

# How Does Ungraded Student Practice Correlate to Exam Scores?

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February 22nd, 2024

Sponsored by DoIT (LA Mini-Grant)

# Practice Questions: Origin Story

- Online Teaching & Assessments: 2020-2021 School Year
- In-class Clicker Questions → Online "Class Questions"
- Paper & Pencil Exams → Online "Weekly Quizzes"
- Question creation – time intensive!
- Repurpose questions as a practice resource
- Student... "Where can I find extra questions to work on?"

Week 2 (Aug 31 - Sept 4) ▾

Build Content ▾ Assessments ▾

- Weekly Quiz 1 -- Part A**  
Availability: Item is available. This is part A of Weekly Quiz 1.
- Weekly Quiz 1 -- Part B**  
Availability: Item is available. This is part B of Weekly Quiz 1.
- Class Questions 1 -- A**  
Availability: Item is hidden. You will have access to the questions. Answers will be available after the due date.
- Class Questions 2 -- Sept 2nd**  
Availability: Item is hidden from students. It was last available on Sep 2, 2020 11:59 PM. You will have access to the class questions the entire day and are allowed three attempts. Answers will be available after the due date at the end of the day.

Week 3 (Sept 7 - 11) ▾

Build Content ▾ Assessments ▾

- Class Questions 3**  
Availability: Item is available.
- Class Questions 4**  
Availability: Item is available.

Week 4 (Sept 14 - 18) ▾

Build Content ▾ Assessments ▾

- Weekly Quiz 2**  
Availability: Item is available.
- Weekly Quiz 3**  
Availability: Item is available.
- Class Questions 5**  
Availability: Item is available.

Week 5 (Sept 21-25) ▾

Build Content ▾ Assessments ▾ Tools ▾ Partner Content ▾

- Weekly Quiz 3 -- Part A**  
Availability: Item is available, but some students or groups may not have access.
- Weekly Quiz 3 -- Part B**  
Availability: Item is available, but some students or groups may not have access.
- Class Questions 7 -- Sept 21**  
Availability: Item is hidden from students. It was last available on Sep 21, 2020 11:59 PM.
- Class Questions 8 -- Sept 22**  
Availability: Item is hidden from students. It was last available on Sep 22, 2020 11:59 PM.

# Fall 2020

# PHYS 122 FALL 2022

- Second Semester Calc-based Intro Physics:  
Thermodynamics, Electricity, Circuits, and Magnetism
- Large Lecture Course: >200 students
- Course components: lecture; discussion; online HW; 6 midterm exams; and final
- Second semester course so ...good study habits? ...preparation? ...prior knowledge?

## What is your neighbor's major?

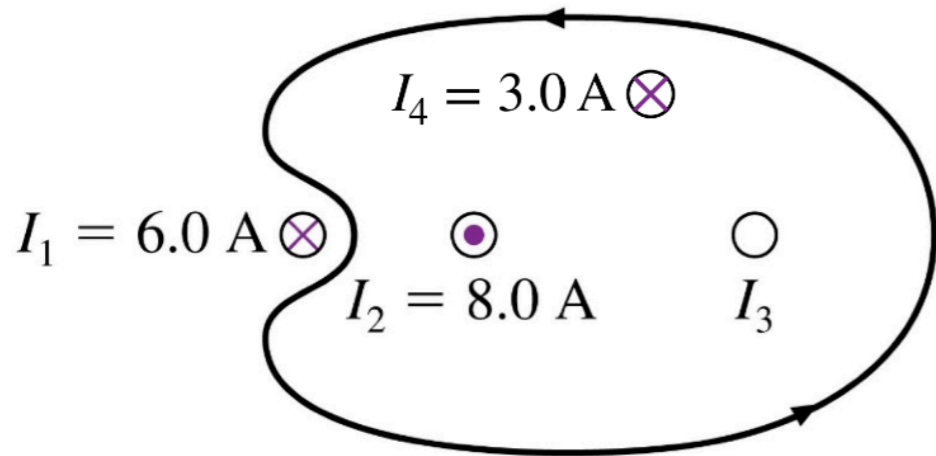
- A) Computer Science / Computer Engineering 37%
- B) Chemistry / Biochemistry / Chemical Engineering 18%
- C) Engineering / Mechanical Engineering 35%
- D) Mathematics 4%
- E) Physics 4%
- F) Something else 3%

# Types of Practice Questions:

## Numerical

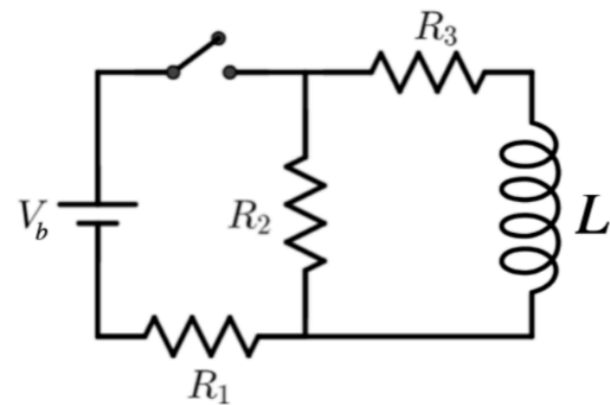
### QUESTION 3

The line integral of  $B$  around this loop is  $\mu_0 (-4 \text{ A})$ . What is  $I_3$ ? Enter a positive value if the current comes out of the page and a negative value if it goes into the page.



### QUESTION 5

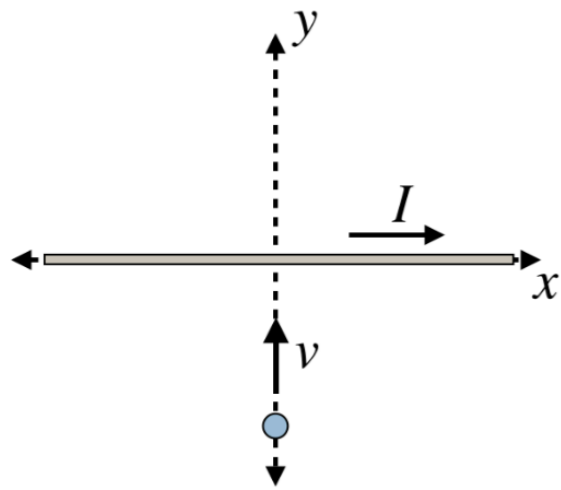
The values for the circuit shown are:  $V = 50 \text{ V}$ ,  $R_1 = 2 \Omega$ ,  $R_2 = 4 \Omega$ ,  $R_3 = 6 \Omega$ , and  $L = 10 \text{ H}$ . The switch has been opened for a very long time and is then closed. Immediately after closing, what is the current through the inductor in Amps?



# Types of Practice Questions: Multiple Choice

## QUESTION 6

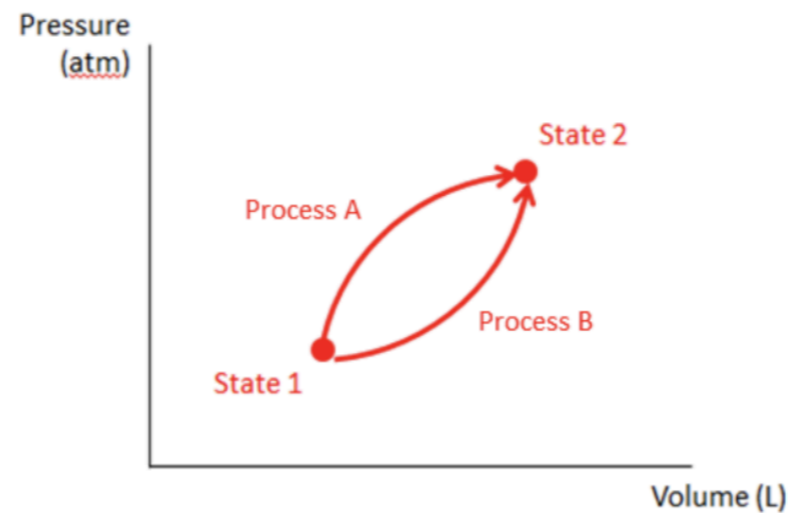
A very long wire is along the x-axis and carries a current in the +x direction. A negatively charged particle is shot along the -y axis right toward the wire. The particle will...



- Hit the wire at the origin
- Go into the screen and be deflected under the wire
- Hit the wire somewhere on the +x axis
- Hit the wire somewhere on the -x axis
- Come out of the screen and be deflected over the wire
- Slow down, come to a stop, and accelerate away from the wire

## QUESTION 5

Two possible processes A and B take an ideal monatomic gas from state i to state f. How does the change in internal energy for process A compare to the change in internal energy for process B?

