Creating Good Clicker Questions in Physics and Astronomy

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Schedule

1:00 pm – 2:30 pm	peer instruction, what makes a good question?
	different types of clicker questions / when to ask a clicker question
	create a clicker question
	share your question with the group and get feedback

Typical Peer Instruction Episode

1. Instructor poses multiple-choice question.

2. Students think about question on their own.

3. Students vote for an answer using clickers, coloured cards, ABCD voting cards,...

4. The instructor reacts, based on the distribution of votes.

Peer Instruction

In effective peer instruction,

- students teach each other immediately, while they may still hold or remember their novice misconceptions
- students discuss the concepts in their own language

} students learn and practice how to think, communicate like scientists

- the instructor finds out what the students know (and don't know) and reacts

Peer Instruction

Effective peer instruction requires

1. identifying key concepts, misconceptions
2. creating multiple-choice questions that require deeper thinking and learning

} before class

3. facilitating peer instruction episodes that spark student discussion
4. resolving the misconceptions (unless leaving the question temporarily unresolved is part of the lesson plan)

} during class

What makes a good clicker question?

clarity	Students should waste no effort trying to figure out what's being asked.
context	Is this topic currently being covered in class?
connection to learning goals	Does the question make students do the right thing to demonstrate they grasp the concept.
distractors	What do the "wrong" answers tell you about students' thinking?
difficulty	Is the question too trivial? too hard?
stimulates thoughtful discussion	Will the question engage the students and spark thoughtful discussions? Is there potential for you to be "agile"?

Clicker question

How many of these are reasons for the seasons?

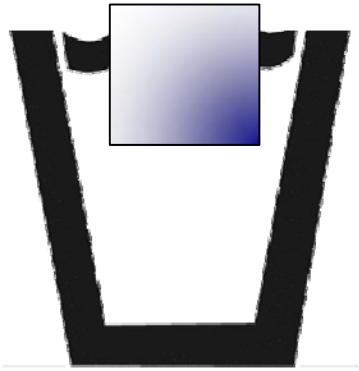
- the height of the Sun in the sky during the day
- Earth's distance from the Sun
- how many hours the Sun is up each day

A) none of them
B) one
C) two
D) all three

clarity context learning goals distractors difficulty discussion

Clicker question

An ice cube is floating in a glass of water that is filled entirely to the brim. As the ice cube melts, the water level will



A) stay the same, remain at the brim.
B) rise, causing the water to spill.
C) fall to a level below the brim.
D) cannot say without knowing the density of ice.

clarity context learning goals distractors difficulty discussion

Types of questions
and
when to ask them

BEFORE:
setting up instruction

AFTER:
assessing learning

assess prior knowledge

provoke thinking

predict

motivate

discover

exit poll

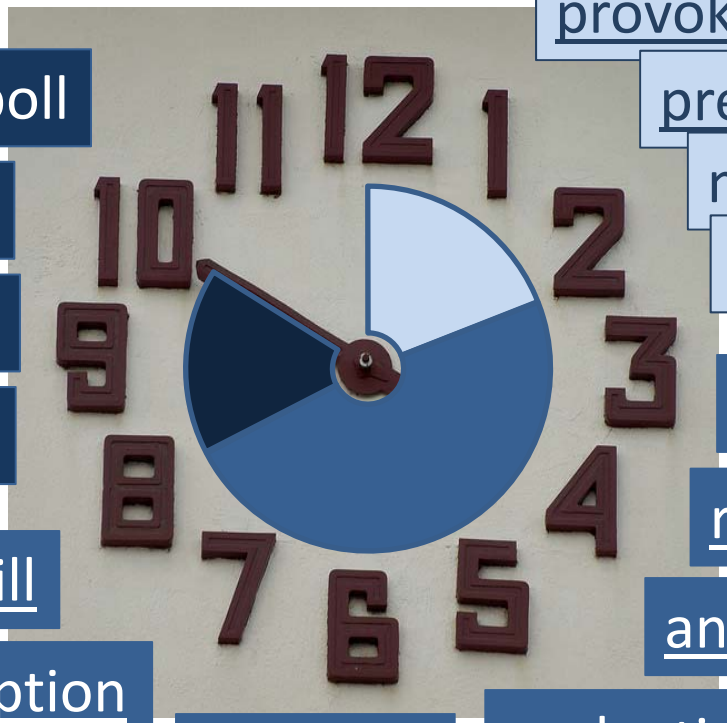
review / recap

"big picture"

demonstrate success

exercise skill

probe misconception



check knowledge

real world application

analysis

evaluation

synthesis

DURING:
developing knowledge

Rosie Piller, Ian Beatty, Stephanie Chasteen
clock by airdiogo on flickr CC

Create your own clicker questions (20 minutes)

1. Find a partner (similar discipline if possible)
2. Identify a concept or learning goal your students have trouble with.
3. Create a clicker question.
   - what type of question is it?
   - when would you present it?

