Just-in-Time Teaching (JiTT)

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http://webphysics.iupui.edu/efw_summer14/index.html

A few of your comments

- Phil: The wikipedia article and JiTT web site were clear about the general concept and rationale to the approach. Now I need more specifics about how to find good warm-up exercises or how to write my own. More information is needed on how the students are engaged during classtime -- this was pretty vague in the readings.
- Michael: I have not tried JITT deliberately, I may have done it without knowing what it is. I assign homework related to an upcoming lesson. I grade students for preparing, and the discussions will highlight the elements of the homework. Am I doing JITT ?

Outline

- Introduction
- Just-in-Time Teaching
  - "Theory"
  - Implementation
  - Aside: How to get great student evaluations
- Assessment
- Getting started

How did you decide how to teach?

- Stefan: I model the teaching styles of others (which I have observed or heard about at AAPT/APS meetings), if I believe that these styles will be useful to my students.
- R: Tradition, suggestions form colleagues, colloquia on teaching and dipping my toes into some education research. Observations of colleagues
- Sally: Anecdotes, presentations, and some literature about successful contemporary methods.
- James: I have a lesson plan that is modified based on student feedback from previous lectures, and student results in homework and tests.

Results

- Classes designed for professors or “pre-professors”
- Problem: Students do not learn like we do
  - Not motivated to be experts
  - Need more time to think
  - Not as good at working alone
  - Not as good at judging their own performance
  - Many under greater pressure
- See R. Felder references on web site

Digression

- Could have spent time “collecting data”
- Instead, spent time discussing it
- **Same content covered at greater depth**

One solution: Active learning

- Proven effective for "regular" students and excellent ones
- Used extensively at MIT, RPI, Harvard, Univ. of Illinois, other research universities
- Also many small colleges (prestigious and not)
- Community Colleges, high schools
- Close to "apprenticeship" or relationship between PhD student and advisor

The “theoretical” background

- Active learning (students think in class)
- Student centered (it is not about you)
- Formative assessment (real-time feedback)
- Peer interaction (it helps to discuss new ideas)
- Many learning styles (faculty not like students)

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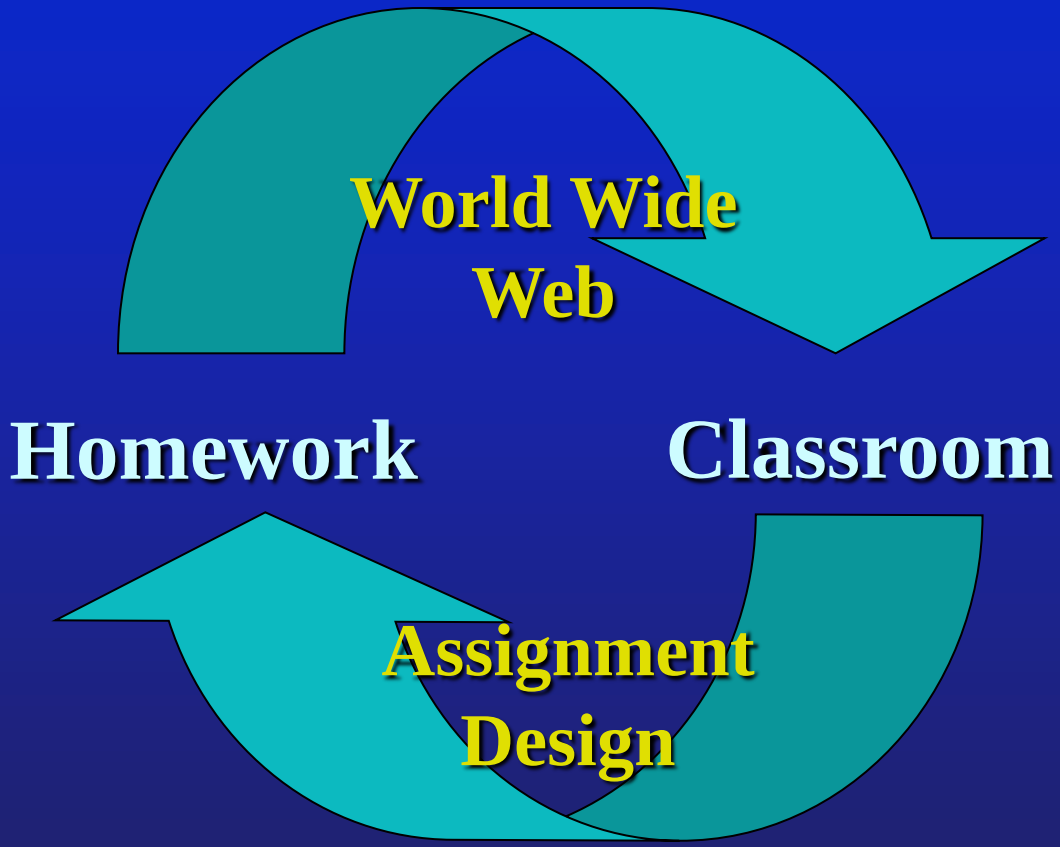
The (original) settings