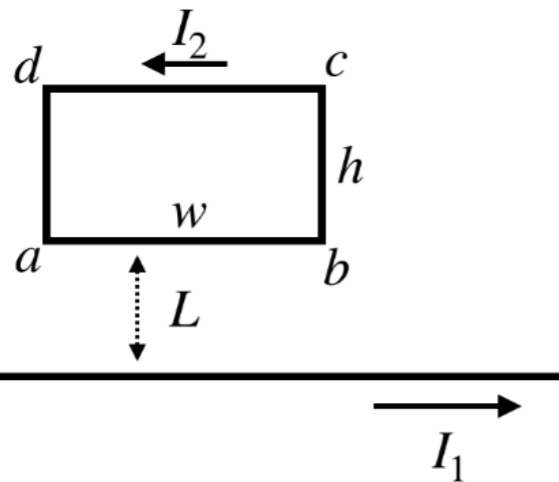


- Need to know how much work is done each process
- $\Delta U_A = \Delta U_B$
- $\Delta U_A > \Delta U_B$
- $\Delta U_A < \Delta U_B$

# Types of Practice Questions: Matching

## QUESTION 8

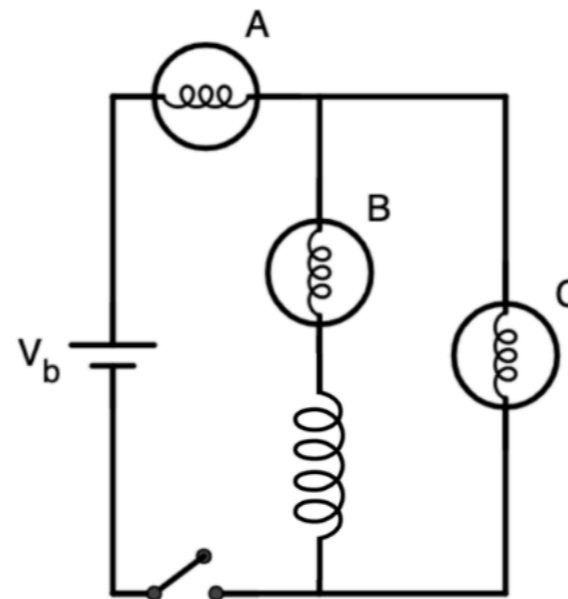
A current carrying wire,  $I_2$ , loop is near a very long current carrying wire,  $I_1$ . Determine the direction of the magnetic force on each wire segment below.



- |   |                                    |
|---|------------------------------------|
| - <input type="checkbox"/> Wire segment ab? | A. Left                            |
| - <input type="checkbox"/> Wire segment bc? | B. Right                           |
| - <input type="checkbox"/> Wire segment cd? | C. Up                              |
| - <input type="checkbox"/> Wire segment da? | D. Down                            |
| - <input type="checkbox"/> The entire loop? | E. Into the page                   |
|   | F. Out of the page                 |
|   | G. No direction; the force is zero |

## QUESTION 3

The circuit shown has three identical lightbulbs, a battery, and an inductor. The switch has been opened

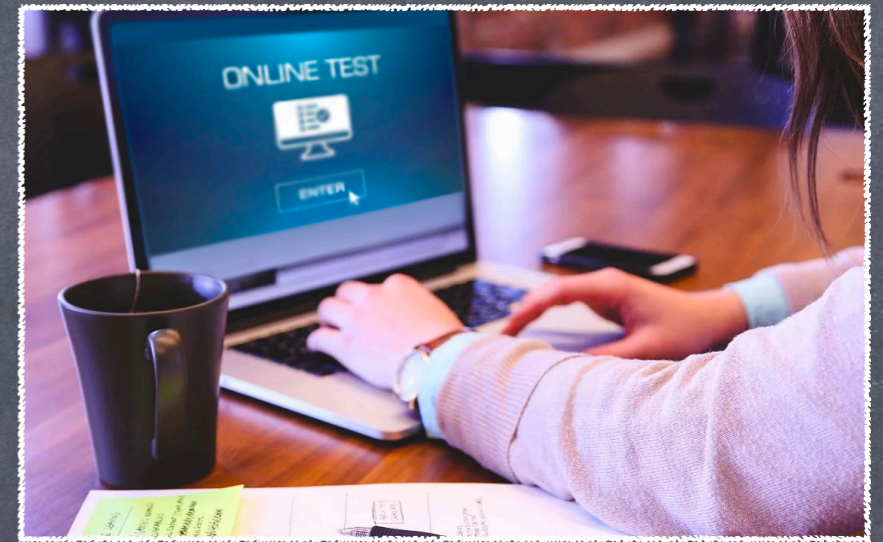


- What happens to the brightness of bulb A?
- What happens to the brightness of bulb B?
- What happens to the brightness of bulb C?

- A. Shines immediately
- B. Does not shine immediately
- C. Shines immediately
- D. Shines immediately completely

# Practice Questions: The Basics

- Do not contribute to their grade
- Each question worth a point
- Associated with each unit (22 total)
- After completion, can see their score, right/wrong answers, and feedback for next attempt.
- Unlimited attempts and four hour limit per attempt
- Data presented is for fall 2022 PHYS 122 course



# Practice Questions: Marketing Campaign



## Unit 1 (Ideal Gas & Thermal Expansion) Practice Questions

These are practice questions for material covered in unit 1. They do not count toward your grade, but the material for each class. You have unlimited attempts and four hours to complete each attempt.

Importantly, after submitting an attempt you will receive feedback on any question that you got wrong.

## Week 7 Announcements

Posted on: Sunday, October 15, 2023 7:47:32 AM EDT

Hi all,

This week we introduce energy and work in our discussion of charges which will lead us to the important topic of electric potential.

- Monday: unit 9 PL & CP due; class on unit 9
- MTuW: discussion on unit 9
- Wednesday: unit 10 PL & CP due; class on unit 10
- Thursday: unit 9 HW due
- Friday: class on unit 10

Exam 2 scores are posted on BB and the solution and grad question 4 on the multiple choice questions was only 1 point.

Please remember to take advantage of the many resources:

- Practice questions available for each FlipIt unit
- Physics Tutorial Center open Monday through Thursday
- TA online office hours TuTh 7-8 PM on BB Collaborate
- SIPASS sessions on Mondays and Wednesdays
- Tutors in the Math & Science Tutoring Center at the
- Post questions on the course discord server

More info available on BB in the "Get Help!" section.

See you in class this week,

Dr. G

## Week 10 Announcements

Posted on: Sunday, October 29, 2023 9:00:00 AM EDT

Hi all,

We finish up circuits this week with Kirchhoff's Laws and RC circuits. Below are reminders for the week ahead:

- Sunday: unit 13 HW due
- Monday: unit 14 PL & CP due; class on unit 14
- MTuW: discussion on units 13 & 14
- Wednesday: unit 15 PL & CP due; class on unit 15
- Thursday: unit 14 HW due
- Friday: class on unit 15

A reminder there are practice questions associated with all the units on Blackboard in that unit's folder. The only way to get good at this stuff and by going through problems so these practice questions are a great low-stakes way of testing yourself and seeing if you know the material. There is feedback associated with questions you don't get correct the first time around.