While your writing it, think about

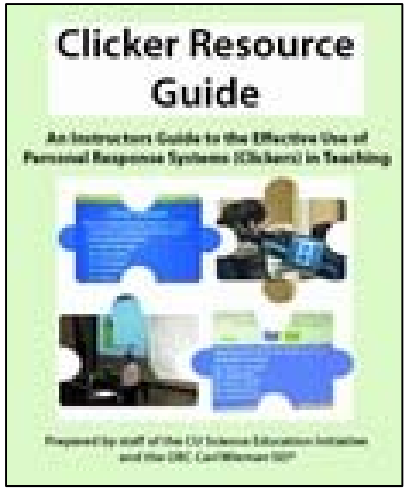
- clarity
- context
- connection to learning goals
- distractors
- difficulty
- stimulating thoughtful discussion

Resources

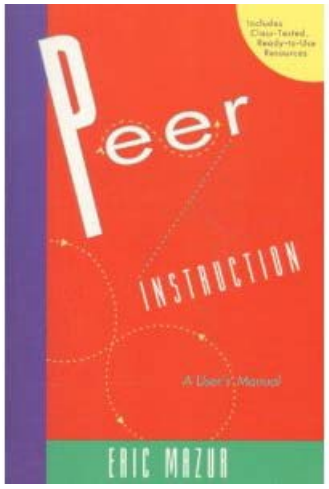
Check the clicker resources pages on the CWSEI website:

http://www.cwsei.ubc.ca/resources/clickers.htm

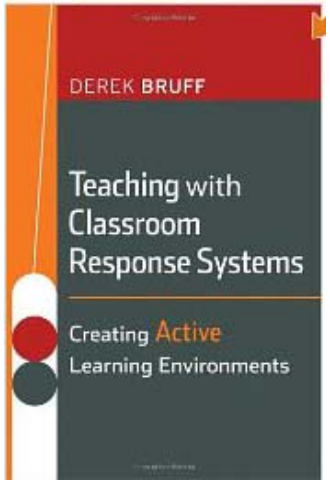
(with links to collections of peer instruction questions)



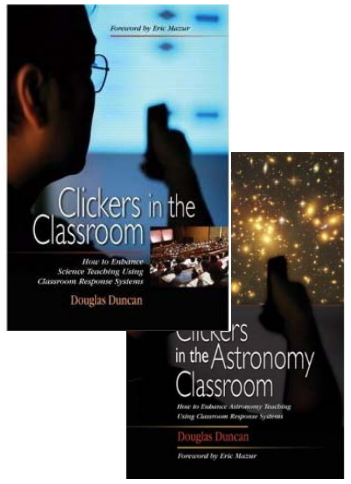
CWSEI



Eric Mazur
(1996)



Derek Bruff
(2009)



Doug Duncan
(2004, 2005)

Thanks

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and you
for investing your time and energy to participate today