- IUPUI: Public, urban university
  - 30,000 students, almost 100% live off campus
  - Most work > 25 hours/week
- United States Air Force Academy: Military
  - All students take physics, even history majors
  - All play sports, train for military
- Davidson College: Liberal arts college
  - Highly selective
  - Small classes

What is JiTT?

- Tom: JiTT is a tool used to probe students (or class) understanding of concepts prior to class meeting time. Ideally such information is used to modify the intended instruction.
- Albert: A systemic way to:
  1. get students prepared before class starts.
  2. encourage students to discuss the subject(s) involved.
  3. use the students feedback as a guide-line to conduct the teaching.
  4. encourage students to develop their problem solving skill(s).

Just-in-Time Teaching (JiTT)



Just-in-Time Teaching

- **Adaptable**
- **Combines "high tech" with "high touch"**
- **WarmUp Exercises = Online, pre-class reading quiz:**
  - Due few hours before class
  - A few open-ended conceptual questions
  - Cover that day's material

Another Digression

- JiTT described in your words
- Jargon already familiar (JiTT, WarmUp)
- “preview” of important concepts

Example

- *Question: Is it possible to add heat to an ideal gas without changing its temperature? If it is possible, please explain how it is done.*
  - "It is not possible because the internal energy of an ideal gas only depends on the temperature.... the internal energy will increase when the temperature rises…."
  - "It is possible to add heat to an ideal gas without it changing it's temperature by the gas receiving the heat, and the atoms of that gas getting excited enough to disperse that heat as fast as they receive it…"
  - "If you add heat to a system while the system is doing the corresponding amount of work, the temperature will not change."

What makes a good WarmUp?

- Kale: A good "warmup exercise" should contain questions that would bring out students' per-conceived notions of the topic to be discussed.
- Beth: A good warmup exercise is at a level where it asks students to think deeply about the concepts they've been asked to learn, but is not so difficult that the majority won't be able to make progress on it.

Online archive of Warmup exercises

http://webphysics.iupui.edu/warmup/physics_archive.html

- Introductory physics (2 semester sequence)
- Statistical/Thermal Physics (2 sets)
- Intermediate Mechanics (2 sets)
- Modern Physics, Quantum Mechanics
- Intermediate E&M (2 semester sequence)
- Mathematical Methods
- Optics, Intro Astronomy
- Needed: Condensed matter, other specialties…

The "Interactive Lecture"

- Step 1: Synchronization
  Read the students' responses…
  What do they understand?
- Step 2: Preparation
  Select excerpts from students work, adjust clicker questions, etc.
- Step 3: Execution
  Class is a dialog based on student excerpts and faculty notes

Choosing and using student responses

- Always say something positive (see last example)
  - This is true, but what if something else occurs simultaneously…
  - This makes sense, but something is missing…
  - This is a great response… how would we know how much heat to add?
- More useful phrases…
  - This is a good answer, but to a different question…
  - This has a great beginning, but more could be added…
  - This is correct, but the reasoning isn't quite right…

Tips and Pitfalls

- Explain methods and purpose on first day
- No need to review all responses before class; sample for “useful” quotes, grade later
- Focus on students strengths, too, not just misconceptions and other problems.
- Use answers from many students: not favorites.
- Do not “isolate” WarmUps - scaffold lecture
- Must be routine. Do not start/stop during semester
- Upper level students can handle more “exploratory” questions, connections to intro.

Results

- Students better prepared for class
  - Familiar with jargon
  - Given thought to ideas
- Faculty better prepared for students
  - Misconceptions identified
  - Just in time adjustment to coverage
- Class time spent more productively
  - Students interact during class

How to get great student evaluations

- First five minutes are critical!
- Be honest, and direct—take time on the first day of class to explain what you are doing and why.
- Be a leader—college is hard, and students look to you for motivation, don't disappoint them.
- Build a team—let students know that you and they are working towards a common goal.
- Hold yourself and your students to high standards—if you work hard, they will too.

