

# Escape Response and Other Examples

Math 102 Section 102  
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# Announcements

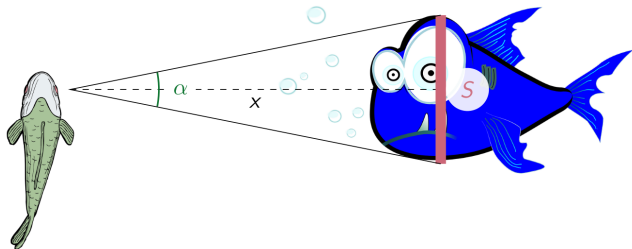
- ▶ Course evaluation [50% done]
- ▶ Elyse's review problems
- ▶ Office hours on Monday (Dec 3rd):
  - ▶ 2:00-3:00 pm @MATX 1118
  - ▶ 5:00-6:00 pm @MATX 1118

## Last time

- ▶  $\frac{d}{dx} \sin(x) = \cos(x)$ ,  $\frac{d}{dx} \cos(x) = -\sin(x)$
- ▶ These derivatives can be demonstrated with motion on a circle, and derived rigorously using the limit definition.
- ▶ Derivatives of other trig functions may be found by using differentiation rules.
- ▶ Derivatives of inverse trig functions can be derived with implicit differentiation.

Today: example!

## Zebrafish's prey response

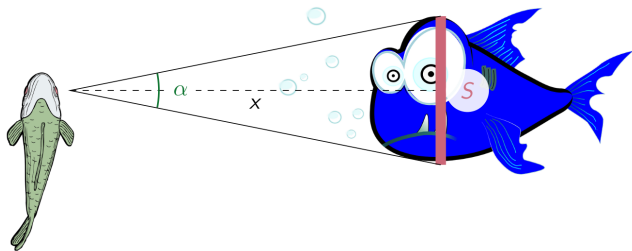


Q: Should the zebrafish flee?

- ▶ You don't want to get eaten.
- ▶ It takes energy and time to flee.

Theory (Larry Dill, SFU Biology): The escape response is triggered when the visual angle  $\alpha$  changes sufficiently quickly.

## Zebrafish's prey response



- ▶ Suppose that the predator approaches the zebrafish with a constant speed  $v$ :

$$\frac{dx}{dt} = -v.$$

- ▶ Calculate  $\frac{d\alpha}{dt}$  in terms of the size  $s$  of the predator, its velocity  $v$  and  $x$  from the zebrafish.

## Zebrafish's prey response

Explore the biological implications.

# Clock hand angle

## Example

Q1. Find the rate of change (in unit of radians per hour) of the angle between the minute hand and hour hand on a normally running clock.

A.  $-\frac{5\pi}{6}$

B.  $-\frac{11\pi}{6}$

C.  $-\frac{5\pi}{12}$

D.  $-\frac{11\pi}{12}$

Hint: use the time it takes the each hand to go around one full cycle.

# Clock hands tip distance

## Example

Suppose that the length of the minute hand is 4 cm and the length of the hour hand is 3 cm. At what rate is the distance between the ends of the hands changing when it is 3:00 o'clock?

Hint: use law of cosines.



# Mathematical thinking

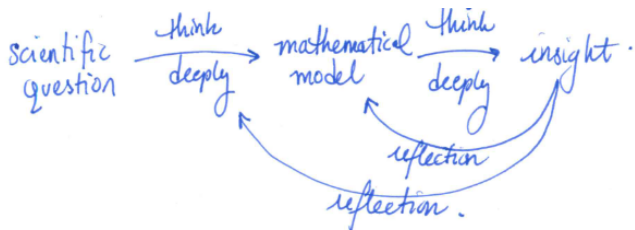


Figure 1. The difficulty.

Figure credit: Cole Zmurchok

# Answers

1. B

## Exam tips

- ▶ It's OK to feel nervous. Keep calm and continue taking derivatives.
- ▶ Don't linger on a difficult problem for too long.
- ▶ Be careful of details.
- ▶ Use other ways to check your answers.

I'm on the same boat with you and I hope you succeed! You can make it!

# Goodbye

Until we meet again.