1. Classify the following equations as (i) linear or nonlinear and (ii) homogeneous or nonhomogeneous, and (iii) determine their orders:

(a) (1 point)
\[ \frac{d^2y}{dt^2} + \ln ty + e^t = 0 \]

(b) (1 point)
\[ y''' + e^ty'y'' + y'' + t^2y = 0. \]

2. Consider the differential equation
\[ \frac{dv}{dt} + \frac{3t^2}{1 + t^3}v = \frac{1}{1 + t^3}. \]

(a) (5 points) Calculate an integrating factor \( \mu \).

(b) (3 points) Solve the differential equation.

(c) (2 points) Suppose we are given the additional condition \( v(0) = 3 \). Solve the resulting initial value problem.

(d) (2 points) Where is this solution valid?

3. Consider the initial value problem
\[ \begin{cases} y' + \frac{1}{t^2}y = \sqrt{\sin(t)} \\ y(1) = 5e. \end{cases} \]

(a) (5 points) What is an integrating factor \( \mu(t) \)?

(b) (5 points) What is the solution to the initial value problem?