no hints are given.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 1

Time: 40 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Configurations of manganese (2 marks)

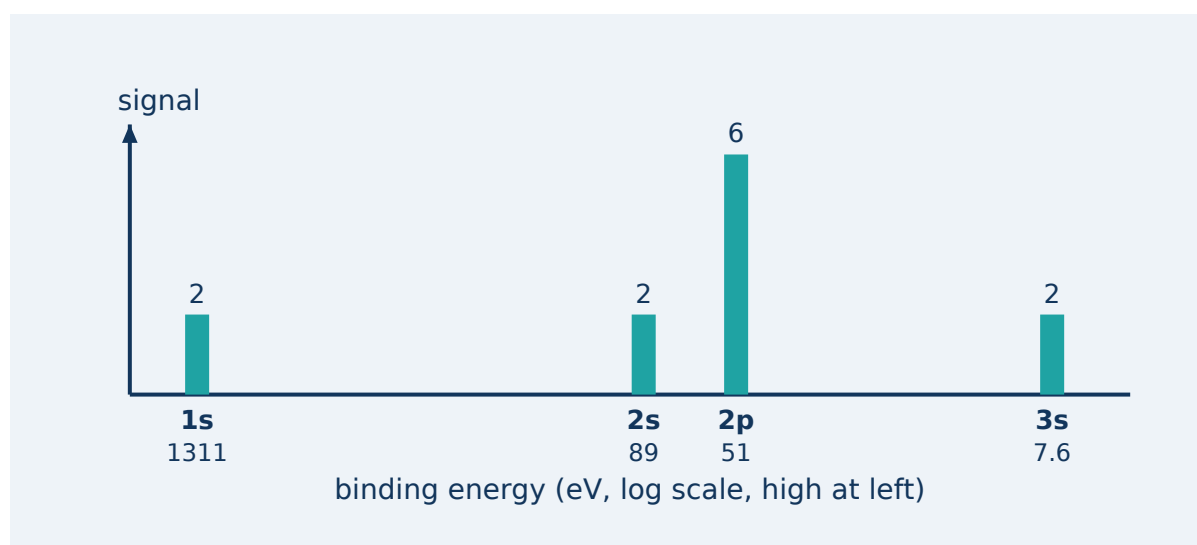
Manganese has atomic number 25.

- Write the configuration of an Mn atom. (1 mark)
- Write the configuration of Mn^{2+} and state its number of unpaired electrons. (1 mark)

Question 2 Reading a PES spectrum (3 marks)

The figure shows the PES of element X.

- Identify the element. (1 mark)
- Assign each peak to a subshell. (1 mark)
- Explain why the 1s peak has the highest binding energy. (1 mark)



PES of element X (approximate energies).

Question 3 Coulomb's law (3 marks)

- The distance between a nucleus and an electron increases by a factor of 1.5 and the effective nuclear charge doubles. Calculate the factor by which the force changes. (2 marks)
- Explain why Mg^{2+} is smaller than Na^+ . (1 mark)

Question 4 Successive ionisation energies (2 marks)

The first four ionisation energies of an element are 899, 1757, 14848 and 21006 kJ/mol. Identify the group of the element and justify your answer. (2 marks)

Question 5 Phosphorus and sulfur (3 marks)

IE_1 for phosphorus is 1012 kJ/mol and for sulfur 1000 kJ/mol. Explain why sulfur's value is lower although its nuclear charge is higher. (3 marks)

Question 6 Order of radii (2 marks)

Arrange Cl, Na, Mg and Cl^- from smallest to largest radius. Give a reason. (2 marks)

Question 7 Binding energy from kinetic energy (3 marks)

Photons of energy 1487 eV eject electrons from an aluminium sample. The faster electrons have a kinetic energy of 1414 eV.

- Calculate their binding energy. (1 mark)
- Identify the subshell, using that 2s is 118 eV and 2p is 73 eV. (1 mark)
- State what kinetic energy the 2s electrons would have. (1 mark)

Question 8 Radius and effective charge (2 marks)

Estimate Z_{eff} for the valence electron in Na and in Cl (core of 10 electrons) and use it to explain why Cl is smaller. (2 marks)