Your Name

Student ID #

1. Consider the differential equation $\frac{dy}{dt} = -0.02y - 3$. The $-0.02y$ term can be given several physical interpretations. For instance, it may arise from heat transfer (where the surrounding temperature is zero), and in that case y is measuring temperature. On the other hand, -3 cannot be interpreted as heat transfer. However, -3 can be interpreted as fluid flowing out of a tank at a constant rate, where y is measuring volume.

   Consider the following physical interpretations:

   A. Gravity

   B. Continuously compounded interest

   C. Population loss via deaths per person

   D. Annual deposits, withdrawals, or payments

   E. Air resistance

   In the following questions, focus only on the indicated term—ignore the rest of the equation.

   (a) Which of the above physical interpretations apply to the term $-0.02y$? In each case, what is y measuring (i.e. what are the units of y)?

   Solution: We have:

Interpretation	Applies?	y's Units
A	Does not apply	
B	Does not apply; negative, so you're losing money, not gaining it	
C	Applies	# of People
D	Does not apply	
E	Applies	Velocity

   (b) Which of the above physical interpratations apply to the term -3? In each case, what is y measuring (i.e. what are the units of y)?

   Solution: We have:

Interpretation	Applies?	y's Units
A	Applies, though in these units $g = -3$	Velocity
B	Does not apply	
C	Does not apply	
D	Applies	Money
E	Does not apply	

2. Write down and solve any initial value problem whose differential equation is **not** separable.

Solution: Perhaps the simplest such problem is $\frac{\partial y}{\partial t} = -y + t$ with $y(0) = 0$. Using integrating factors, we have $\mu(t) = e^t$, so that

$$y(t) = e^{-t}\left(\int te^t\,dt + c\right) = e^{-t}(te^t - e^t + c) = t - 1 + ce^{-t}.$$

The initial condition gives $c = 1$, so we have

$$y(t) = t - 1 + e^{-t}.$$