See you in class this week,

Dr. G

## Unit 13: Electric Current & Resistors

### FlipIt

Unit 13 HW due Sunday

Unit 14 PL & CP due Monday

### Practice Question

Available for each unit on BB



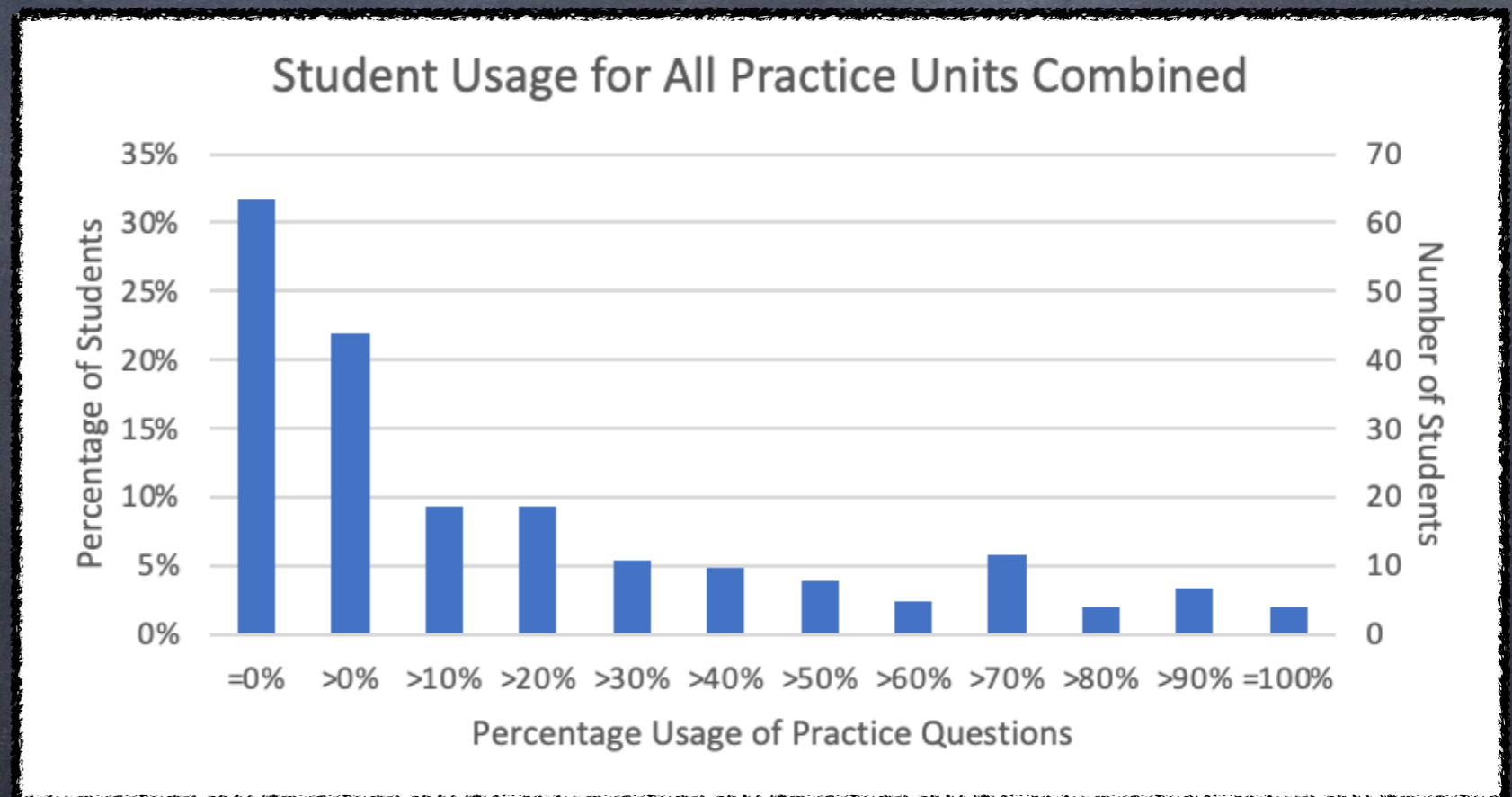


# Student Overall Usage of Practice Questions (PQ)

- 100% means they accessed all 22 units.
- >90% means they accessed 90%-100% of the units.
- 72% of students had less than 30% usage
- Small percentage utilized most or all of the units. Only 4 students accessed all 22 units.

