

4B5 2006 short/numerical Answers

1. (a) Matter waves: $E = \hbar^2 k^2 / 2m$, dispersion; electromagnetic waves, $E = \hbar\omega$, no dispersion unless in a dispersive medium.

(b) Momentum operator = $-i\hbar d/dx$

Energy operator = $i\hbar d/dt$

2. (a) $R = ((k_1 - k_2) / (k_1 + k_2))^2$.

(b) $R = 0.29$

(c) $R = 0.627$

3.

4. (d) noise = 64 pm

5. $E_1 = 373 \text{ meV}$, $E_2 = 1.492 \text{ eV}$, $E_3 = 3.357 \text{ eV}$