Question 2

```plaintext
restart: with(LinearAlgebra): with(plots):

# \( \frac{dx}{dt} = f1 \)

f1 := r \cdot x + x^3; \quad f1 := x^3 + r x \quad (1)

soln := [solve(f1, x)]; \quad soln := [0, \sqrt{-r}, -\sqrt{-r}] \quad (2)

x1 := soln[1]; \quad x1 := 0 \quad (3)

x2 := soln[2]; \quad x2 := \sqrt{-r} \quad (4)

x3 := soln[3]; \quad x3 := -\sqrt{-r} \quad (5)

# stability

F := diff(f1, x); \quad F := 3 x^2 + r \quad (6)

F1 := subs(x = x1, F); \quad F1 := r \quad (7)

F2 := subs(x = x2, F); \quad F2 := -2 r \quad (8)

F3 := subs(x = x3, F); \quad F3 := -2 r \quad (9)

# x1 = 0 exists for all real values of r. It is stable if r is negative, unstable if r is positive

# x1 and x2 exist for all nonpositive values of r and unstable

implicitplot(f1, r = -1..1, x = -1..1, numpoints = 50000, thickness = 3)
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