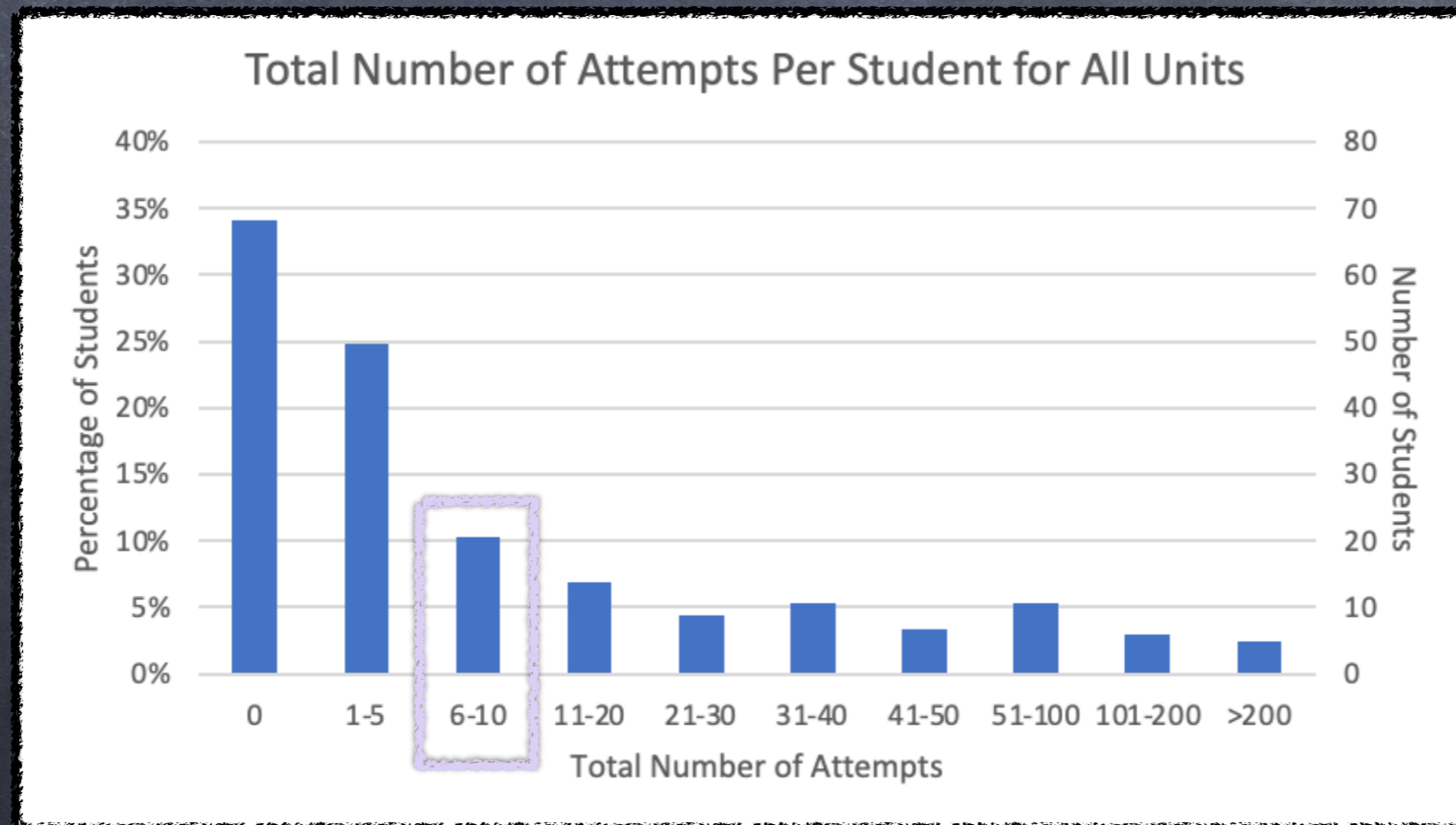
Usage = at least  
one attempt

22 Units  
in total



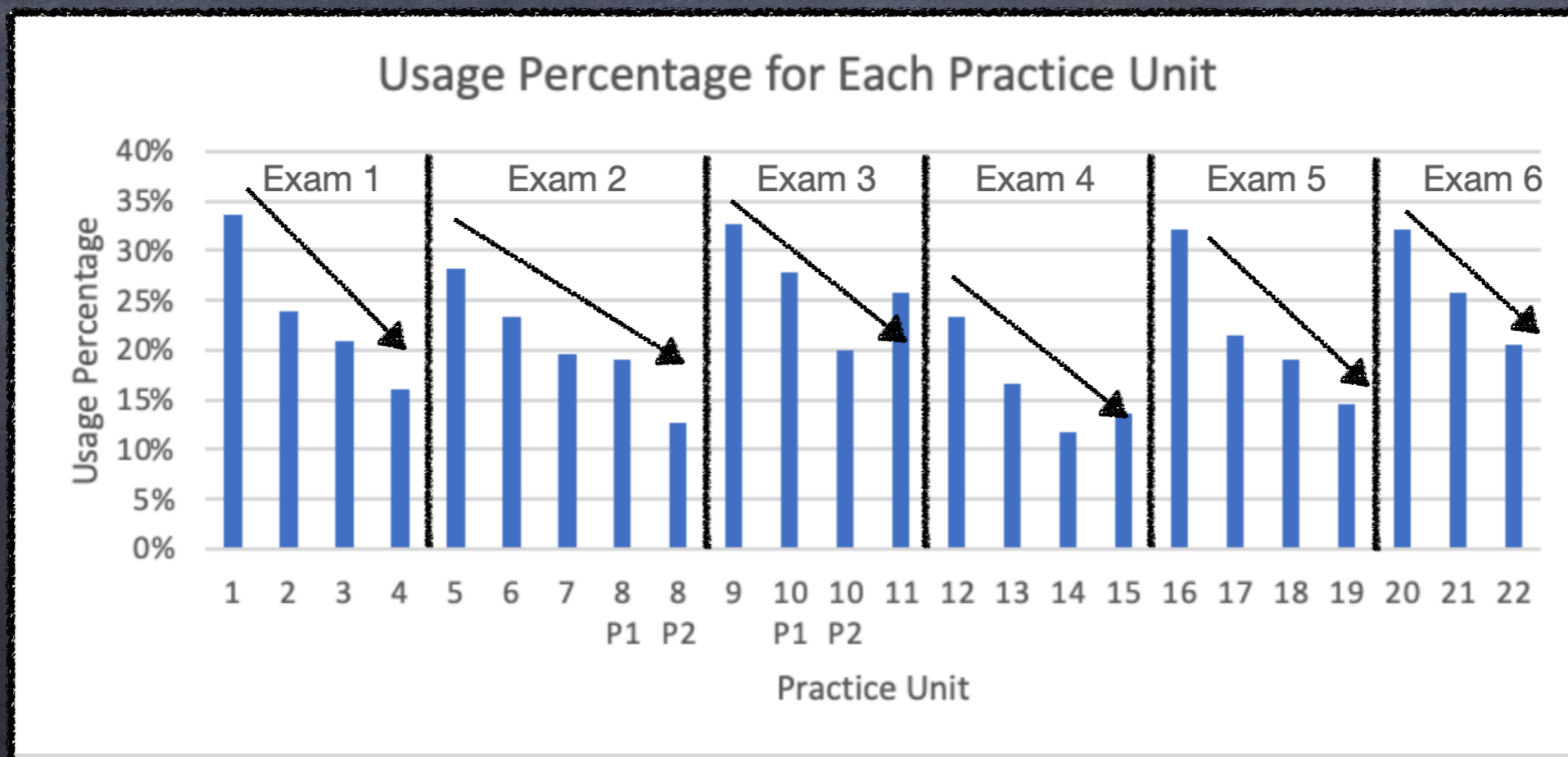
# Total Number of Attempts Per Student for ALL Units

- Example: 20 students (10%) had 6-10 attempts on all practice questions for the entire semester
- Most students had no or very few attempts
- Some students had a lot! 700 attempts was the most!



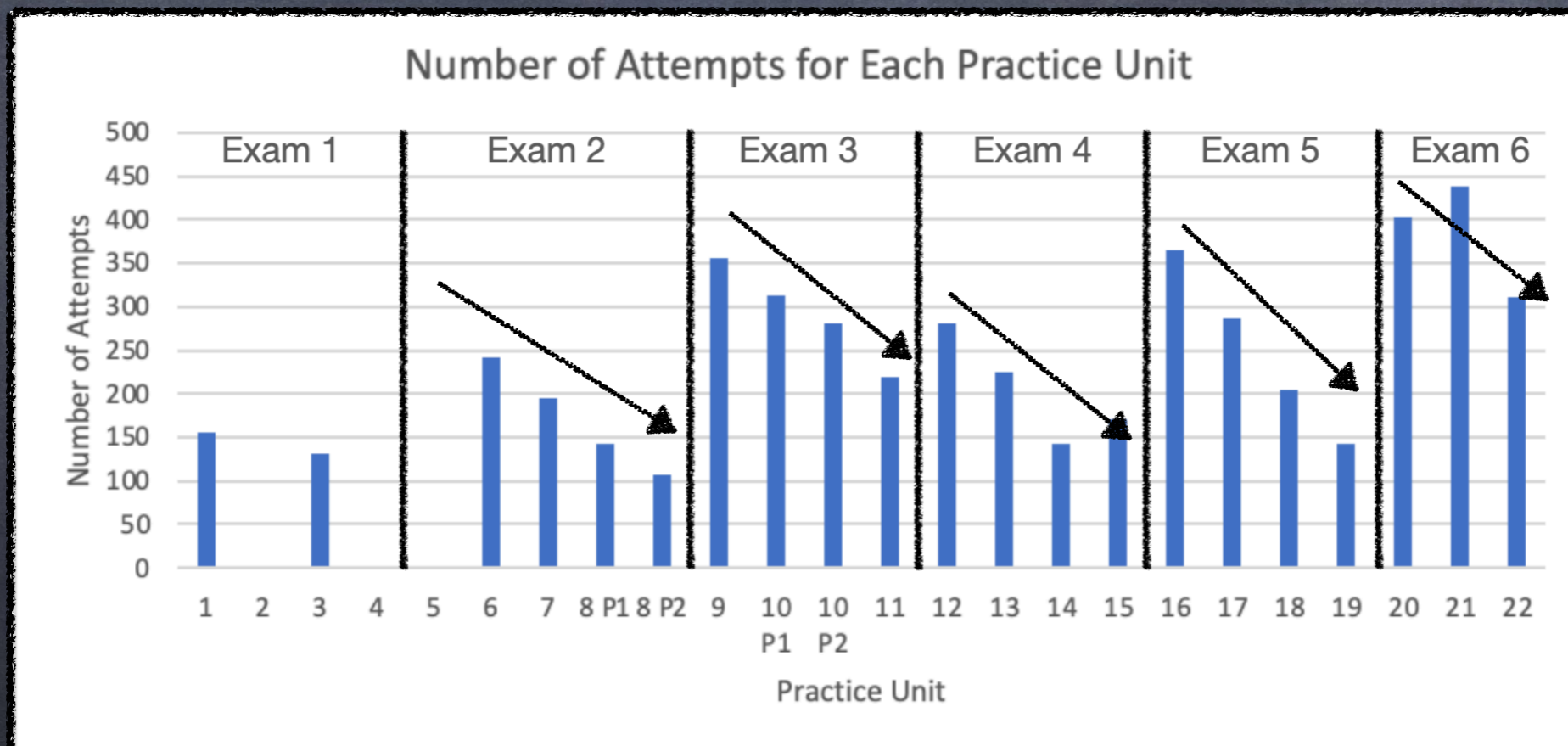
# Student Usage of PQ per Unit

- Example: unit 1 – 34% of students accessed at least once
- Range of usage: 34% to 12%
- Trend: usage highest after an exam and decreases until next exam