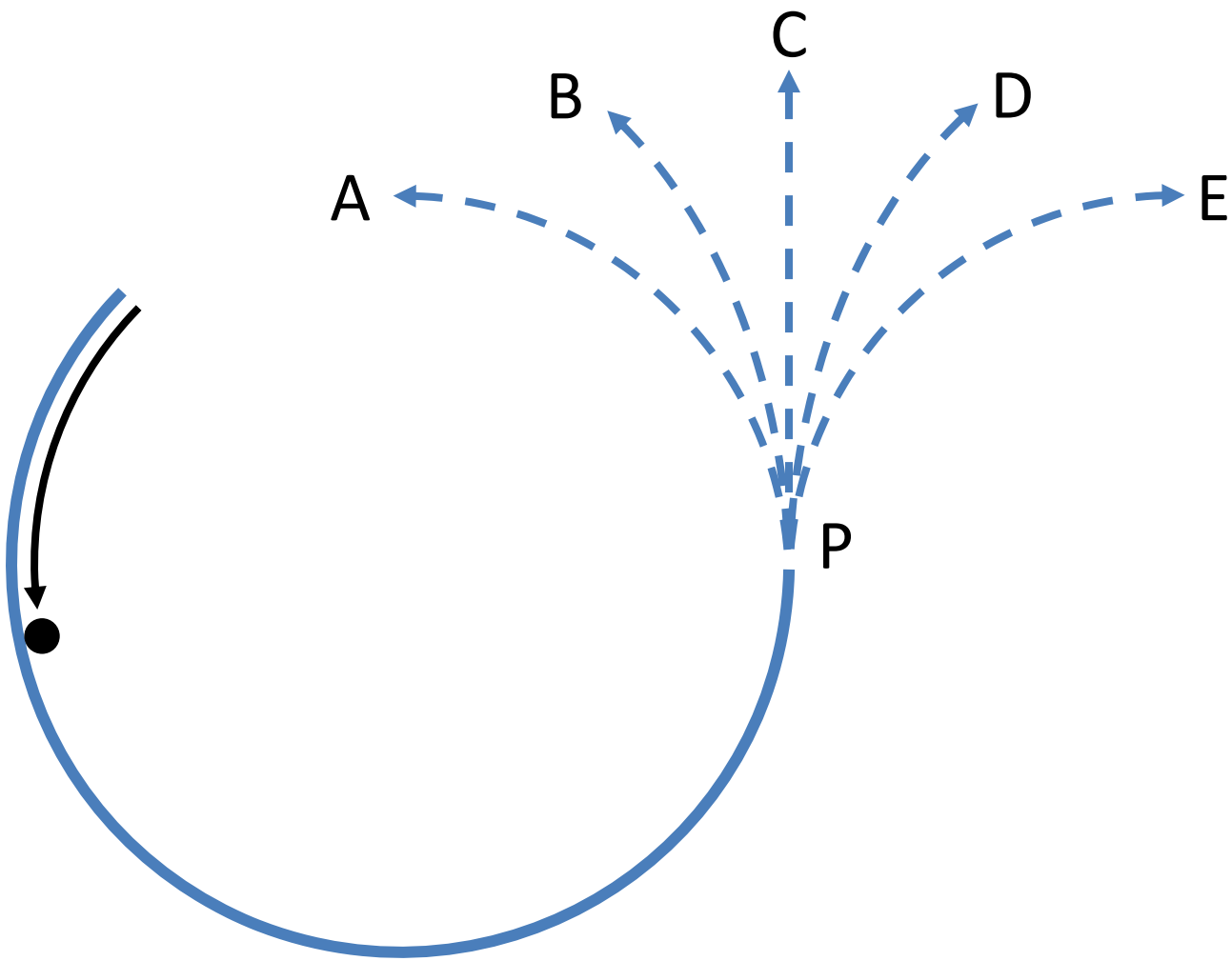
Example clicker questions

predict

Clicker question

A ball is rolling around the inside of a circular track. The ball leaves the track at point P.

Which path does the ball follow?



(Mazur)

real world application

Clicker question

Suppose you pass white light through a prism and all of the colours of the spectrum are projected on a screen. If you then put a red filter over your eye and look at the spectrum, what colours do you see?

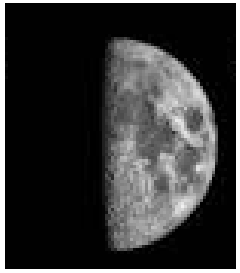
A) you see mostly red light; the blue and green disappears
B) you see mostly blue light; the other colours disappear
C) all of the colours turn red

(Duncan)

probe misconception

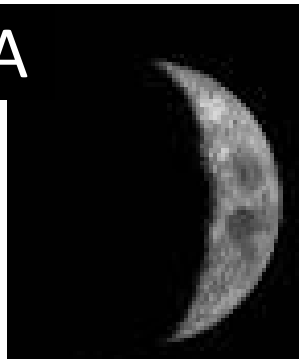
Clicker question

If this is the phase of the Moon when it rises:



what is the phase of the Moon 12 hours later?

A



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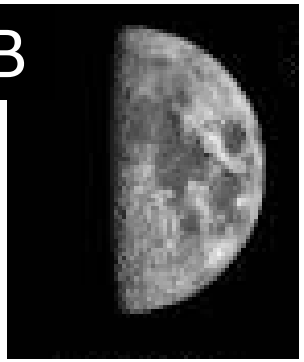
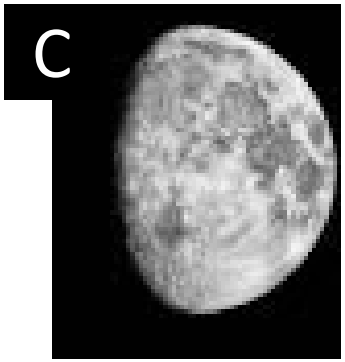
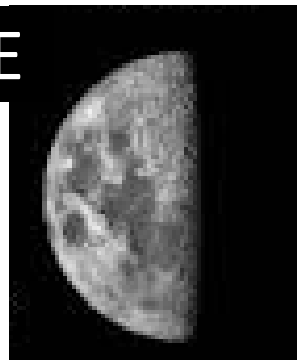


C



D

E



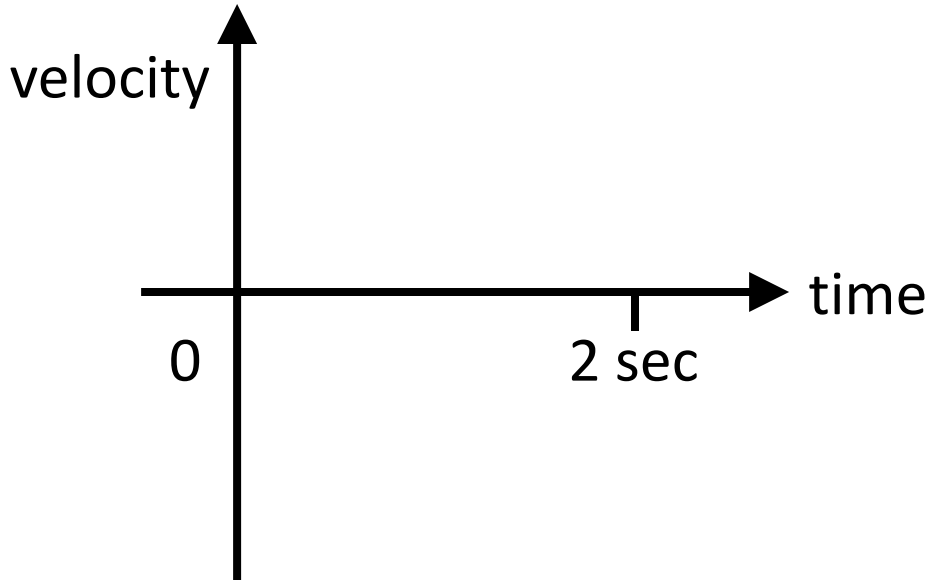
(Prather)

