Quiz 1 Solution.

1. $V = \frac{p}{m} = \frac{h}{\lambda \cdot m} = 9.97 \times 10^{4}$ m/s 2'

$V_g = V = 9.97 \times 10^{4}$ m/s 1'

$V_p = \frac{1}{2} V_g = 4.99 \times 10^{4}$ m/s 1'

2. $\cos ka = p' \frac{\sin \alpha a}{\alpha a} + \cos \alpha a$

$\because ka = 2\pi, \ p' = 8$

$\therefore 1 = 8 \cdot \frac{\sin(\alpha a)}{\alpha a} + \cos(\alpha a)$ 1' 1'

① $\alpha a = 2\pi \equiv \alpha_1 a$

$\therefore \alpha_1 a = \sqrt{\frac{2mE_1}{\hbar^2}} \cdot a = 2\pi$

$\therefore E_1 = \frac{4\pi^2 \cdot \hbar^2}{2ma^2} = 1.189 \times 10^{-18}$ J 1'

② $\alpha a \approx 7.87 \equiv \alpha_2 a$ (by calculator / Matlab) 1'

$\because \alpha_2 a = \sqrt{\frac{2mE_2}{\hbar^2}} \cdot a = 7.87$

$\therefore E_2 = \frac{(7.87)^2 \cdot \hbar^2}{2ma^2} = 1.865 \times 10^{-18}$ J 1'

$\therefore E_g = E_2 - E_1 = 6.76 \times 10^{-19}$ J $= 4.22$ eV 1'