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## Homework 4.2: Separation of time scales

## Separation of time scales

1/1 point (graded)

Consider the following system of equations

$$\left\{ egin{aligned} rac{du}{dt} &= f\left(u
ight) - m \ \epsilon rac{dm}{dt} &= -m + c\left(u
ight) \end{aligned} 
ight.$$

where  $f(u)=-0.5u-2,\ \epsilon>0.$ 

If dynamics of the variable m is very fast, then it means that  $\dots$ 

(Note that more than one option may be correct.)

- $\frac{1}{\epsilon} \ll 1$ .
- $\checkmark$  the variable m converges to its fixed point very rapidly.
- f(u(t)) can be approximated by c(u(t)) for all times t.
- $lap{\epsilon}\ll 1$  and so  $m\left(t
  ight)pprox c\left(u\left(t
  ight)
  ight)$ .
- lacksquare the system of two equations can be reduced to one:  $rac{du}{dt}=f\left(u
  ight)-c\left(u
  ight)$
- reduced equation is  $\epsilon rac{du}{dt} = -f\left(u
  ight) + c\left(u
  ight)$ .



Submit

You have used 1 of 1 attempt

✓ Correct (1/1 point)

## Stability of the fixed point

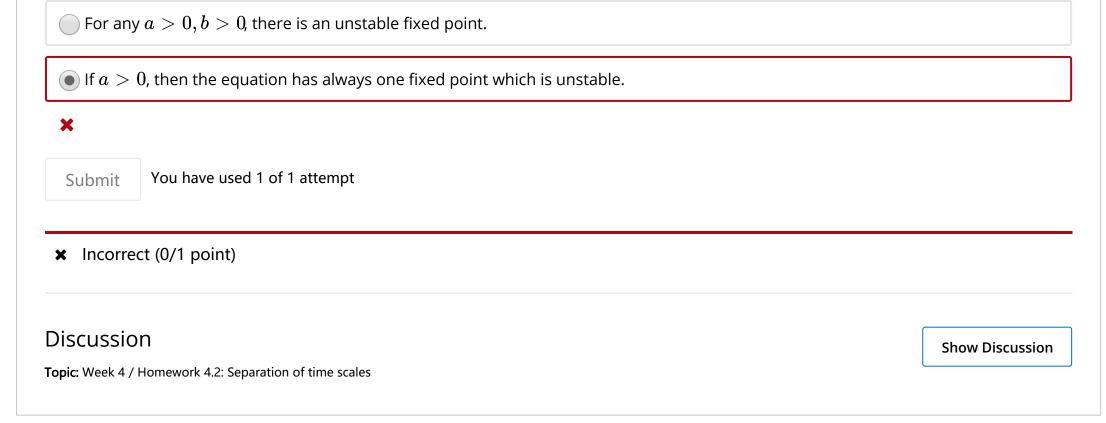
0/1 point (graded)

Imagine the reduced equation above is written as

$$rac{du}{dt}=-au+b-tanh\left( u
ight)$$

where a, b are real numbers. Which of the following is correct regarding the fixed points of the equation?

- ab > 0 is a necessary condition to have a stable fixed point.
- b > 0 guarantees the existence of at least one stable fixed point.
- If a>0, then the equation has always one fixed point which is stable.
- $\bigcirc$  If b>0, then the equation has always one fixed point which is unstable.



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