exercise skill

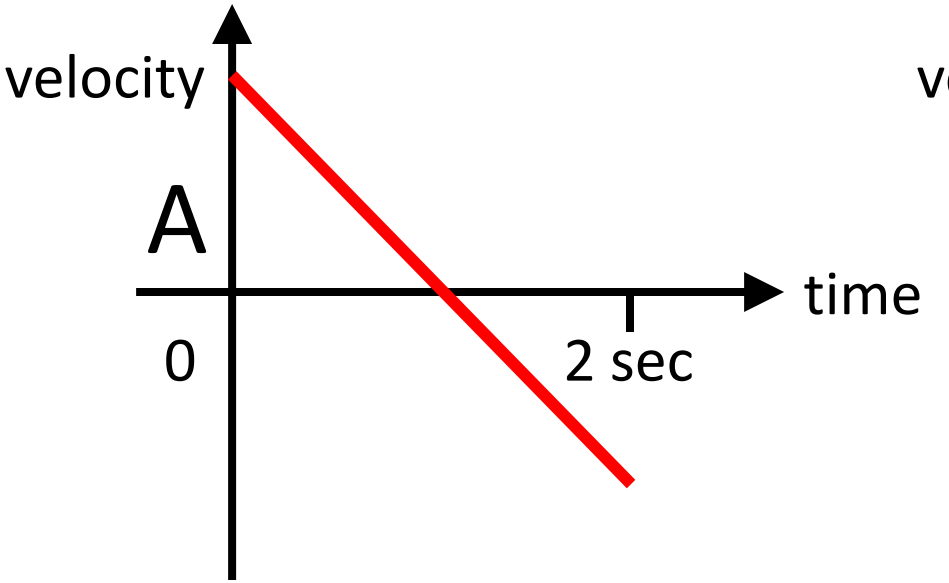
Clicker question

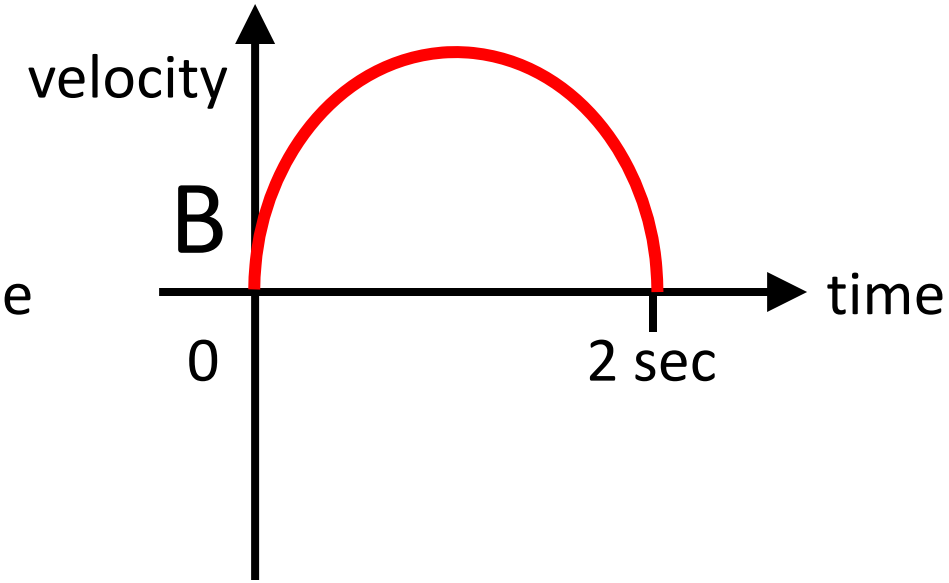
Susan throws a ball straight up into the air. It goes up and then falls back into her hand 2 seconds later.