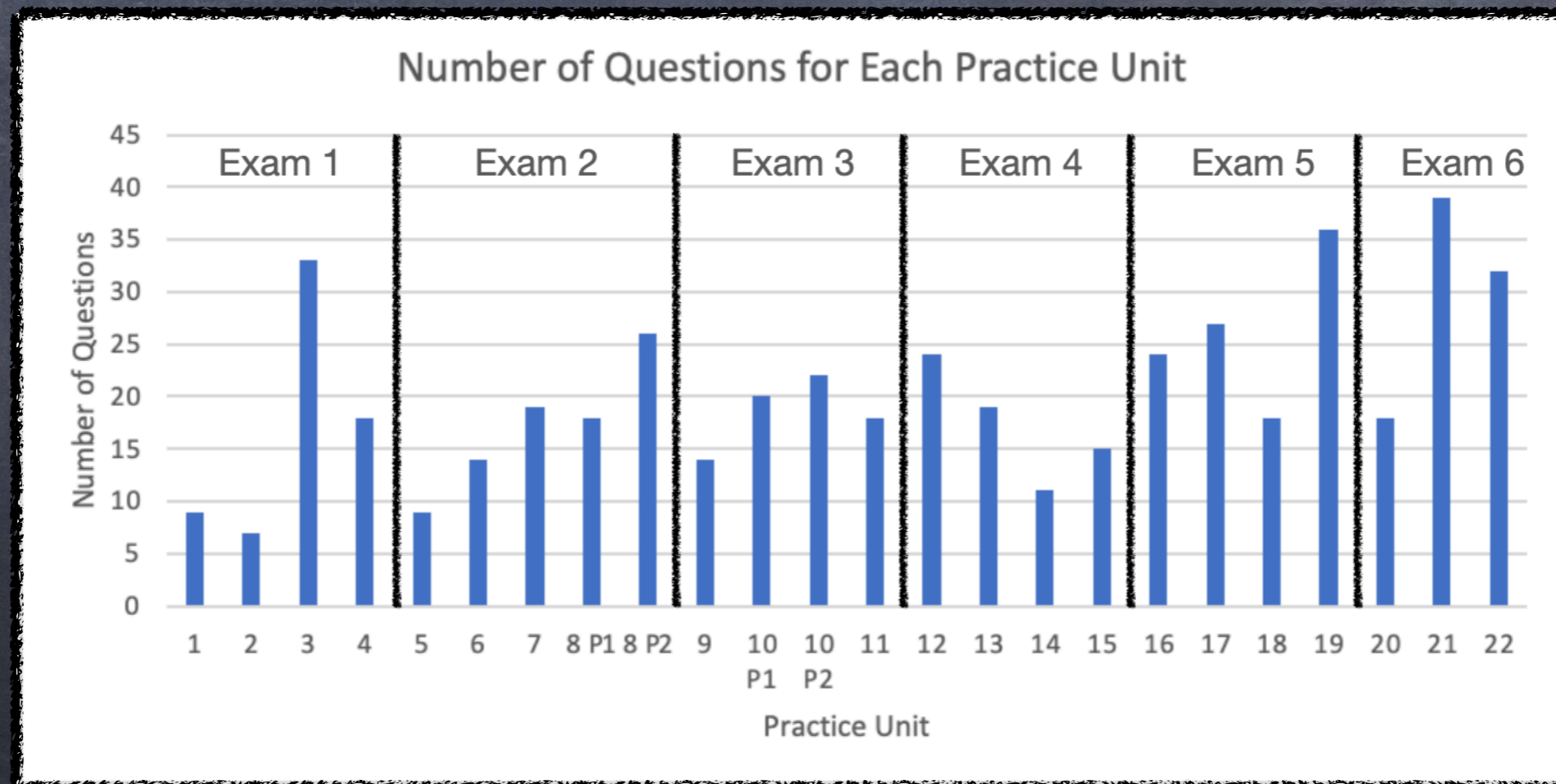
# PQ Attempts for each Unit

- Total number of attempts for each unit for all students
- Students have unlimited attempts
- Might attempt to see if just one question is correct
- Trend from before is still present



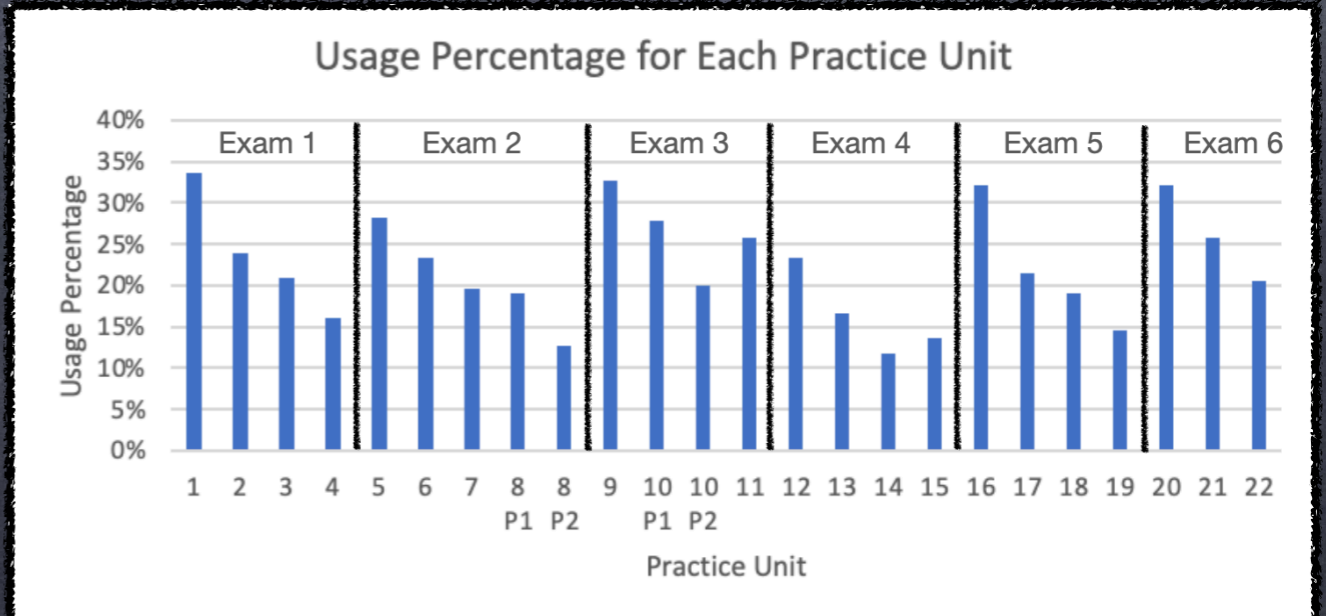
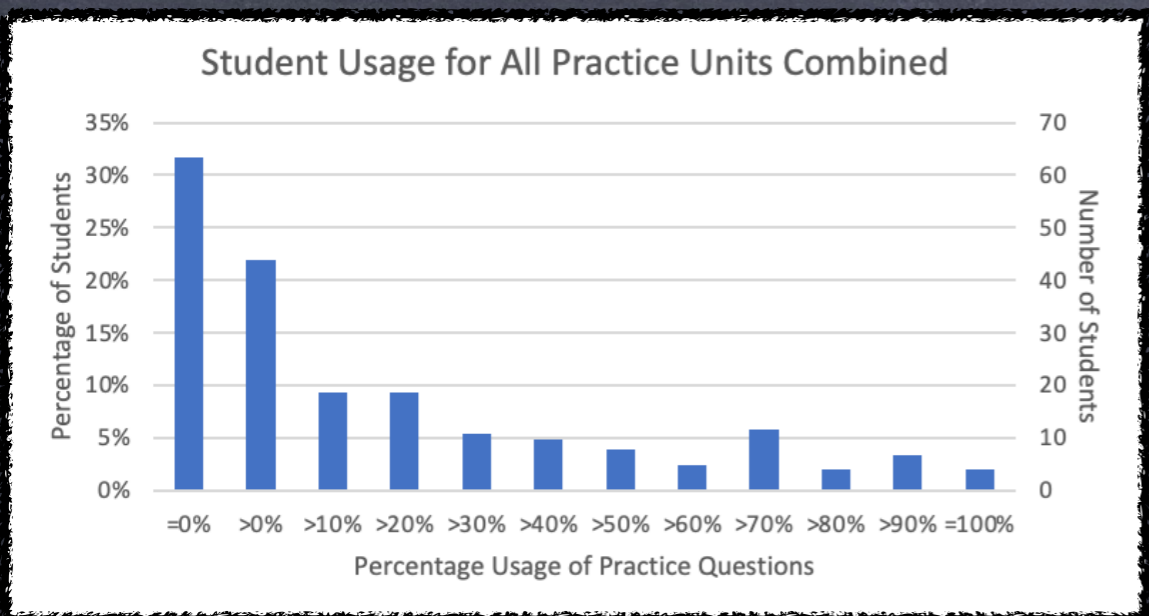
# Number of Questions for Each Unit

- Maybe the number of attempts is related to the number of questions? Doesn't seem like it...
- Reason for Trend? Exam schedule? Longest time to practice? Motivation?



# Student Usage and Attempts Summary

- Majority of students do not utilize practice questions
- Trend of high usage/attempts after exams
- Why: High performing students don't need them? Low performing students not using them? Intrinsic vs extrinsic motivation?
- Issues with PQs: can't check answers for individual question; can't tell right/wrong on matching questions



# Practice Units Accessed and Exam Scores

- Example: exam 1 25 students accessed all four practice units – average exam score 83%.
- Exam scores are highest for those that accessed all units associated with that exam.
- Lowest averages for those that accessed some units.

# of Practice Units Assessed & Exam Averages (# of Students)						
# Accessed	Exam 1	Exam 2	Exam 3	Exam 4	Exam 5	Exam 6
5		85% (16)				
4	83% (25)	76% (14)	85% (28)	80% (15)	84% (24)	
3	72% (10)	80% (11)	83% (16)	73% (7)	77% (14)	85% (36)
2	79% (17)	70% (11)	75% (16)	69% (15)	69% (10)	67% (17)
1	78% (30)	70% (20)	79% (26)	66% (23)	71% (21)	68% (19)
0	81% (123)	77% (133)	78% (119)	69% (145)	73% (136)	75% (133)

