

You have 20 minutes to complete this quiz which is worth 20 points. Calculators are permitted, but no other aids are allowed. Show all work neatly and in order, and clearly indicate your final answers. Answers must be justified whenever possible in order to earn full credit. When you do use your calculator, sketch all relevant graphs and write down all relevant mathematics.

1. (8 points) Solve the following initial value problems:

a. (4 pts) $\frac{dy}{dx} = 2x + 3, y(0) = 4.$

b. (4 pts) $\frac{d^2y}{dx^2} = 3x + 2, y(0) = 4, y'(0) = 1$ where $y'(0)$ denotes $\frac{dy}{dx}$ evaluated when $x = 0.$

2. (5 points)

a. (4 pts) Suppose that you and your cat are hurtling through space at a velocity of $3e^{1.5t}$ km/s. Derive appropriate formulas for your acceleration $a(t)$, velocity $v(t)$, and position $s(t)$.

b. (1 pt) What is your initial velocity?

3. (7 points) The concentration of a particular drug in a patient's bloodstream declines at a rate proportional to the concentration, but it is not known what the constant of proportionality is.

a. (2 pts) Write a differential equation which models the concentration of this drug in the bloodstream.

b. (2 pts) What is the general solution to this equation?

c. (2 pts) The blood concentration is measured twice; once shortly after the injection when the concentration is 12 mm/ml and two hours later when the concentration is 6.5 mm/ml. Use this information to determine the constant of proportionality.

d. (1 pt) Predict what the concentration will be 12 hours after the injection.

(Sources: Coursepack Page 104 #2a, #3a; Page 93 #5; Page 105 #7)