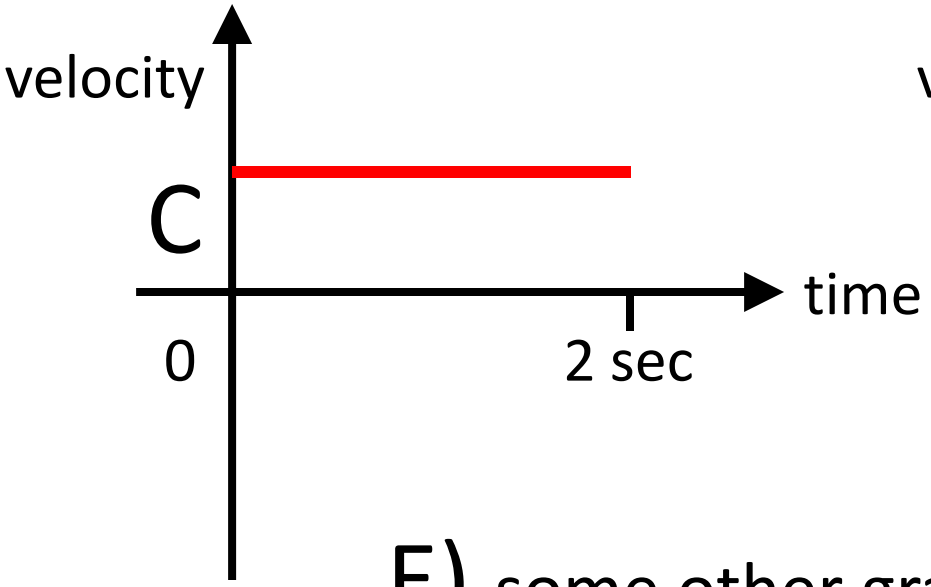
Draw a graph showing the velocity of the ball from the moment it leaves her hand until she catches it again.

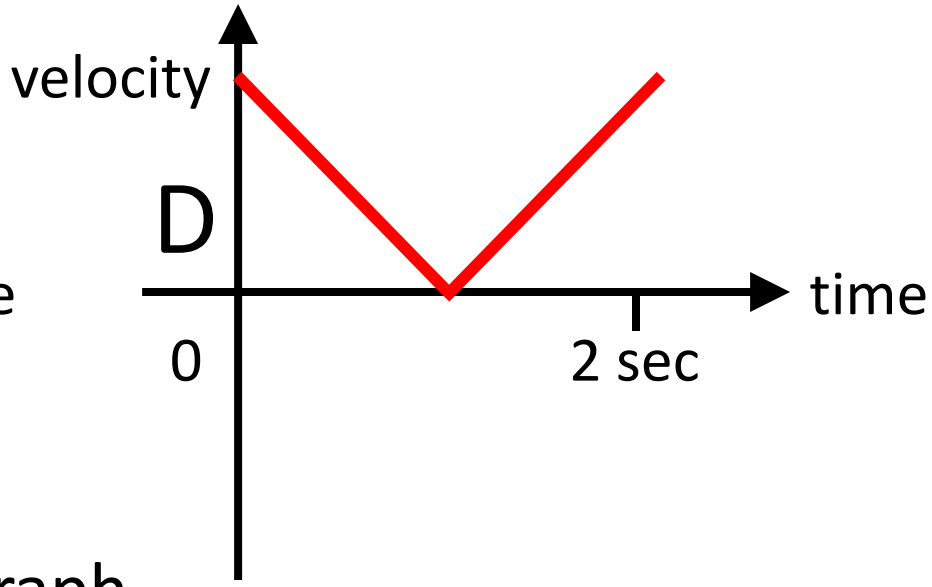


Which one is the closest match to your graph?







