Problem 1. (a) Justify the calculation
\[
\int_{-\infty}^{\infty} \int_{\mathbb{R}^d} (e^{it\Delta} f)(x) g(x,t) \, dx \, dt = \int_{\mathbb{R}^d} f(x) \int_{-\infty}^{\infty} (e^{it\Delta} g)(x,t) \, dt \, dx
\]
for \( f \in \mathcal{S}(\mathbb{R}^d), \ g \in \mathcal{S}(\mathbb{R}^d \times \mathbb{R}) = \mathcal{S}(\mathbb{R}^{d+1}) \) (see p. 96 in the lecture notes and p. 68 in [LP]).

(b) Similarly, justify the calculation in (4.19) on p. 69 in [LP] for \( g \in \mathcal{S}(\mathbb{R}^{d+1}) \).

(c) Verify the calculations in the proof of equation (2) (resp. (4.15) in [LP]) of Theorem 4.2 on the parameters \( \alpha, p, q \) leading to the constraints in (*) (resp. (4.18) in [LP]). (See p. 93 in the lecture notes and pp. 68-69 in [LP].)

Problem 2. Verify Example 4.4 on p. 66 in [LP].

Problem 3. Solve Exercise 4.7 on p. 90 in [LP].