

<ul style="list-style-type: none"><li>Determine an electronic transition involving the <math>n = 5</math> level of the <math>\text{He}^+</math> ion that emits light in the visible region (400–700 nm) of the electromagnetic spectrum.</li></ul>	<b>Marks</b> <b>3</b>
<ul style="list-style-type: none"><li>Describe one piece of experimental evidence supporting the conclusion that electrons have wave-like character.</li></ul>	<b>1</b>

**Marks**  
**8**

- Complete the table below showing the Lewis structures and the predicted shapes of the following species.

Species	Lewis Structure	Approximate F-X-F bond angle(s)	Name of molecular shape
$\text{SiF}_4$			
$\text{SF}_4$			
$\text{XeF}_3^+$			
$\text{XeF}_3^-$			

**Marks**  
**6**

- An “excimer laser” is a type of ultraviolet laser used for lithography, micromachining and eye surgery. In one type of laser, an electrical discharge through HCl and Xe in a helium buffer gas yields metastable XeCl molecules, described like an ion pair. These then emit 308 nm light and dissociate into Xe and Cl atoms.

element	Ionisation energy / $\text{kJ mol}^{-1}$	Electron affinity / $\text{kJ mol}^{-1}$
Xe	1170.4	–
Cl	1251.1	–349

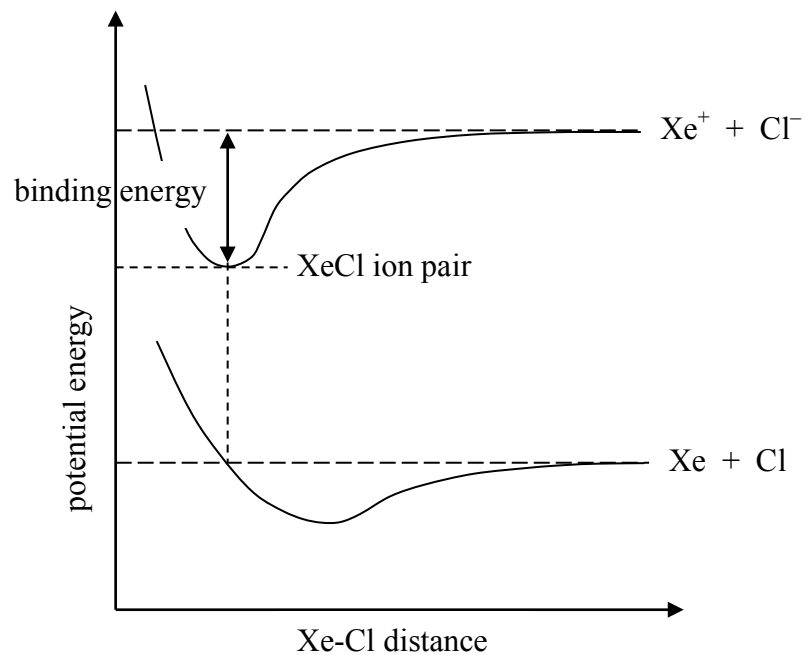
What energy, in eV, is required to convert a pair of Xe and Cl atoms into  $\text{Xe}^+$  and  $\text{Cl}^-$  ions?

Answer:

What energy (in eV) is released when the XeCl molecules emit ultraviolet light?

Answer:

**THIS QUESTION CONTINUES ON THE NEXT PAGE.**



What is the binding energy (in J) of the XeCl ion pair?

Answer:

If the binding is electrostatic, what is the approximate equilibrium bond length of XeCl if the binding energy is given by the Coulomb formula:  $E = \frac{q_1 q_2}{4\pi\epsilon_0 r}$  ?

Answer:

**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