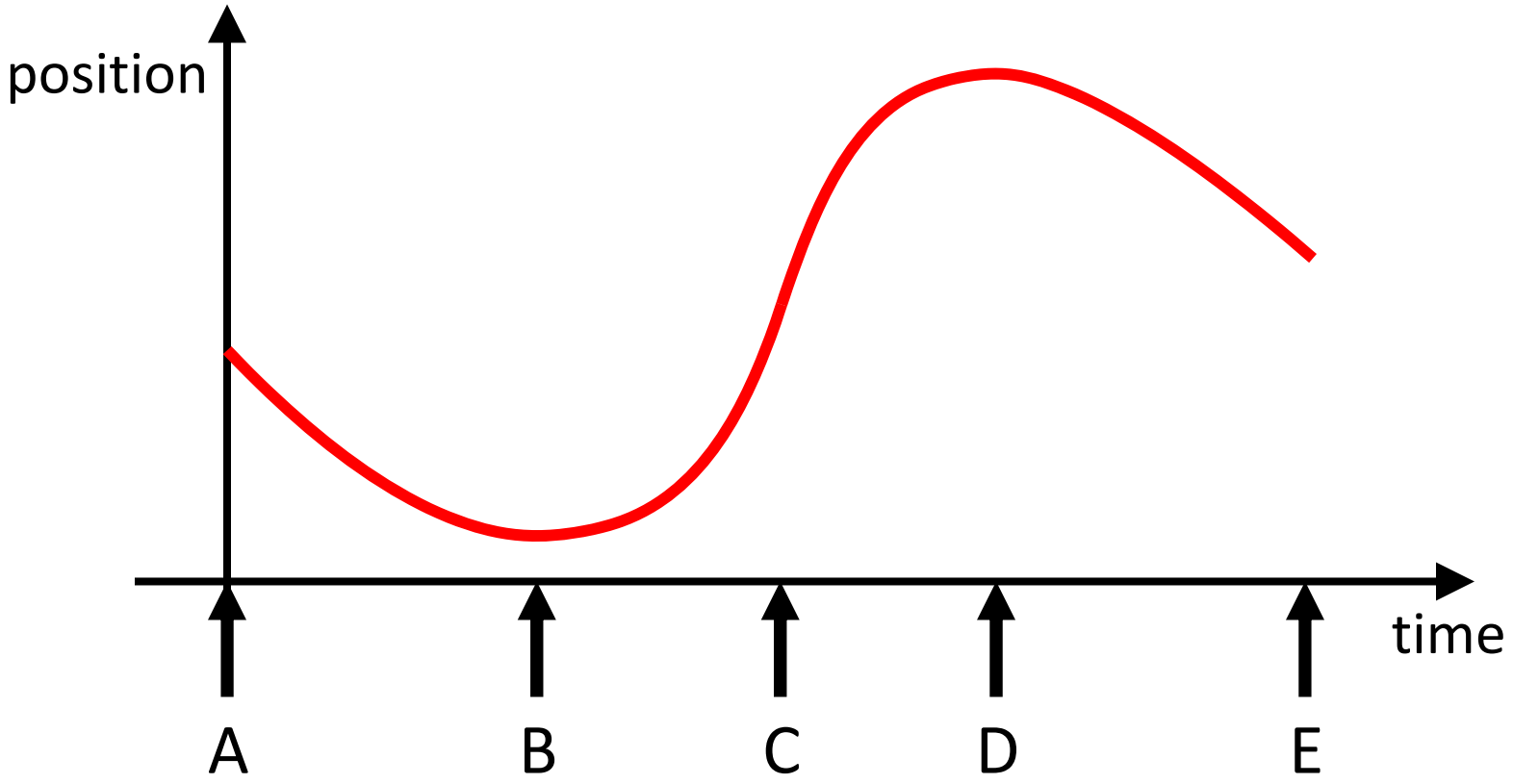


E) some other graph

analysis

Clicker question

John is walking to school. This graph shows his position as a function of time. When is John moving with the greatest velocity?



evaluation

Clicker question

Which of the following is an incorrect step when using the substitution method to evaluate the definite integral

$$\int_0^4 x^2\sqrt{1+x^3}\,dx$$

A) $u = 1 + x^3$

B) $\dfrac{du}{3} = x^2 dx$

C) $\dfrac{1}{3}\displaystyle\int_0^4 \sqrt{u}\; du$

D) none of the above

(Bruff)

"big picture"

Clicker question

To minimize the work you do getting a heavy bag of groceries from the first floor to the second floor of a building, you should

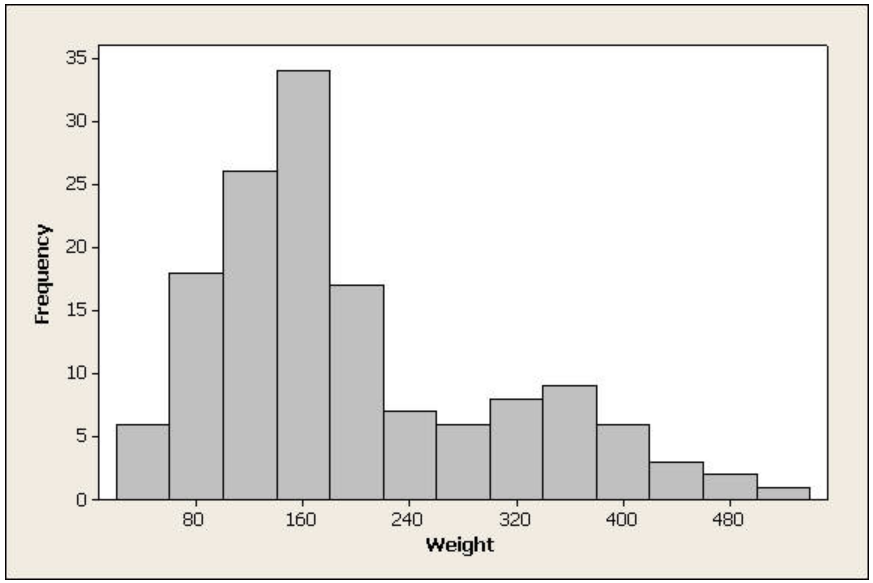
A. carry the bag up the stairs
B. carry the bag up in an elevator
C. put the bag on the floor of an elevator, ride up with it, and then pick up the bag again
D. carry the bag up a ramp
E. put the bag in a cart and push it up a ramp

(Chasteen)

check knowledge

Clicker question

For the data set displayed in the following histogram, which would be larger, the mean or the median?