Outline

- The Challenges ✓
- Just-in-Time Teaching ✓
  - Background ✓
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Study Habits (N=155, biology)

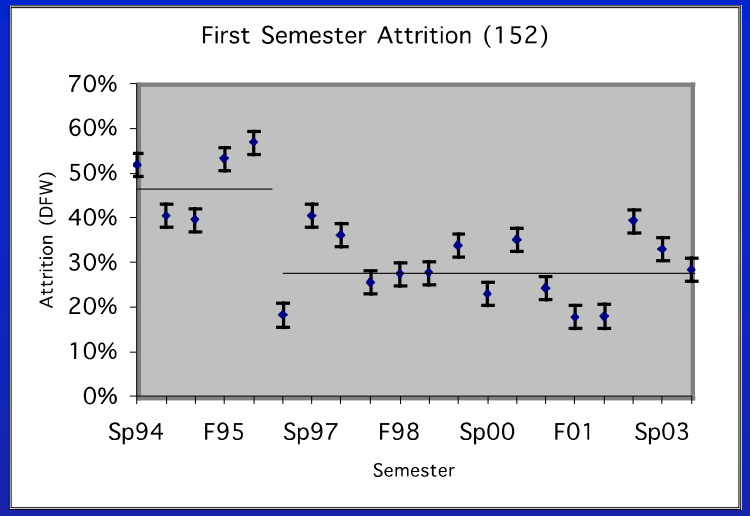
Q1 Do the WarmUps help you stay caught up?

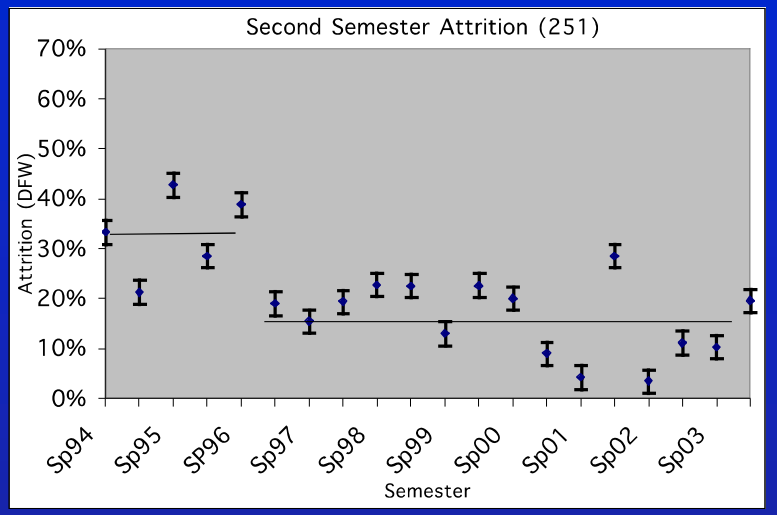
Q2 Do you "Cram" before tests in this course?

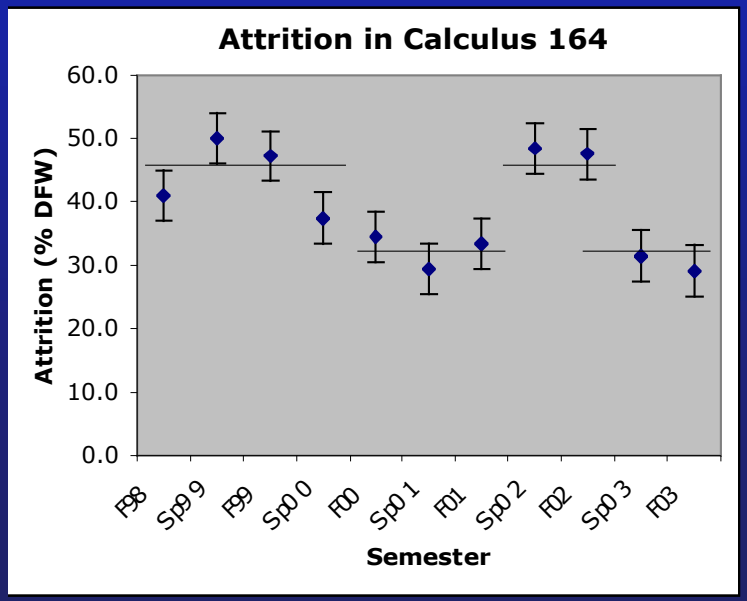
Q3 Do you "Cram" in your other courses?