# Usage & Attempts by Final Course Grade

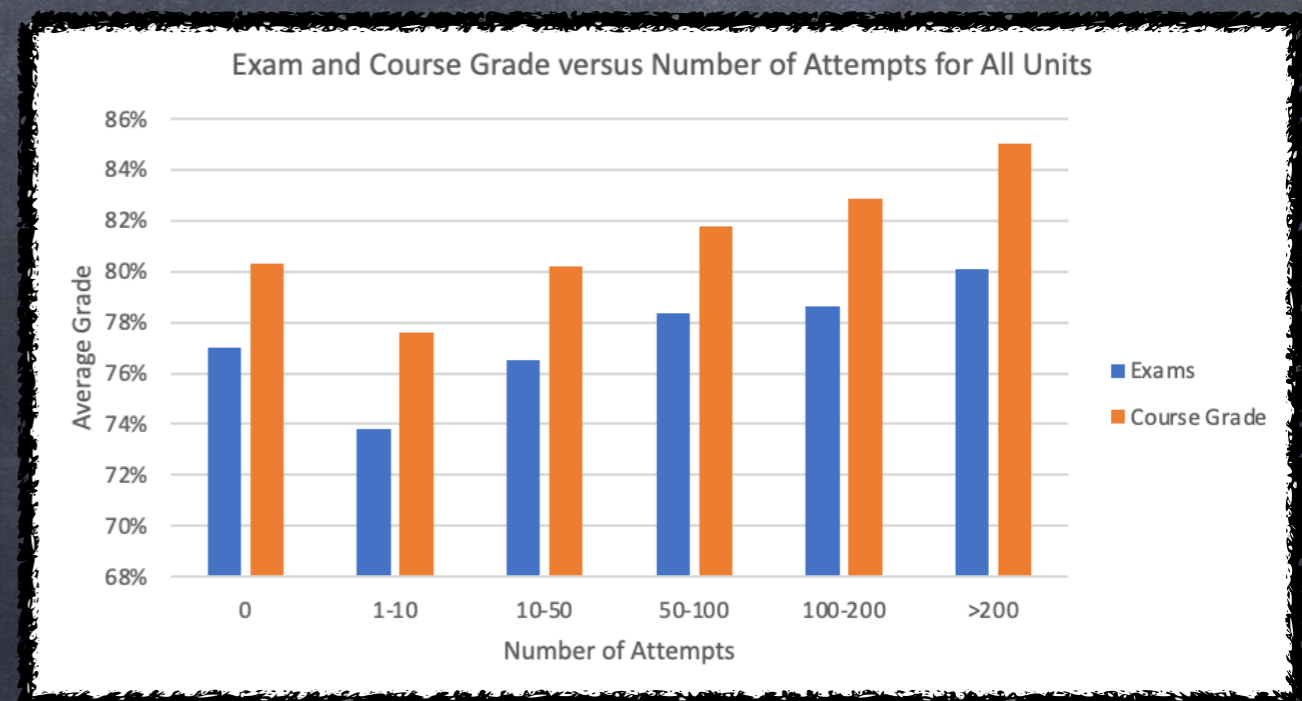
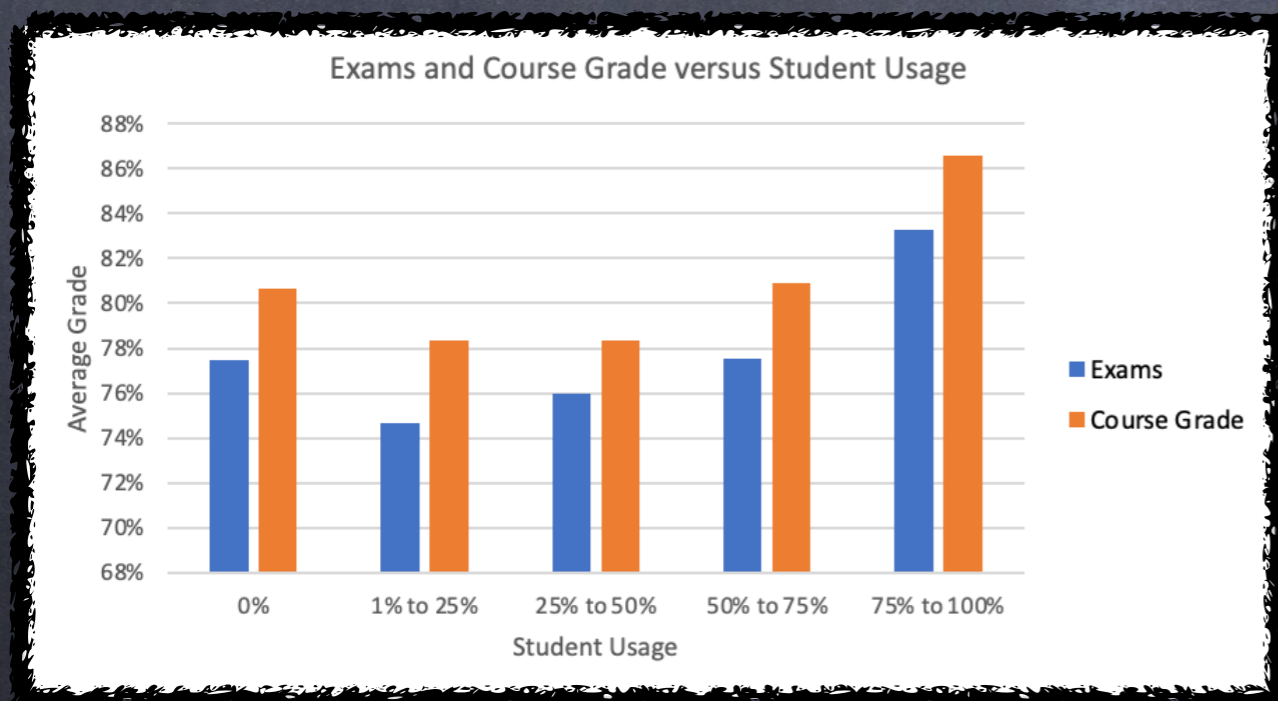
- Example: 61 students earned an A in the course. On average they accessed the units 23% and had 26 attempts
- Highest usage by students earning C & D. Students earning C had highest number of attempts
- Students earning an F had lowest access/attempts
- Time management issues with high number of attempts?

Course Grade	Usage Average (Median)	Attempts Average (Median)	# of Students
A	23% (8%)	26 (1)	61
B	22% (8%)	16 (3.5)	56
C	26% (15%)	44 (6.5)	52
D	25% (17%)	14 (4)	17
F	9% (4%)	6 (1)	19



# Exam and Final Course Grade Based on Practice Question Usage and Attempts

- Highest usage and highest number of attempts corresponds to highest scores.
- Lowest scores are for students with minimal but non-zero usage and attempts



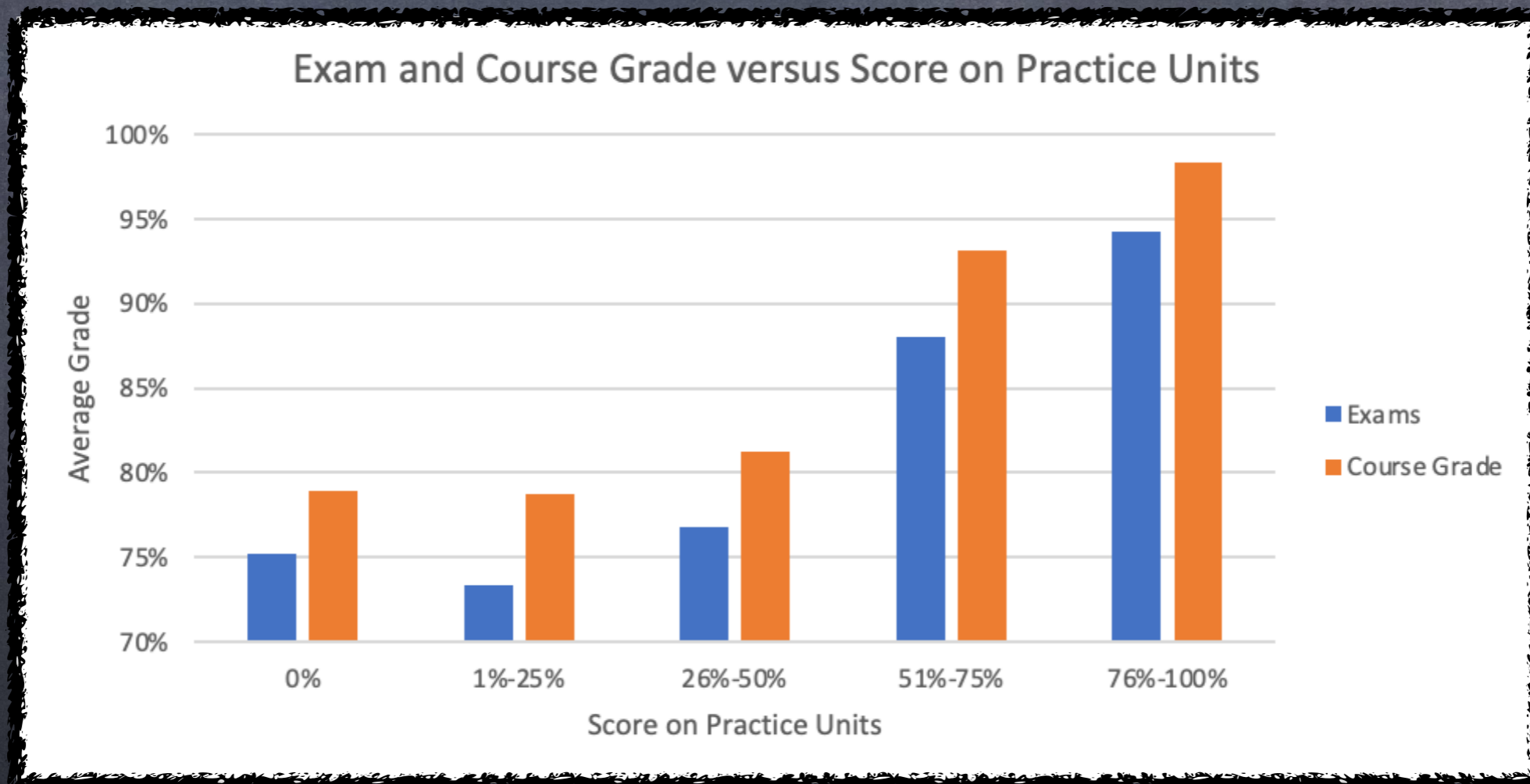
# Score on Practice Questions and Average Score on Exams

