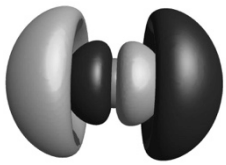
	Marks
• A schematic representation of a *p* orbital is shown below. The central sphere (mostly obscured) represents the atomic nucleus.	**2**



How many spherical and planar nodes does this orbital have? Label them on the diagram above.

Number of spherical nodes:	Number of planar nodes:

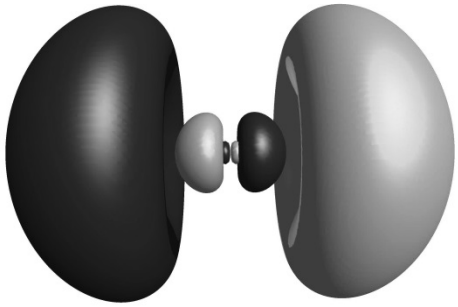
What is the principal quantum number, *n*, of this orbital? Explain your answer.

• Shielding is important in multi-electron atoms. Briefly explain the concept of shielding.	**3**

Give one example of a consequence of shielding.

Marks 3

- Consider the 4*p* orbital shown below. Note that, for clarity, the nucleus of the atom is not shown.



How many spherical and planar nodes does this orbital have?

Number of spherical nodes:	Number of planar nodes:

Complete the following table to give a set of quantum numbers that describes an electron in a 4*p* orbital.

Quantum number	*n*			
Value	4			

Marks 4

- The "Paschen" series of emission lines corresponds to emission from higher lying energy states to the $n = 3$ state in hydrogen-like atoms. Calculate the wavelength (in nm) of the lowest energy "Paschen" emission line in Li^{2+}.

Answer:

What are the possible l states for the $n = 4$ level of Li^{2+}?

Sketch the atomic orbital with $n = 3$ and the lowest value of l.

Marks 5

e) The oxygen atom in the reaction in part d) is formed in its ground electronic state. What is the ground state electronic configuration for O?

Draw an atomic orbital energy level diagram for the ground state O atom. Name the orbitals and show all electrons.

Name and sketch the atomic orbitals for the highest occupied atomic orbital and the lowest unoccupied atomic orbital in the ground state O atom. Make sure all nodes are clearly identified in your sketch.

sketch of highest occupied orbital	sketch of lowest unoccupied orbital
Name:	Name:

- Sketch the wavefunction of the 3*s* atomic orbital as described below. Clearly mark all nodes and the relative sign (+ or –) of the wavefunction.

a) using lobe representations

b) by plotting wavefunction *versus* distance from the nucleus

Explain the significance of (a) the lobes, (b) the nodes and (c) the sign of the wavefunction, in terms of the probability of finding an electron at a given point in space relative to the nucleus.

Marks 5

- Sketch the following wavefunctions using lobe representations. Clearly mark all nodal surfaces, nuclear positions and the relative sign (+ or –) of the wavefunction within the lobes.

a 2*s* atomic orbital	a 3*p* atomic orbital

Explain the significance of (a) the lobes, (b) the nodes and (c) the sign of the wavefunction, in terms of the probability of finding an electron at a given point in space relative to the nucleus.

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY

• Calculate the energy (in J) and the wavelength (in nm) expected for an emission associated with an electronic transition from $n = 4$ to $n = 2$ in the Be^{3+} ion.	**Marks 3**
Energy: | Wavelength:	

• What two properties do electrons in atoms have which lead to discrete energy levels? Explain your answer.	**2**

• What is the % transmission of a sample measured in an atomic absorption spectrometer to have an absorbance of 0.5?	**2**
Answer:	