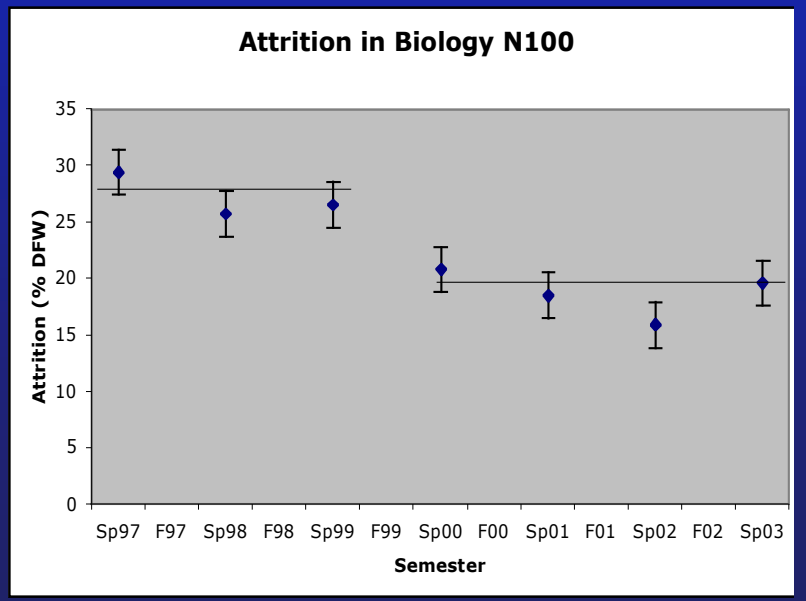
	1- Yes	2- Yes	3- Yes
"A" students	85%	14%	43%
"B" students	89 %	39%	61%
"C" students	89%	47%	68%
"D" students	84%	68%	68%
"F" students	92%	58%	58%

Retention (N~80-150/semester)









Cognitive (biology, N~200)

Final exam questions tied to…	**% Gain (Post%-pre%)**	**Average Normalized Gain**
no interventions	%G = 15% (25%-10%)	<g> = **0.16 7**
additional homework problems	%G = 17% (35%-18%)	<g> =**0.20 7**
WarmUp **or** cooperative learning questions	%G = 45% (59%-14%)	<g> = **0.51 1**
WarmUp **and** cooperative learning questions	%G = 56% (68%-12%)	<g> = **0.63 6**

Affective (E&M, N~60)

1. Do you feel that the warm-up assignments helped your professor make good use of the classroom time?	Yes 47 **87%**	No 7 13%
2. Do other professors have better ways to determine how class time should be used?	Yes 14 26%	No 40 74%
3. Do you feel that the warm-up assignments helped your professor focus on important topics in class?	Yes 49 **91%**	No 7 13%
4. Do your other professors have effective methods for focusing on important topics in class?	Yes 33 61%	No 21 39%
5. Did the warm-up assignments help your professor get a good feel for what the students know?	Yes 42 **81%**	No 10 19%
6. Do your other professors have effective methods for getting a feel for what their students know?	Yes 20 38%	No 33 62%
7. Do you think the warm-up assignments help your professor get students involved during the lecture?	Yes 37 **70%**	No 16 30%
8. Do your other professors have effective methods for getting their students involved in lecture?	Yes 23 43%	No 31 57%

Student Comments

- “This was a fantastic course. It was the hardest course I’ve taken yet, but also the most fun.”
- I think the WarmUps are a good idea because they give students a chance to think about the material prior to lecture.
- "This course was very well structured. It was obvious that a lot of time was spent in preparation for it.”
- "152 & 251 have made me reach more than any courses I have taken.”
- Don’t tell anyone, but I think I will greatly miss my physics class.

Summary

- JiTT is based on feedback between homework and classroom
- WarmUp exercise: a pre-class, online reading quiz
- Improved study habits, retention, content knowledge, morale.
- Instructor knowledge of student difficulties
- Easily adopted and adapted

