1. 6 pts) Consider the following predator-prey system
\[
\frac{dR}{dt} = 3R - 1.6RF
\]
\[
\frac{dF}{dt} = -F + 2RF.
\]
Modify this system to include the effect of hunting the prey at a rate proportional to the number of predators.
\[
\frac{dR}{dt} = 3R - 1.6RF - kF
\]
\[
\frac{dF}{dt} = -F + 2RF
\]
\[k: \text{ constant of proportionality for hunting}\]
\[k > 0\]
2. (6 pts) Determine which of the following differential equation corresponds to the vector field given. No explanation is needed.

\[
(i) \quad \frac{dx}{dt} = y - 1 \quad (ii) \quad \frac{dx}{dt} = x + 2y \quad (iii) \quad \frac{dx}{dt} = x^2 - 1 \\
\frac{dy}{dt} = -x - 1 \quad \frac{dy}{dt} = -y \quad \frac{dy}{dt} = -y
\]

When \( x = -1 \) \( y = 1 \), then \( \frac{dx}{dt} = 0 \) and \( \frac{dy}{dt} < 0 \)

For (i) \( x = -1 \) \( y = 1 \) \( \Rightarrow \) \( \frac{dx}{dt} = 0 \) \( \frac{dy}{dt} = 0 \)

(ii) \( x = -1 \) \( y = 1 \) \( \Rightarrow \) \( \frac{dx}{dt} = -1 + 2 = 1 \neq 0 \)

(iii) \( x = -1 \) \( y = 1 \) \( \Rightarrow \) \( \frac{dx}{dt} = 0 \) \( \frac{dy}{dt} = -1 < 0 \)

\[ 2 \quad \text{So (iii)} \]
3. (8 pts) Find the general solution for the following differential equation:
\[ \frac{dy}{dt} = -2ty + t. \]

\[ \frac{dy}{dt} + 2ty = t \]

\[ \mu(t) = e^{t^2} \]

\[ y(t) = \frac{1}{e^{t^2}} \int e^{t^2} t \, dt \]

\[ = \frac{1}{e^{t^2}} \int e^{u} \cdot \frac{1}{2} \, du \]

\[ = \frac{1}{2} e^{-t^2} \left[ e^u + C_1 \right] \]

\[ = \frac{1}{2} e^{-t^2} \left[ e^{t^2} + C_1 \right] \]

\[ = \frac{1}{2} e^{-t^2} t^2 + C_1 e^{-t^2} \]

Let \( C = \frac{C_1}{2} \)

\[ \Rightarrow y(t) = \frac{1}{2} + C e^{-t^2} \]