1. **Remark.** Section 10 of the Dimension 1.5 handout was written to help with the next question. You may use the Theorems from that section. They also serve for Problem 2 of Homework 3.

2. **18/15. Hint.** Note that \( p < q \) is given. Denote \( p(x) := \phi(T, x) \) the Poincaré map. Find the sign of \( p(x) - x \) for \( x = p, q \). Toward that end show that the solution with \( x(0) = p \) must satisfy \( x(t) > p \) for \( t > 0 \). For \( 0 < t < 1 \) prove and use \( x'(0) > 0 \). If it is violated there would be a smallest \( t > 0 \) with \( x(t) = p \). Derive a contradiction. **Hint** Draw a picture. **Discussion.** The conclusion is valid if the hypotheses are weakened to \( f(t, p) \geq 0 \) and \( f(t, q) \leq 0 \). You need not prove that harder result. It is used below.

3. Exercise 2.1 of the Dimension 1 handout.

4. Exercise 5.1 of the Dimension 1.5 handout.

5. Exercise 5.2 of the Dimension 1.5 handout.

6. Exercise 8.1 of the Dimension 1.5 handout. **Remark.** This is your first problem on Perturbation Theory. The online handout "The Steps of Perturbation Theory" may prove useful.

7. **(408/5 Variant) Construct a nonpositive solution of**

\[
x' = x^{1/5}, \quad x(0) = 0
\]

that is not identically zero. Show that there are infinite number of such solutions. **Discussion.** On page 386, the text constructs nonnegative examples of a closely related equation.