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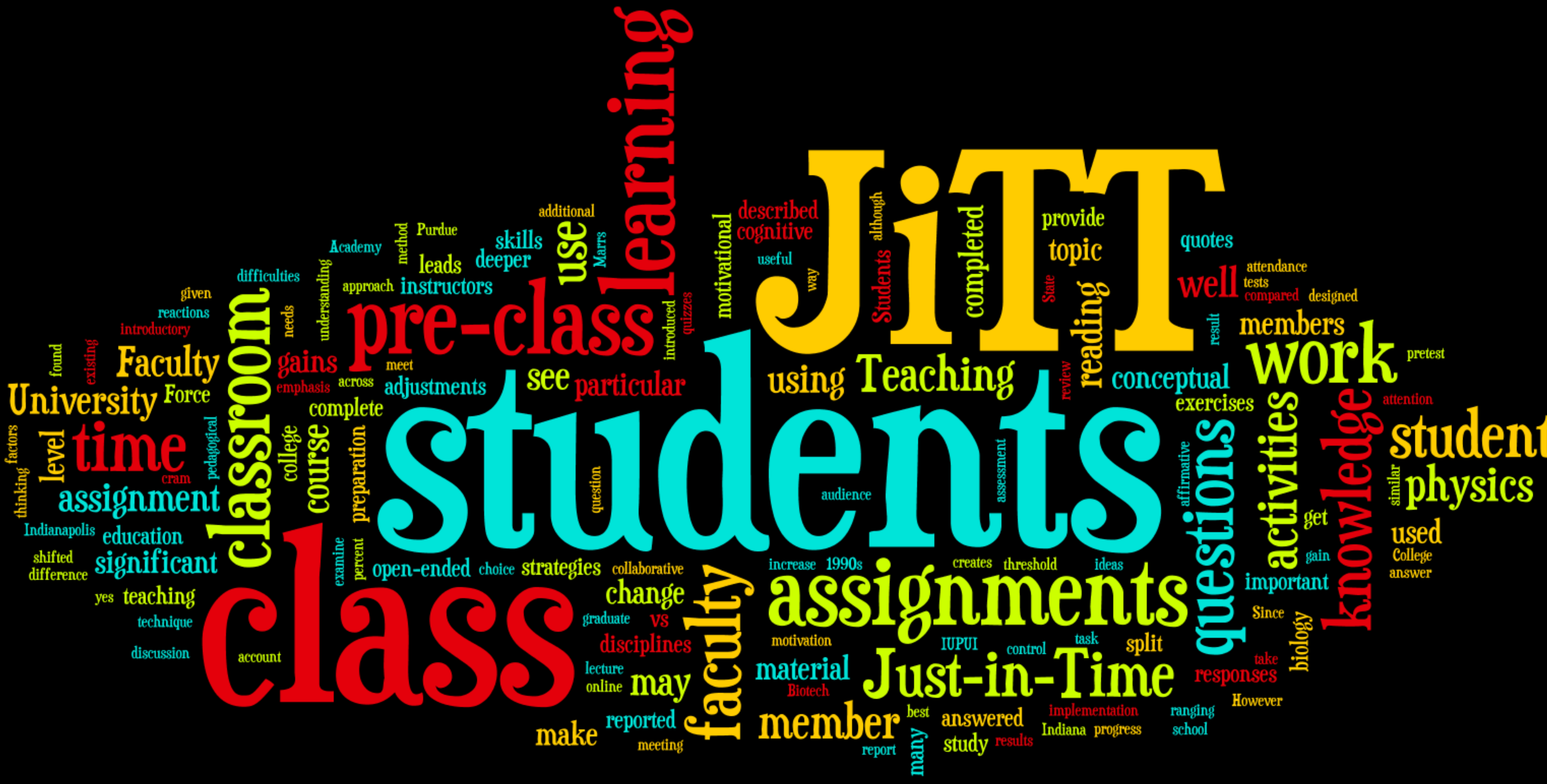
Getting started:

- **Use the handout to start developing a warmup exercise for the course you are most likely to teach next fall.**


