Name:

Each of the multiple choice questions below has one correct choice. Circle the correct choice. (NOTE: The quiz presented in class had errors in Q1 and Q2, these have been corrected.)

Q1

An SIR model of an epidemic is created and described by the following differential equations, where A, B, C represent susceptible, infectious, and recovered populations, but not necessarily in that order.

$$\begin{aligned} A' &= \gamma C \\ B' &= -\beta BC \\ C' &= \beta BC - \gamma C \end{aligned}$$

A vaccine is developed, and the model is updated to incorporate this change. Assuming that vaccinated individuals are immune from the disease and are not infectious, which of the following is a change equation in the new model?

(a) $A' = \gamma C - \delta A$

(b) $B' = -\beta BC - \delta B$

(c) $C' = \beta BC - \gamma A - \delta A$

(d) $C' = \beta BC - \gamma A + \delta A$

Q2

Recall the Romeo and Juliet model given by the change equations

$$\begin{aligned} J' &= R \\ R' &= -J. \end{aligned}$$

Which of the following statements regarding the vector field of the model is false?

(a) If the vector field is rotated by 180° around the origin, the rotated vector field is identical to original vector field.

(b) The length of a vector at a point (A, A) is $|A|\sqrt{2}$.

(c) Only one vector in the vector field has length 0.

(d) Vectors at different points have different directions.

Q3

The growth of a certain protozoa population is found to be described by

$$P' = \sqrt{P} + 4.$$

At time $t = 100$ the population is 9. Euler's method is used to estimate the population at time $t = 102$ using the interval $\Delta t = 1$. This estimate is:

(a) $4 + \sqrt{7}$

(b) 16

(c) 24

(d) $18 + \sqrt{14}$

Q4

A line in the xy-plane has passes through the points $(2, 0)$ and $(0, 1)$. The line has slope:

(a) -2

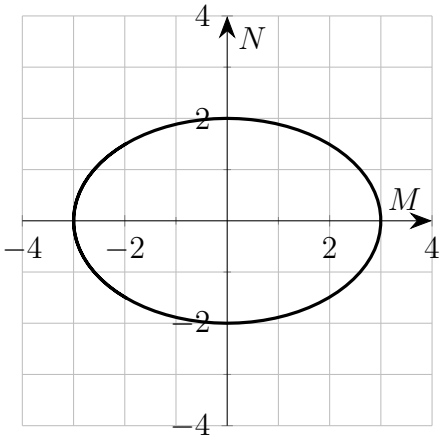
(b) 2

(c) $-\frac{1}{2}$

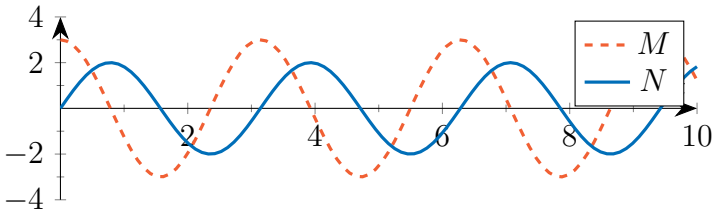
(d) $\frac{1}{2}$

Q5

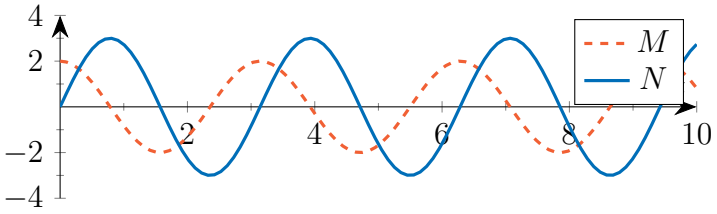
The state space trajectory of a system with variables M, N is shown below. Assuming that as time increases *the trajectory goes in a clockwise direction*, which of the following graphs is a possible time-series of the trajectory? (Note: in the time-series graphs, the horizontal axis represents time.)



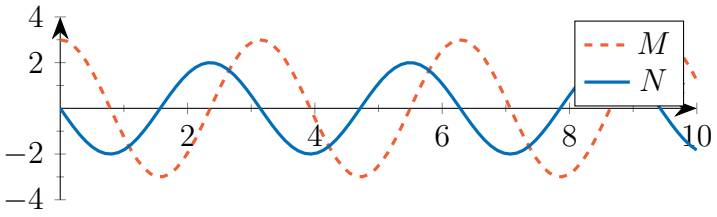
(A)



(B)



(C)



(D)