

# Two-Stage Exams: An Effective Learning Tool?

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## THE TWO-STAGE EXAM

A two-stage exam<sup>†</sup> 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

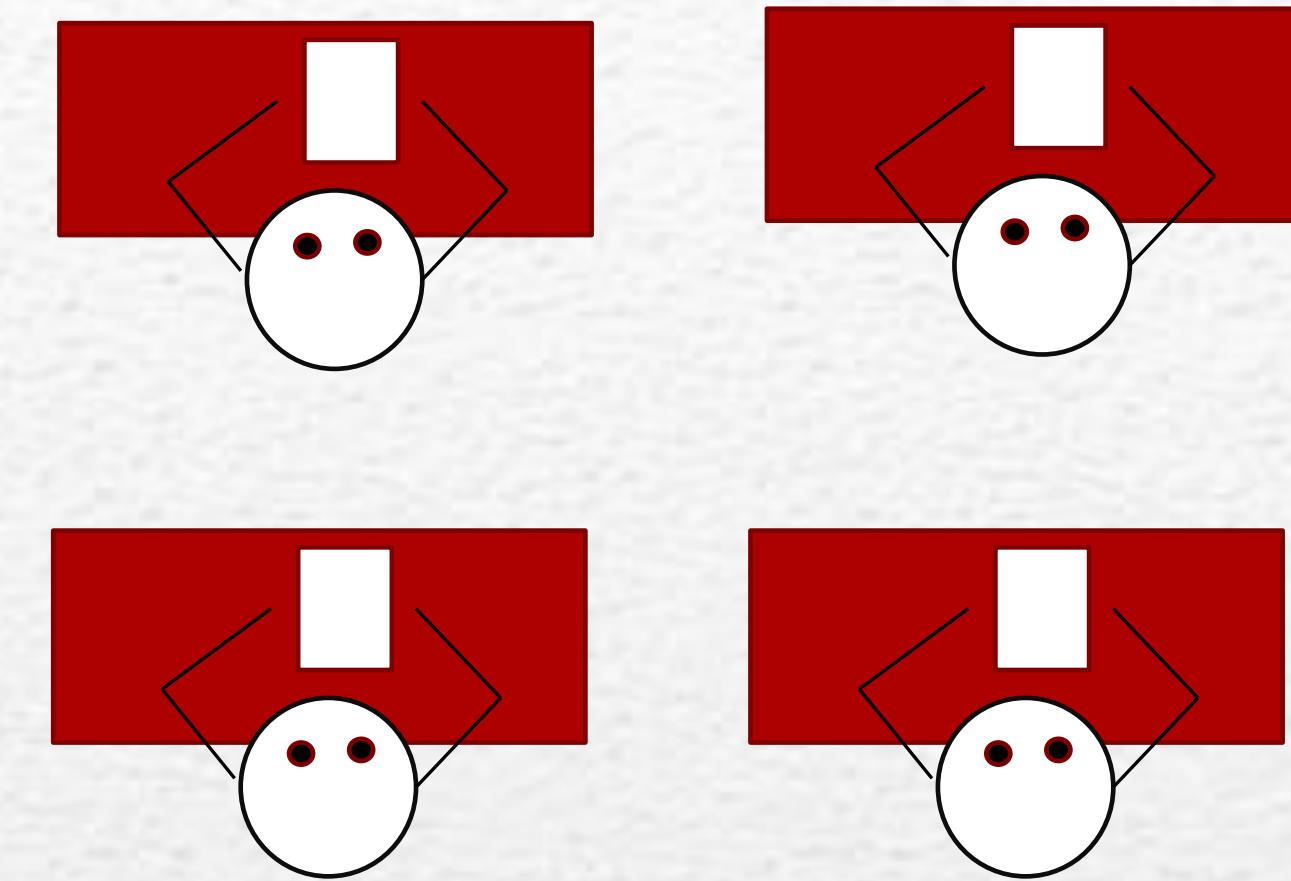
- Completed independently
- Exam Time = 50-60% of class period
- Point Allocation = 85-90% of exam grade

### Stage Two

- Completed collaboratively
- Exam Time = 20-30% of class period
- Point Allocation = 10-15% 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 one solution.

