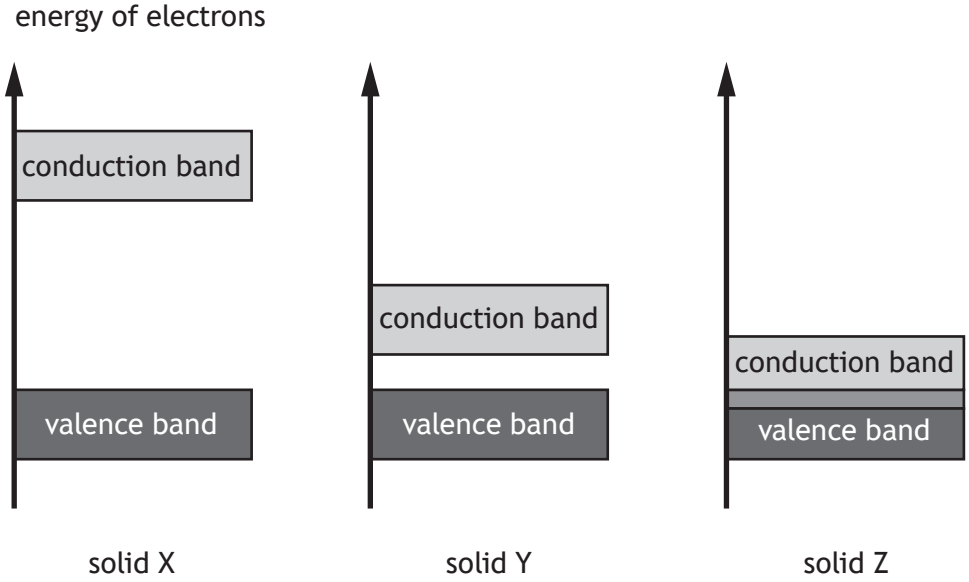
14. Solids can be categorised as conductors, insulators or semiconductors depending on their ability to conduct electricity. Their electrical conductivity can be explained using band theory.

The diagrams show the valence and conduction bands of three solids X, Y and Z.

One represents a conductor, one represents an insulator and one represents a semiconductor.



(a) Complete the table to show which solid represents a conductor, an insulator and a semiconductor. **1**

Solid	Category
X	
Y	
Z	

14. (continued)

(b) Using **band theory**, explain why conduction can take place in a semiconductor at room temperature. **2**

(c) Silicon can be doped with arsenic to produce an n-type semiconductor.

State the effect that doping has on the conductivity of silicon. **1**

(d) Resistivity is a measure of a material's property to oppose the flow of charge.

The resistivity of silicon is $2{\cdot}3 \times 10^{3}\,\Omega\,\text{m}$.

The resistivity of copper is $1{\cdot}7 \times 10^{-8}\,\Omega\,\text{m}$.

Compare the resistivity of silicon to the resistivity of copper in terms of orders of magnitude. **2**

Space for working and answer