**4**. [11 points] The function $P(t)$ models the number of bees (in thousands) in a colony at time $t$ (in years). Suppose the function $P(t)$ satisfies the differential equation

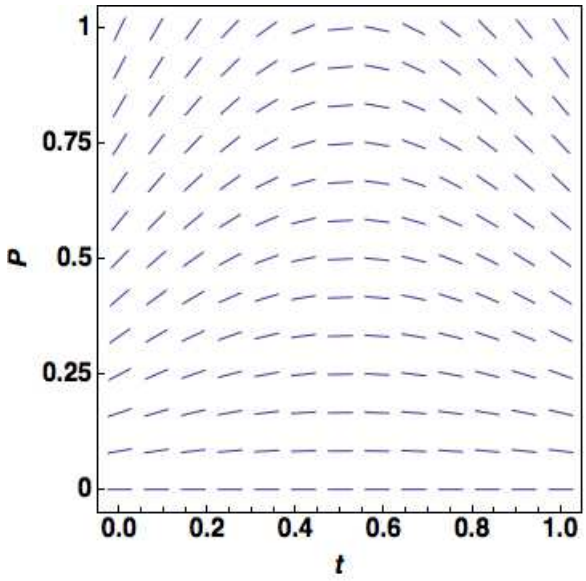
$$\frac{dP}{dt} = 2(1 - 2\sin t)P.$$

The colony initially has 500 bees.

**a**. [6 points] Use Euler's method, with three steps, to find the approximate number of bees (in thousands) in the farm after one year. Fill in the table with the appropriate values of $t$ and your approximations.

| $t$ (in years) | 0 | | | 1 |
|---|---|---|---|---|
| $P(t)$ (in thousands) | | | | |

**b**. [1 point] The slope field of the differential equation $\frac{dP}{dt} = 2(1 - 2\sin t)P$ is shown below. Use it to sketch the graph of $P(t)$, the number of bees (in thousands) in the colony after $t$ years.




**c**. [2 points] Use the differential equation $\frac{dP}{dt} = 2(1 - 2\sin t)P$ to find the exact value of $t$ during the first year at which the number of bees in the colony has a maximum.

**d**. [2 points] Does the approximation of $P(1)$ obtained with Euler's method in (a) guarantee an underestimate, an overestimate or neither? Justify without solving the differential equation.