- What factors determine the lattice energy of an ionic crystal?

3

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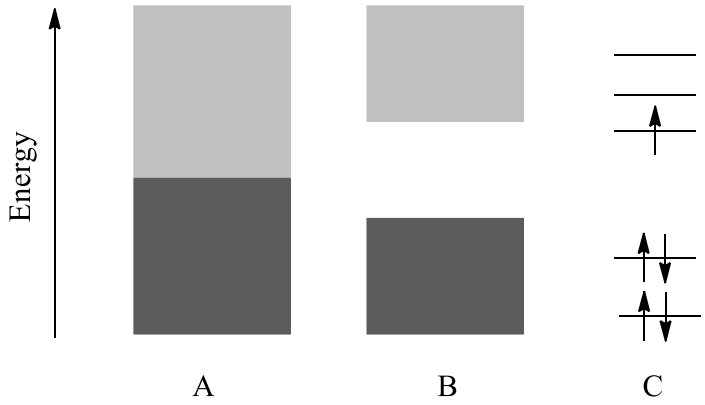
Marks 5

- The diagram below shows the band structure of two solid elements, A and B. Dark grey denotes filled electron energy levels, light grey denotes unfilled levels. Also shown are the atomic energy levels (valence electron orbitals only) of another element, C.



Describe the electrical properties of elements A and B, explaining your reasoning.

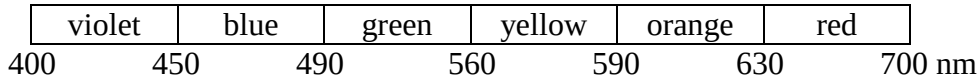
If a small amount of element C is deliberately added to each of A and B, describe what effect this will have on the electrical properties of each. Give reasons.

Marks 4

- Explain what is meant by the term "band gap".

The band gap of the semiconductor gallium(II) sulfide is 2.53 eV. What range of wavelengths (in nm) would you expect this material to absorb?

For reference, the relationship between colours and wavelengths is as follows:



Predict the colour of a single crystal of GaS according to a human observer when it is illuminated with white light. Explain your answer.

	Marks
• Pure silicon is an insulator. Explain, with band structure diagrams, how doping pure silicon with a small amount of aluminium can turn it into a p-type semiconductor.	**4**
• Sketch the wave function of a 2*p* orbital as a lobe representation. Clearly mark all nodes (spherical and/or planar) and nuclear positions.	**2**

	Marks
• Pure silicon is an insulator. Explain, with sketches of band structure diagrams, how 'doping' pure silicon with a small amount of phosphorus can turn it into an 'n-type' semiconductor.	2

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	Marks
• Pure silicon is an insulator. Explain how incorporation of a small amount of nearby elements can bring about 'p-type' semiconduction. Explain your choice of dopant and use diagrams as required.	3

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