Another R&J problem: Do opposites attract?

Okay, here’s another stunningly important question... do opposites attract? Consider the following dynamical system

\[
\frac{dR}{dt} = R + 2J \\
\frac{dJ}{dt} = -R - 2J
\]

where Juliet’s response is always exactly opposite that of Romeo’s.

1. Find the general solution to this dynamical system for arbitrary initial condition \( u_0 \).

2. Do opposites attract? What happens as \( t \to \infty \) if they start out equally in love \( R = J = 1 \)?

3. Draw the “phase portrait” of this love affair. Describe the set of all “steady state” solutions (this thing is called an attractor).

Review/challenge question (not graded but fun)

Analyze the general form of this problem

\[
\frac{dR}{dt} = aR + bJ \\
\frac{dJ}{dt} = -aR - bJ
\]

for all real \( a \) and \( b \).