### Collaborative Groups

- Groups of 3-4 students
- Groups selected and approved ahead of time
- Vast majority of students chose nearest neighbors

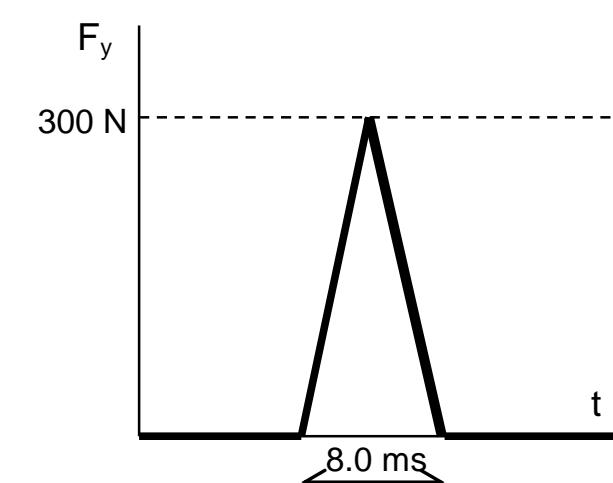


### STAGE ONE

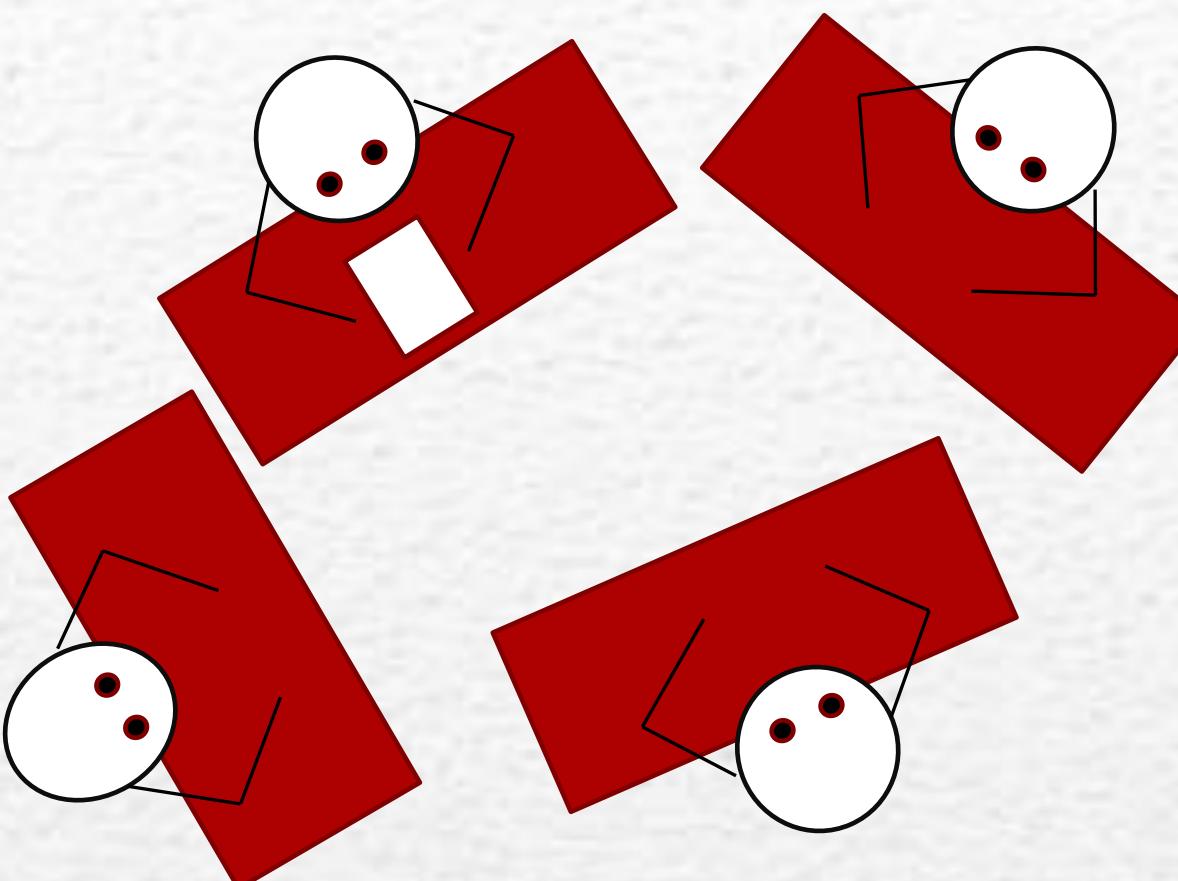
#### ▪ Sample problem (1 of 4 on Part One):

A 200 g rubber ball is dropped from rest from a height of 1.0 m onto a hard floor. The figure below shows the force that the floor exerts on the ball.