- Score associated with practice questions. Each question worth 1 point. Students can see their score at the end.
- Example: those students earning 76%-100% on the practice units associated with exam 1 actually earned an average score of 85% on exam 1

Practice Question Score	Exam 1 Average	Exam 2 Average	Exam 3 Average	Exam 4 Average	Exam 5 Average	Exam 6 Average	All Exams Average
76%-100%	85%	98%	94%	86%	102%	101%	94%
51%-75%	82%	87%	89%	90%	94%	86%	88%
26%-50%	77%	78%	78%	77%	70%	80%	77%
1%-25%	84%	73%	78%	65%	72%	68%	73%
0%	80%	76%	78%	69%	72%	75%	75%

# Exam and Final Course Grade Based on Practice Question Performance

- Clear trend showing students who earn higher scores on practice questions perform better on the exams and ultimately earn higher course grades.



# Number of Students

Practice Question Score	Exam 1 Average	Exam 2 Average	Exam 3 Average	Exam 4 Average	Exam 5 Average	Exam 6 Average	All Exams Average
76%-100%	85%	98%	94%	86%	102%	101%	94%
51%-75%	82%	87%	89%	90%	94%	86%	88%
26%-50%	77%	78%	78%	77%	70%	80%	77%
1%-25%	84%	73%	78%	65%	72%	68%	73%
0%	80%	76%	78%	69%	72%	75%	75%

Number of Students Corresponding to Table Above							
	Exam 1	Exam 2	Exam 3	Exam 4	Exam 5	Exam 6	All Exams
76%-100%	10	3	2	4	3	5	4.5
51%-75%	14	8	18	2	14	10	11
26%-50%	22	20	16	16	9	19	17
1%-25%	19	34	45	35	39	32	34
0%	140	140	124	148	140	139	138.5

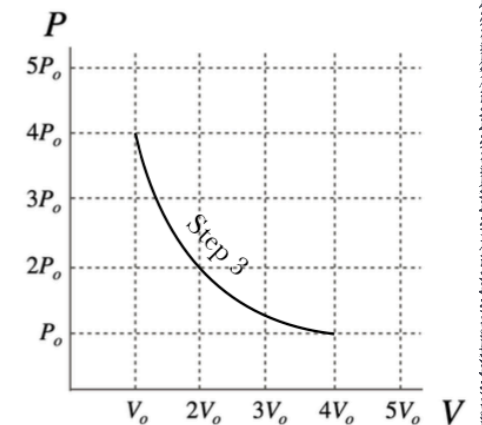
# Practice Exams for Spring 2023

- Fall 2022 exams were converted into online Blackboard tests. Time limit of 50 minutes (same as exams), unlimited attempts.
- Trying to replicate exam conditions. Students might not use practice exams in the best way...non-exam conditions; unlimited time; internet; notes; read solutions
- Some questions modified for the online environment.

Q2) A sample of  $n$ -moles of a monatomic gas is in a container at initial pressure,  $P_o$ , and initial volume,  $4V_o$ . The gas undergoes the following thermodynamic cycle. Represent your answers in terms of  $P_oV_o$ .

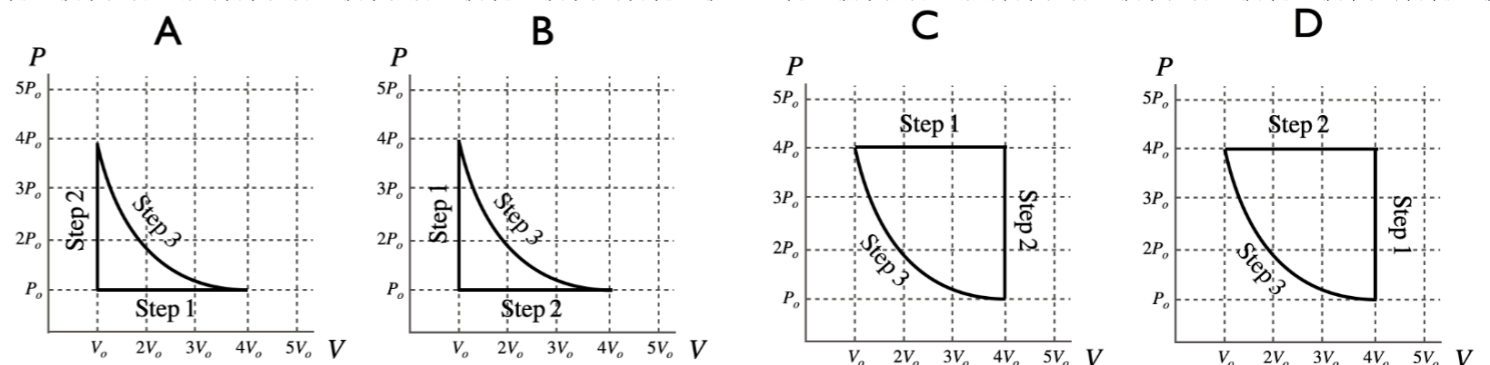
- Step 1: volume decrease to  $V_o$  at constant pressure  $P_o$
- Step 2: pressure increase to  $4P_o$  at constant volume  $V_o$
- Step 3: volume increase to  $4V_o$  at constant temperature

a) Sketch steps 1 and 2 on the PV diagram and label each step. Step 3 is already drawn and labeled. (2 pt)



