

1. (12 points) The world shrimp production can be represented by the differential equation

$$\frac{dP}{dt} = -0.1P(P - 7),$$

where t is the number of years since 1982 and $P(t)$ is the quantity of shrimp farmed in the world during year t in hundreds of thousands of metric tons. In 1982 the world shrimp production was 100,000 metric tons.

- (a) (3 pts.) Determine all of the equilibrium solutions of the differential equation given above. Classify each as either stable or unstable. No explanation required.
- (b) (4 pts.) Sketch a graph of the solution to the given initial value problem. Be sure to indicate clearly on your graph where the solution curve is increasing/decreasing and where it is concave up/concave down. Clearly mark the value of any asymptotes.
- (c) (3 pts.) Use Euler's method with $\Delta t = 0.5$ to estimate the world shrimp production in the year 1984 ($t = 2$).
- (d) (2 pts.) Is the estimate of world shrimp production in part (c) bigger or smaller than the exact solution to the initial value problem at $t = 2$? Explain in one sentence.