- a. Find the impulse on the ball during the interaction with the floor.



- b. If the ball reaches the ground at a speed of 4.4 m/s, what is the rebound speed of the ball?

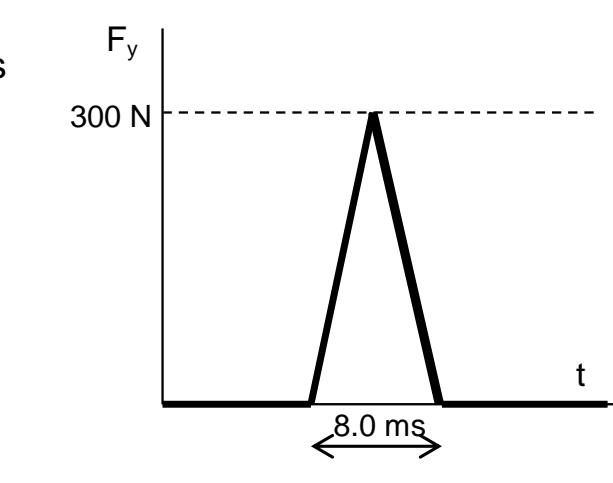


### STAGE TWO

#### ▪ Sample problem (1 of 2 on Part Two):

A 200 g rubber ball is dropped from rest from a height of 1.0 m onto a hard floor. The ball reaches the floor at a speed of 4.4 m/s and the floor provides an impulse of 1.2 Ns to the ball.

- a. Find the rebound speed of the ball.



- b. During the collision of the ball with the floor, is the energy of the ball conserved? Briefly explain your answer.

- c. During the collision of the ball with the floor, is the momentum of the ball conserved? Briefly explain your answer.

- d. If the ball were to land on a squishier floor, what would happen to the shape of the graph? Make a quick sketch to illustrate your answer.

## EFFECTIVE STRATEGIES

The two-stage exam is most effective:

- In a 75-minute class period than a 50-minute class period.
- Given in one class period rather than split over two different days.
- When students are allowed to choose their group members
- When questions on Part Two build off of questions on Part One

## CONCERNs

- How will this affect overall exam grades?
- Does this change the difficulty level of exams?
- How can we ensure fair group dynamics?
- Should the instructor intervene if students don't pull equal weight?
- Is it necessary to reach a single answer?
- Do students remember what they learn?

## STUDENT ATTITUDES

At the end of the semester, students volunteered to participate in an interview to discuss the two-stage exam process. A question of interest is whether students from different backgrounds – those taking a class required by their science major or those taking a general education requirement – view the two-stage exam process differently.

Students answered questions on a 3-point Likert scale.

	Mean Response per Question	
	3 = agree	2 = neutral
	Science Major (N=28)	Gen. Ed. Course (N=17)
Reduced Stress	$1.6 \pm 0.8$	$2.2 \pm 0.9$
Improved Confidence	$1.5 \pm 0.8$	$2.5 \pm 0.9$
Learned During Exam	$2.4 \pm 0.9$	$2.1 \pm 0.7$
Improved Feedback	$2.2 \pm 0.6$	$1.7 \pm 0.9$
Affected Grade	$2.4 \pm 0.7$	$2.7 \pm 0.5$
Points Allocation Fair	$2.8 \pm 0.4$	$2.9 \pm 0.3$
Time Allocation Fair	$2.2 \pm 0.7$	$1.9 \pm 0.6$
Group Assignment Fair	$2.4 \pm 0.6$	$2.6 \pm 0.7$
Process is Positive	$2.7 \pm 0.6$	$2.6 \pm 0.6$
Would Recommend	$2.6 \pm 0.6$	$2.5 \pm 0.5$

## OBSERVATIONS

General Education students are more likely to say:

- The Two-Stage exam reduces stress and improves their confidence
- The time allocation was unfair, typically preferring a longer time period for the individual portion
- The Two-Stage exam affected their grade, with most saying it improved their grade

The vast majority of all students find the experience positive and would recommend it to other instructors.

<sup>†</sup>G.W.Reiger and C.E. Heiner, Journal Of College Science Teaching, Vol 43, No. 4, pg 41