Exploring the Origins of Physics Student Misconceptions in Mathematics

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SCAN ME

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Exploring Areas of Introductory Physics Student Difficulties in Mathematics

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Motivation

- Math skills are correlated with student success in physics
- By better understanding areas of student difficulties, we can work to address them
- Why are certain mathematical operations so difficult for students?
- Are there patterns of common difficulties between students?
- Difficult to determine student mindset from written work alone

The Project and Findings

- 7 student interviews with students in algebra-based physics immediately after they take the 15-question diagnostic
- 90% average score, much higher than average across all students in similar courses
- Errors were representative of those commonly seen in the larger student population

➔ Interesting findings will be presented, along with statistics for similar classes

Questions with Interesting Results

Question 3 - Trigonometry

3. Find the value of each of the following.

$cos(0°) = ?$

$sin(90°) = ?$

$tan(0°) = ?$

- 86% (6/7) got all values correct
  - *Similar courses: 65% correct (N = 660)*
- 71% (5/7) students did not remember values without a calculator

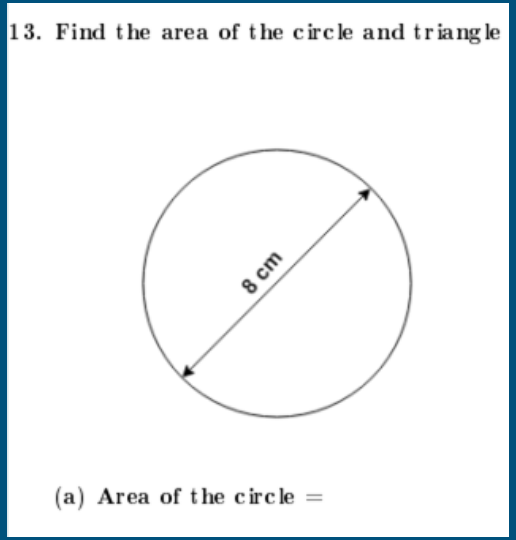
➔ We should not assume students in intro courses remember cos (0°) = 1 and sin (90°) = 1.

Question 13 - Area

- 71% provided correct numerical answer
  - *Similar courses: 77% correct (N = 596)*
- Only 29% provided any units, *even with prompting*
  - *Similar courses: < 50% correct units*

“I don’t include units until the end, it gets me too confused.” - Student 1

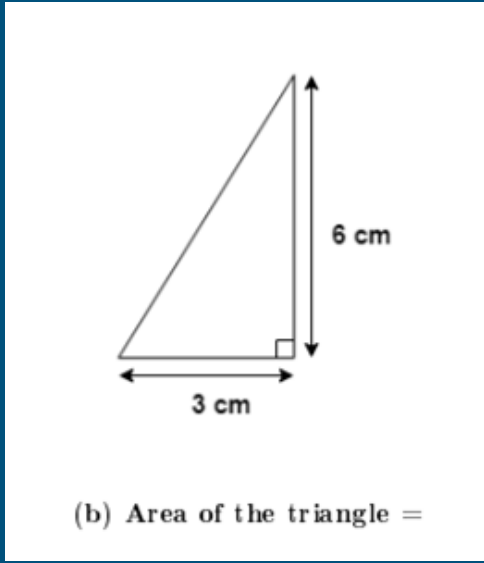
➔ We should not assume that students know how to find the area of a circle, or the correct units.



Question 13 - Area

- 100% provided correct numerical answer for triangle
  - *Similar courses: 87% correct (N = 588)*
- Only 29% provided correct units, even with prompting
- Two students provided no units for the circle, and *incorrect* units for the triangle (cm)

➔ We should not assume that students can provide correct units for area.

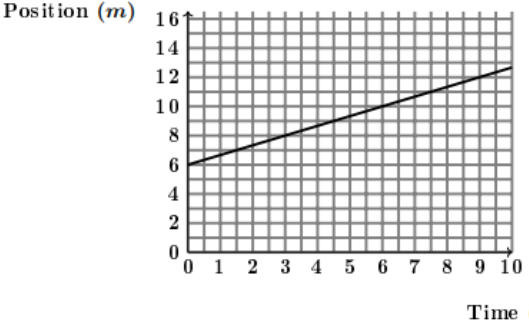


Question 4 - Graphing

- 71% provided correct answer (C)
  - *Similar courses: 37% correct (N = 133)*
  - *Common error: ignore axis labels*

➔ We should not assume that students read and utilize the axis labels on graphs.

4. What is the slope of the graph below?



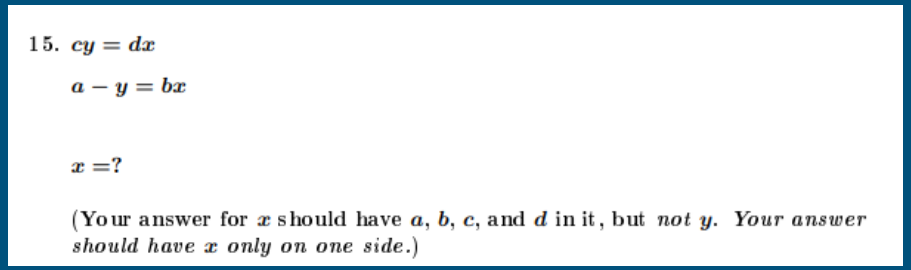
A. $\frac{1}{3}$ m/s because the object moves 1 meter in 3 seconds.

B. $\frac{1}{3}$ m/s because the line rises 1 box while it goes 3 boxes in the horizontal direction.

C. $\frac{2}{3}$ m/s because the object moves 2 meters in 3 seconds.

D. $\frac{2}{3}$ m/s because the line rises 2 boxes while it goes 3 boxes in the horizontal direction.

Question 15 - Algebra



15. $cy = dx$

$a - y = bx$

$x =$?

(Your answer for x should have a, b, c, and d in it, but *not* y. *Your answer should have x only on one side.*)

- 57% initially provided correct answer
  - *Similar courses: 31% correct (N = 372)*
- Most students corrected their errors during interviews with no prompting
  - *Similar to findings in larger interview samples*
- Multiple students had issues with isolating x from fractions

➔ Students frequently make algebra errors, many of which might be correctable with prompting

Future Work

- Reassess interview recruitment strategies. (Larger interview sample sizes are needed for any definitive conclusions.)
- Focus on how to help students automatically self-correct their errors.
- New questions should be designed to specifically examine student difficulties with units.

References

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