c) $E_{vib} = (v+\frac{1}{2})\hbar\omega = (v+\frac{1}{2})hf \qquad v = 0, 1, 2, \dots$

$v=0 \qquad E_{vib} = \frac{hf}{2} = \frac{6.02\times10^{-34}\times 8.72\times10^{13}}{2} = \boxed{0.164 \text{ eV}}$

$v=1 \qquad E_{vib} = \frac{3}{2}\hbar f = 3\times 0.164 = \boxed{0.492 \text{ eV}}$

for $v=0 \qquad \frac{1}{2}kA^2 = E \Rightarrow A = \sqrt{\frac{2E}{k}} = \boxed{1.05\times10^{-11} \text{ m}}$

for $v=1 \qquad A = \sqrt{\frac{2E}{k}} = \boxed{1.81\times10^{-11} \text{ m}}$

d) λ_{max} corresponds to E_{min} !

* For rotational motion $\quad \Delta E_{0\to1} = \frac{\hbar^2}{2I_{cm}} = \frac{hc}{\lambda_{max}} = 2.63\times10^{-3} \text{ eV}$

$\Rightarrow \lambda_{max} = \frac{hc}{E_{0\to1}} = \frac{12400 \text{ eV Å}}{2.63\times10^{-3} \text{ eV}} = 4.71\times10^{6} \text{ Å}$

$\boxed{\lambda_{max} = 4.71\times10^{-4} \text{ m}}$

* For vibrational motion $\quad \Delta E_{min} = hf = \frac{hc}{\lambda_{max}}$

$\lambda_{max} = \frac{hc}{hf} = \frac{c}{f} = \frac{3\times10^{8}}{8.72\times10^{13}} = \boxed{3.44\times10^{-6} \text{ m}}$

Pb # 9.

$E_{vib} = (v+\frac{1}{2})\hbar\omega \qquad v = 0, 1, 2, \dots$

take $E_{vib} = 4.5 \text{ eV} \Rightarrow v = ?$

$4.5\times1.6\times10^{-19} = v\hbar\omega + \frac{\hbar\omega}{2} \Rightarrow v = 7.28$

$\Rightarrow$ The highest $v = 7$ that can be excited without dissociating the molecule.