

Name: \_\_\_\_\_

Quiz Score: \_\_\_\_\_/16

Student Number: \_\_\_\_\_

Answer questions in the space provided. Show your work. No calculators or notes.

1.

$$\frac{dy}{dt} = (1 - y)(1 + y)$$

(a) (2 points) Determine the steady state values of the differential equation.

(b) (5 points) Sketch the state space (phase line) diagram for the differential equation.

(c) (2 points) Determine stability of steady state values [classify each steady state value as stable or unstable].

(d) (1 point) For  $y(0) = -1$ , determine  $\lim_{t \rightarrow \infty} y(t)$ .

(e) (1 point) For  $y(0) = 0$ , determine  $\lim_{t \rightarrow \infty} y(t)$ .

(f) (1 point) For  $y(0) = 2$ , determine  $\lim_{t \rightarrow \infty} y(t)$ .

- (g) (3 points) For initial condition  $y(0) = 2$  and step size  $\Delta t = 1/2$ , use two steps of Euler's method to determine approximate solution values of the differential equation at  $t = 1/2$  and  $t = 1$ .

- (h) (1 point) Are the approximate solution values you found in part (g) underestimates or overestimates? Explain your reasoning.