A) mean

B) median

C) can't tell from the given histogram

(Peck, mathquest.carroll.edu/resources.html)

provoke thinking

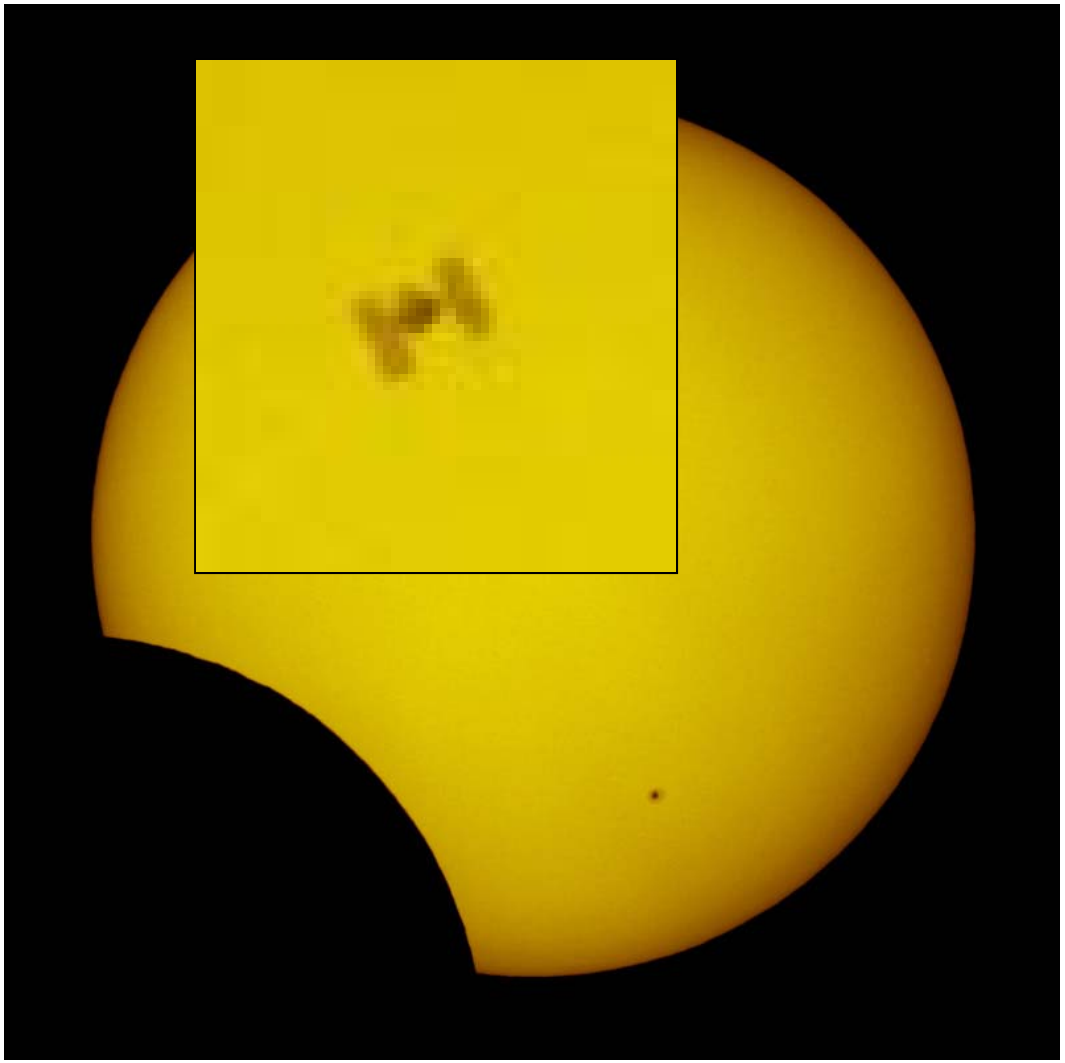
Clicker question

Can your eyes resolve things better at night or during the day?

A) you can resolve things better at night
B) you can resolve things better during the day
C) you can resolve things the same during the day and at night

What do you think is most interesting about this picture?

discover



A) lunar eclipse
B) solar eclipse
C) cloud blocking the Sun
D) sunspots
E) other

Astronomy Picture of the Day
2011 January 5

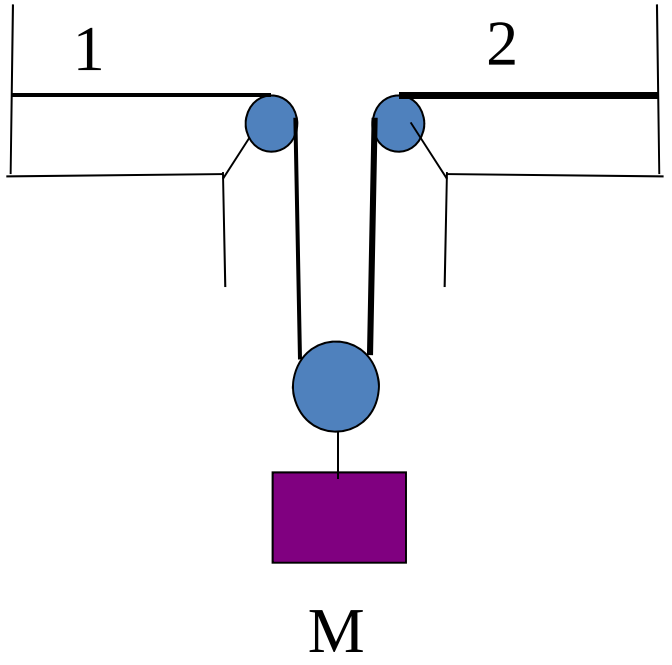
"big picture"

Clicker question

String 1 has a linear mass-density of 3.00 g/cm and string 2 has a linear mass density of 5.00 g/cm. They are under tension due to a hanging block of mass M = 500 g. (a) Calculate the wave speed in each string.

