Two-Stage Exams as an Extension of Peer Learning

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THE TWO-STAGE EXAM

A two-stage exam[†] is a process in which students complete an exam in two parts, first independently and then as part of a peer learning group. In principle, the two-stage exam:

- Reinforces the importance and the benefits of collaborative learning
- Demonstrates that learning can and should take place throughout the entire semester, not just in compartmentalized chunks
- Provides immediate feedback on exam performance
- Encourages exams to be a learning and not just a regurgitative process
- Reminds students that mastery of content is not achieved through memorization and regurgitation, but through practice and application

Stage One

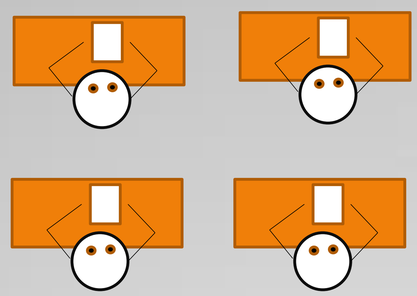
- Completed independently
- Exam Time = 45 minutes
- Point Allocation = 90% of exam grade

Stage Two

- Completed collaboratively
- Groups of 3-4 students
- Groups selected ahead of time
- Exam Time = 20 minutes
- Point Allocation = 10% of exam grade

- May contain some of the same problems as were on Stage One.
- May contain conceptual questions, computational problems or both.

- Each group submits <u>one</u> solution.

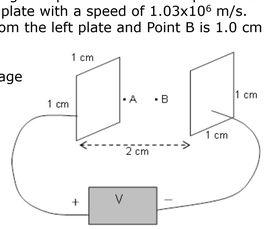


STAGE ONE

- Sample problem:

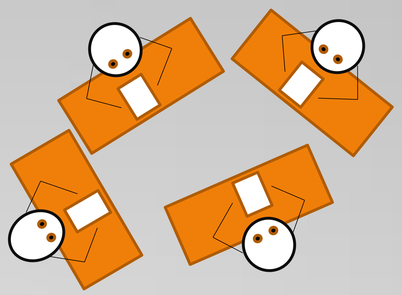
A parallel plate capacitor consisting of two 1 cm^2 square plates separated by a distance of 2 cm is connected to a battery with voltage V. An electron released from rest at the surface of the negative plate crosses the capacitor and strikes the positive plate with a speed of 1.03×10^6 m/s. Point A is 0.5 cm from the left plate and Point B is 1.0 cm from the left plate.

a. What is the voltage of the battery?



b. What is the electric field at points A and B?

c. Is the final electric potential of the electron higher or lower than its initial electric potential? Briefly explain.



STAGE TWO

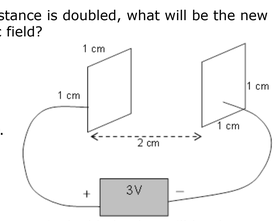
- Sample problem:

A parallel plate capacitor consisting of two 1 cm^2 square plates separated by a distance of 2 cm is connected to a 3V battery. The electric field between the plates is 150 V/m. All questions refer to the original scenario.

If the separation distance is doubled, what will be the new value of the electric field?

a. 600 V/m
b. 300 V/m
c. 150 V/m
d. 75 V/m
e. 37.5 V/m

Explain your choice.



If the separation distance is doubled, what will be the new value of ΔV_C?

a. 12 V
b. 6 V
c. 3 V
d. 1.5 V
e. 0 V

Explain your choice.

The terminals of the battery are reversed so that the left plate becomes negatively charged and the right plate becomes positively charged (but the physical dimensions are not changed). Circle the quantities listed below that will also change.

a. The magnitude of the total charge on the plate
b. The surface charge density of the plate
c. The potential difference of the capacitor ΔV_C
d. The magnitude of the electric field
e. The direction of the electric field
f. The potential energy of an electron on the – plate
g. The trajectory of a + charge that enters the capacitor from above.

Briefly explain your reasoning for (b).

CONCERNS

- How will this affect overall exam grades?
- Does this change the difficulty level of exams?
- How can we ensure fair group dynamics?
- Is it necessary to reach a single answer?
- Do students remember what they learn?

EFFECT ON EXAM SCORES

General Physics for Life Science Majors			
	Exam 1	Exam 2	Exam 3
Fall 2014	70%	77%	67%
3-yr ave. 2011-2013	77%	78%	68%

Natural Science for Non-Science Majors			
	Quiz 1	Quiz 2	Mid-Term
Fall 2014	76%	76%	76%
3-yr ave. 2011-2013	81%	77%	79%

STUDENT ATTITUDES

Percentage of Students who Agree That….		
	Physics	Nat. Science
Experience was a Positive	94%	83%
Would Recommend	76%	92%
Learned during exam	72%	83%
Improved confidence	25%	50%
Reduced Stress	33%	50%

FUTURE QUESTIONS

- Does the two-stage exam really facilitate learning?
- Do students remember what they learn during the exam?
- Does the two-stage exam benefit some more than others?
- How do students reach a decision?

[†]G.W.Reiger and C.E. Heiner, Journal Of College Science Teaching, Vol 43, No. 4, pg 41

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