

Name: _____

Directions: Show all work. No credit for answers without work.

1. A traffic study examines the average daily usage of a stretch of road. The study finds that, in the absence of any congestion, the daily usage would increase at a rate of 60 vehicles per day. The effect of congestion is to reduce the daily usage at a rate proportional to the current daily usage, with proportionality constant $0.004(\text{days})^{-1}$. Let y be the daily usage of the road (in vehicles) at time t (in days).

(a) [**1 point**] Write a differential equation for y .

(b) [**2 points**] Solve the initial value problem with $y(0) = y_0$.

(c) [**2 points**] If the average daily usage is currently 700 vehicles, how long will it take for the usage to increase to 90% of the limiting value?

2. [2 points] Determine the values of r for which $w = e^{rt}$ is a solution to $\frac{d^2w}{dt^2} + 3\frac{dw}{dt} - 4w = 0$.

3. [3 points] Solve the initial value problem $y' + \frac{3}{t}y = \frac{\cos t}{t^2}$ with $y(\pi) = 1$ and $t > 0$.