Which equation sets up the problem correctly?

A) $T_1 + T_2 = mg$, where T1≠ T2
B) $T_1 - T_2 = mg$, where T1≠ T
C) $2T = mg$
D) $2T = -mg$
E) choices C & D are correct because we are only concerned with magnitude



Question

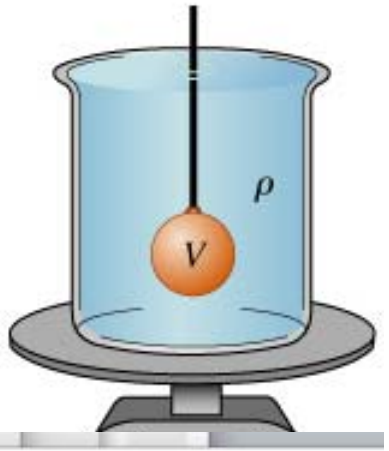
- If you lower a 1.5 kg mass on a string into a 5 kg beaker filled with water, what happens to the reading on the scale?

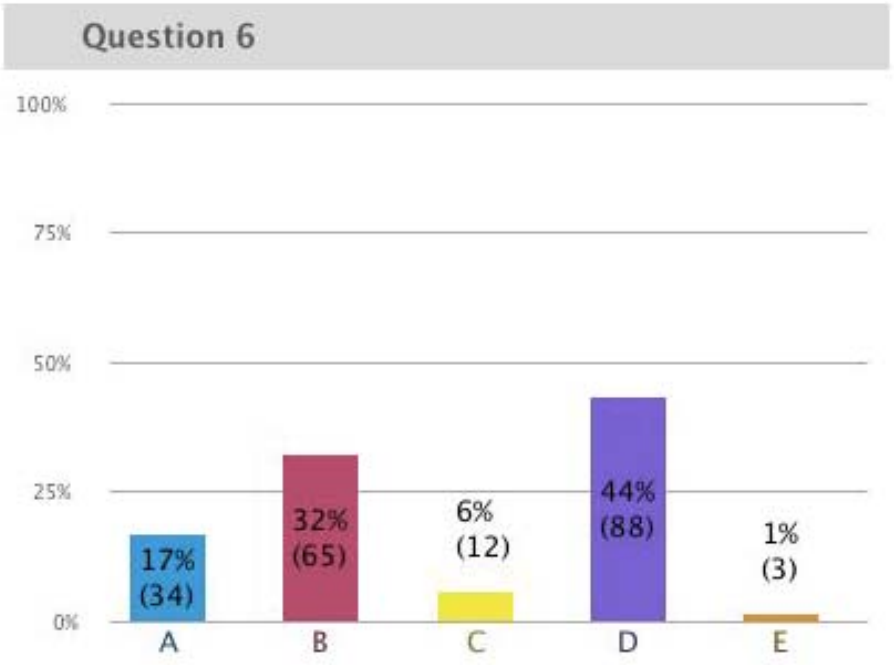
(A) increases to 6.5 kg

(B) increases to a value < 6.5 kg

(C) increases to a value > 6.

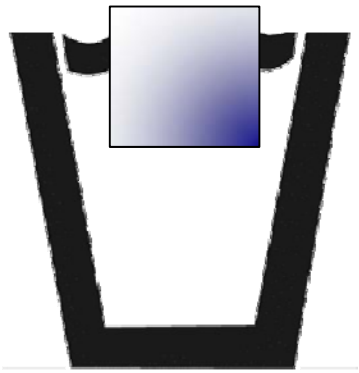
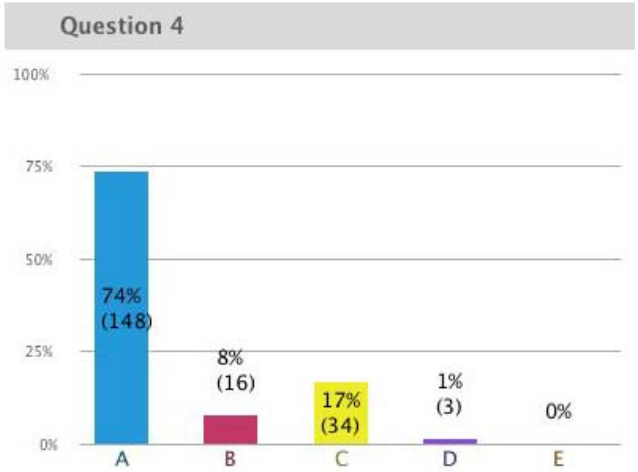
(D) stay the same





Prediction

An ice cube is floating in a glass of water that is filled entirely to the brim. As the ice cube melts, the water level will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B. rise, causing the water to spill.
C. fall to a level below the brim.
D. cannot say without knowing the density of ice.