JiTT
students
class
learning
pre-class
assignments
classroom
Just-in-Time
faculty
questions
knowledge
activities
work
student
physics
time
Teaching
member
material
Faculty
University
assignment
significant
education
teaching
course
preparation
adjustments
instructors
deeper
skills
leads
use
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exercises
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disciplines
strategies
open-ended
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level
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understanding
Academy
Purdue
additional
method
Marrs
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difficulties
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reactions
introductory
needs
found
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Force
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across
meet
factors
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pedagogical
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Indianapolis
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yes
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Biotech
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Indiana
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answer
pretest
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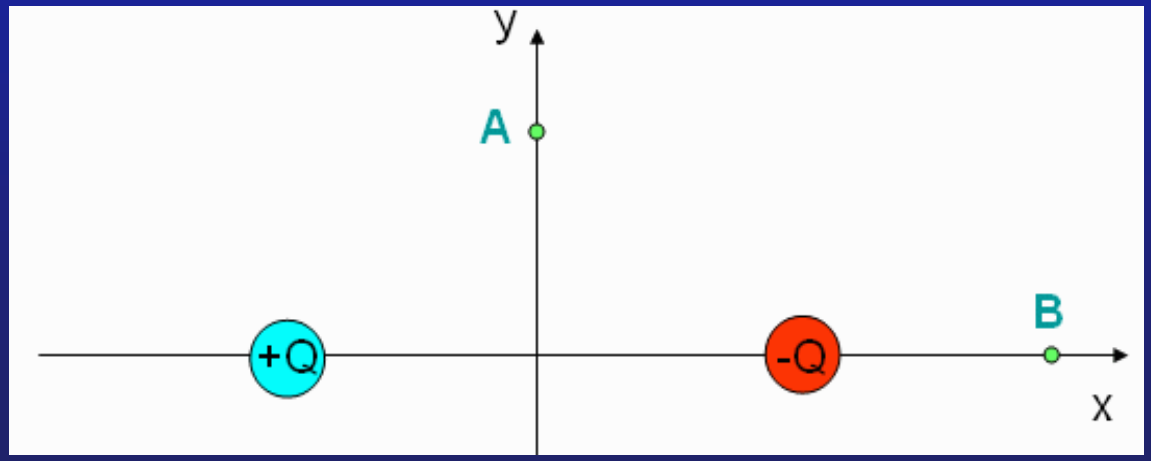
attendance
tests
compared
designed
result
review
State
Students
although
way
useful
introduced
quizzes

smartPhysics checkpoint

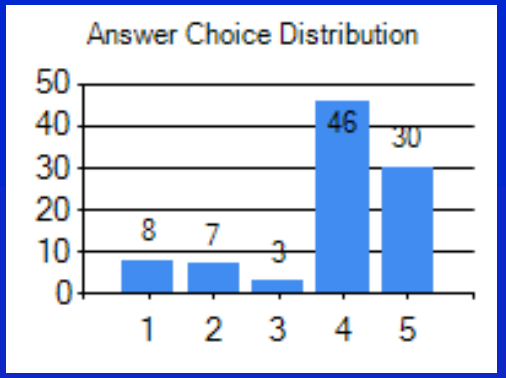
1. Two equal, but opposite charges are placed on the x axis. The positive charge is placed at to the left of the origin and the negative charge is placed to the right, as shown in the figure. What is the direction of the electric field at point A?

a) up b) down c) left d) right e) zero

2. Explain your reasoning



smartPhysics output



Aaron (aaron@iupui.edu)

1) 4

2) the field from Q+ points up and to the right, while Q- points down and to the right therefore when adding them together it points to the right.

Beatrice (beatrice@iupui.edu)

1) 4

2) point A is equidistant from each charge and they would therefore cancel out

Ada (ada@iupui.edu)

1) 2

2) The charges will cancel out so the direction of the force will be down

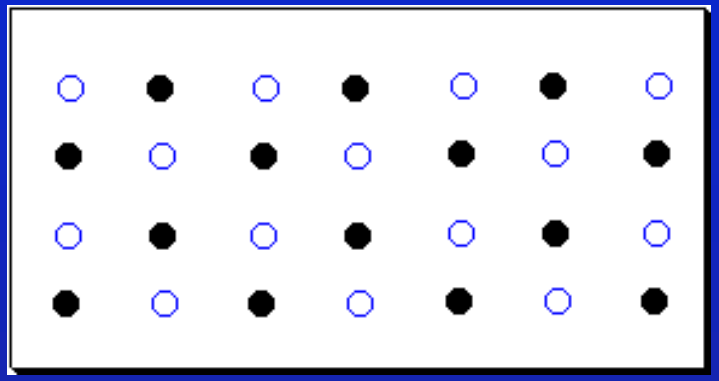
Ahmed (ahmed@imail.iu.edu)

1) 4

2) the field is toward the negative charge and away from the positive charge which makes the direction to the right

Chemistry example

This picture depicts matter at the submicroscopic level. Describe what you see and take a guess as to what the identity of the substance is.



- "The particles are well spaced out so I would guess the substance to be a gas. The substance is a gas composed of 2 elements that are in an equal ratio."
- "After reading Chapter 1 in the book I would guess that the substance is water in the form of a solid because the atoms are in order. However, I could be wrong because I think the atoms in a solid might be closer together."