Schwartz 7.4 (a)

$$H_0 = \frac{1}{2}\phi\Box\phi \qquad H_{int} = \frac{1}{2}m^2\phi^2$$

$O(1)$: $1 \text{ --- } 2$

$O(m^2)$: $1 \text{ --- } x \text{ --- } 2$

$O(m^4)$: $1 \text{ --- } x_1 \text{ --- } x_2 \text{ --- } 2$

$O(m^6)$: $1 \text{ --- } x_1 \text{ --- } x_2 \text{ --- } x_3 \text{ --- } 2$.

(b) $O(1)$: 1 — 2 gives $1\ \delta(p_1 - p_2)$

$O(m^2)$: 1 — x — 2 gives $i m^2\ \delta(p_1 - p_2)$

$O(m^4)$: 1 — x_1 — x_2 — 2

gives $\displaystyle\int \frac{d^4k}{(2\pi)^4} (i m^2)^2 \frac{i}{k^2 + i\varepsilon} \delta(p_1 - k)\,\delta(k - p_2)$

$$= (i m^2)^2 \frac{i}{p_1^2 + i\varepsilon} \delta(p_1 - p_2)$$

$O(m^6)$: 1 — x_1 — x_2 — x_3 — 2. gives

$$\int \frac{d^4k_1}{(2\pi)^4} \frac{d^4k_2}{(2\pi)^4} (i m^2)^3 \frac{i}{k_1^2 + i\varepsilon} \frac{i}{k_2^2 + i\varepsilon} \delta(p_1 - k_1)\,\delta(k_1 - k_2)\,\delta(k_2 - p_2)$$

$$= \int \frac{d^4k_1}{(2\pi)^4} (i m^2)^3 \frac{i}{k_1^2 + i\varepsilon} \frac{i}{k_1^2 + i\varepsilon} \delta(p_1 - k_1)\,\delta(k_1 - p_2)$$

$$= (i m^2)^3 \frac{i}{(p_1^2 + i\varepsilon)} \frac{i}{(p_1^2 + i\varepsilon)} \delta(p_1 - p_2)$$