

**Marks**  
**7**

Carbon, silicon, germanium and tin all adopt the diamond structure. Diamond has a band gap of 5.5 eV, while silicon absorbs wavelengths shorter than 1100 nm. Predict the band gaps of germanium and tin.

Predict the band gap of SiC, which also has a diamond like structure, but with Si bonded to 4 C atoms, and C bonded to 4 Si atoms.

Use the information in the following table to predict the density of tin.

<b>Element</b>	<b>Atomic Mass</b>	<b>Density (g cm<sup>-3</sup>)</b>	<b>Bond length (pm)</b>
Ge	72.64	5.323	244
Sn	118.7		280.

Answer:

**Marks**  
**2**

- In the spaces provided, explain the meaning of the following terms. You may use an example, equation or diagram where appropriate.

(a) covalent bond

(b) electronegativity

(c) free radical

(d) band gap

**Marks**  
**4**

- In the spaces provided, explain the meaning of the following terms. You may use an example, equation or diagram where appropriate.

(a) antibonding molecular orbital

(b) emission spectroscopy

(c) band gap

(d) a triple bond

**Marks**  
**4**

- In the spaces provided, explain the meaning of the following terms. You may use an example, equation or diagram where appropriate.

(a) diamagnetic

(b) covalent bond

(c) Hund's rule

(d) electrical conductor

**Marks**  
**6**

- In the spaces provided, explain the meaning of the following terms. You may use an example, equation or diagram where appropriate.

(a) Pauli exclusion principle

(b) electronegativity

(c) ionic bond

(d) paramagnetic

(e) n-type semiconductor

(e)  $\sigma$  bond

- Explain, with reference to the distribution of electronic energy levels, why crystalline  $\text{SiO}_2$  (quartz) is transparent while crystalline Fe is opaque.

	<b>Marks</b>
<ul style="list-style-type: none"><li>Describe (or sketch) the shape and arrangement of the <u>nodes</u> in the following three atomic orbitals: <math>2s</math>, <math>2p</math> and <math>3s</math>.</li></ul>	2
<ul style="list-style-type: none"><li>Explain the different roles of neutrons and protons in stabilising nuclei.</li></ul>	2
<ul style="list-style-type: none"><li>Explain, with reference to the distribution of electronic energy levels, why crystalline <math>\text{SiO}_2</math> (quartz) is transparent while crystalline Fe is opaque.</li></ul>	2