## Original Exam Question

## Modified Blackboard Question

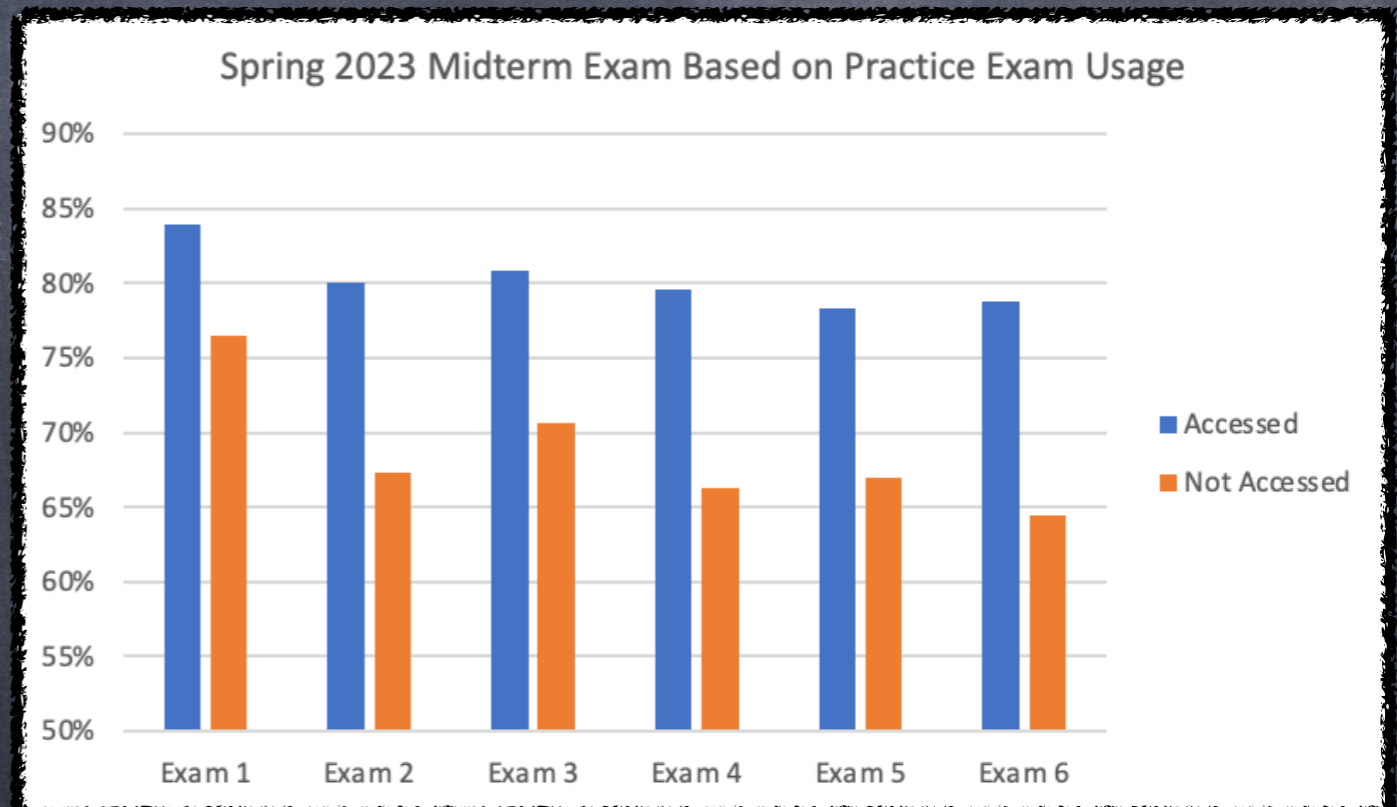


# Exam Performance Based on Accessing Practice Exam

Students accessed the practice exams more than the practice questions

	Exam 1	Exam 2	Exam 3	Exam 4	Exam 5	Exam 6
% of Students Accessing Practice Exam	41%	44%	49%	37%	39%	44%

Students accessing the practice exams consistently scored around a letter grade higher than those who did not access the practice exam



# Actual Exam Performance Based on Practice Exam Performance

- Example: students earning an A on the practice exam for exam 1 had an average score of 91% on the actual exam.
- Highest average for each exam.

Practice Exam Grade	Exam 1	Exam 2	Exam 3	Exam 4	Exam 5	Exam 6
A	91%	83%	89%	84%	84%	86%
B	89%	96%	86%	91%	76%	87%
C	85%	97%	82%	85%	93%	81%
D	80%	86%	83%	84%	93%	81%
F	69%	70%	78%	74%	74%	76%
0%	78%	71%	78%	63%	65%	60%

# Actual Exam Performance Based on Practice Exam Performance

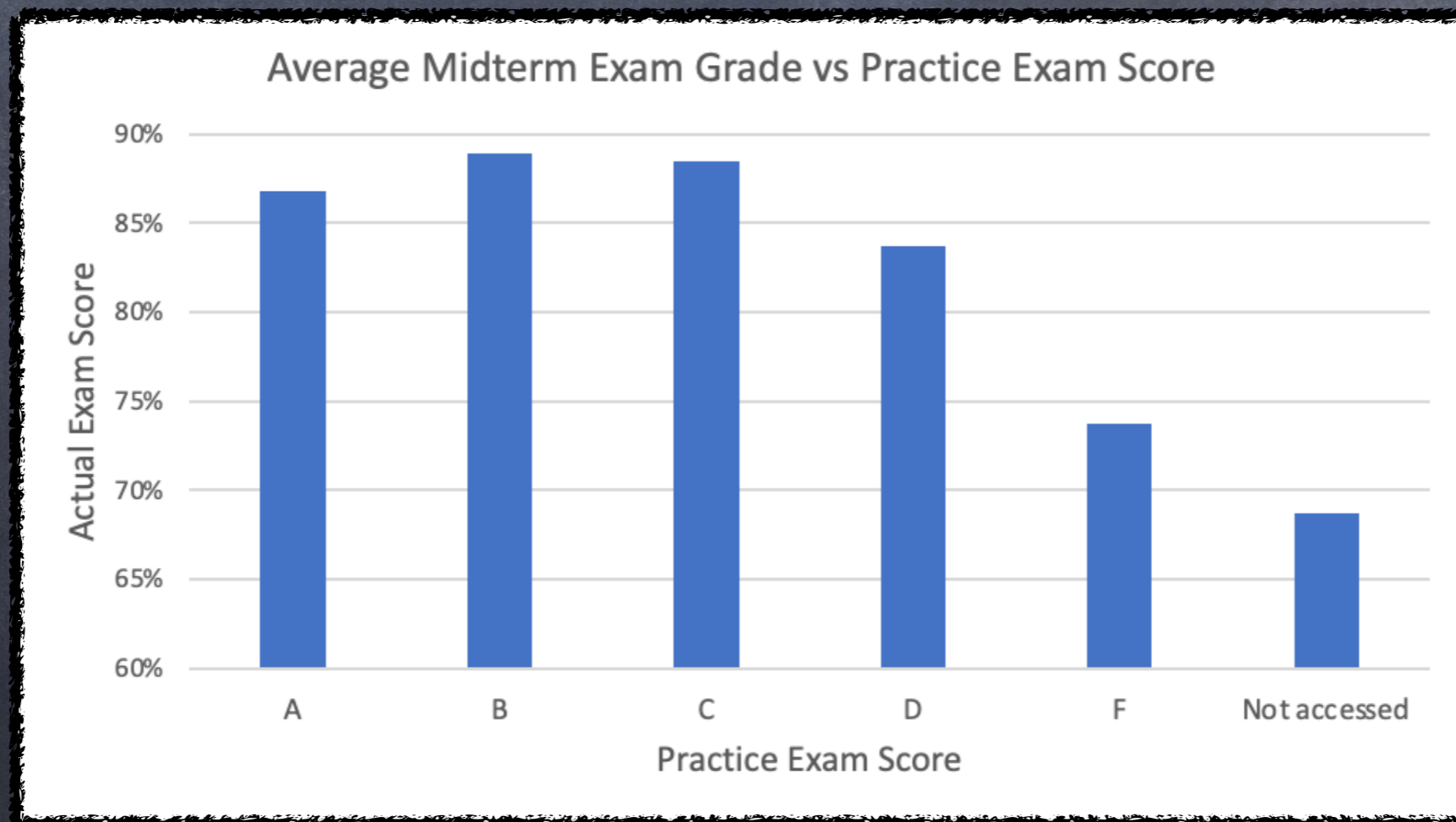
- Example: students earning an A on the practice exam for exam 1 had an average score of 91% on the actual exam.
- Highest average for each exam. Lowest average.

Practice Exam Grade	Exam 1	Exam 2	Exam 3	Exam 4	Exam 5	Exam 6
A	91%	83%	89%	84%	84%	86%
B	89%	96%	86%	91%	76%	87%
C	85%	97%	82%	85%	93%	81%
D	80%	86%	83%	84%	93%	81%
F	69%	70%	78%	74%	74%	76%
0%	78%	71%	78%	63%	65%	60%



# Actual Exam Performance Based on Practice Exam Performance

- Students earning A, B, or C on the practice exams performed well (>85%) on the actual exams.
- Those who did not access the practice exams performed the worst



# Wrap it Up! Summary and Main Takeaways

- The majority of students do not use practice questions: 14% to 34% usage for each practice unit.
- Better for practice exams: 34% to 49% usage
- Those with at least one attempt on all practice units associated with an exam scored much higher on that exam
- High usage and attempts correlates to higher final course grade
- Converse does not seem to be true: students earning an A do not have the highest usage or attempts
- Actual performance on practice questions/exams seems to be good indicator of performance on actual exam

# What Does It ALL Mean?

- Low usage? Plenty of course resources already; student with good study habits may not be additional practice; students who could use the additional practice not taking advantage of it.
- Motivation? Intrinsic & extrinsic for earning points on practice question.
- Performance on Practice Questions/Exams? Not too surprising...if they did well on the practice stuff probably going to do well on the actual exam.
- Practice Questions/Exams just one resource. Could be a distraction or hurt performance? Student with 700 total attempts earned 78% for final course grade.

# Onward! Next Steps and Future Exploration

- Continue to develop and add to practice questions
- Analyze additional semesters adding in how student usage and performance might relate to student demographics
- How much time are students spending on questions?
- Student survey gathering feedback on practice questions: Do students find the practice questions helpful? Why do students use or not use them? Issues with the practice questions or ways to improve them?
- Keep sharing results with students and providing ample resources and the right learning environment for them

# Thank you for coming!

## Questions? Comments? Suggestions?

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Feedback Survey:  
<http://tiny.cc/124921>



My slides will be made available. Feel free to reach with questions or want to discuss further: [cagc@umbc.edu](mailto:cagc@umbc.edu)

Sponsored by DoIT (LA Mini-Grant) – Thanks again!