USING MOBILE DEVICES TO CONDUCT PRE-LABORATORY EXERCISES

Dr. Kendrew K. W. Mak
Department of Chemistry

Supported by:
Course Development Grants (2011-12)

BASIC GOAL OF OUR UNDERGRADUATE PROGRAM

Students finished high schools

Undergraduate training

Professional and Independent Chemists

CHEMISTRY IS AN EXPERIMENTAL SCIENCE

Chemistry is an experimental science – Laboratory training is very important.

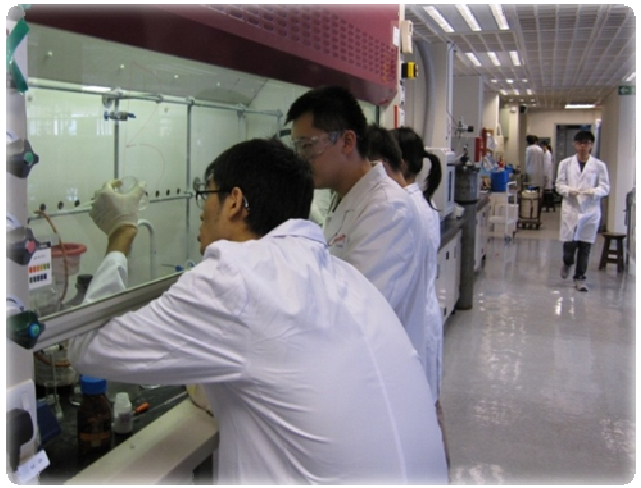
Year 1: 4 x 2-units lab courses
Year 2: 5 x 2-units lab courses
Year 3: 1 x 2-units lab course
+ 1 x 4-units FYP

(Total: 24 units)
(1/3 of the major requirement)

- Students should acquire a good level of lab skills for developing their career.
- Develop their skills for chemical research.

IN THE LAB COURSES, WE TRAIN STUDENTS TO ……

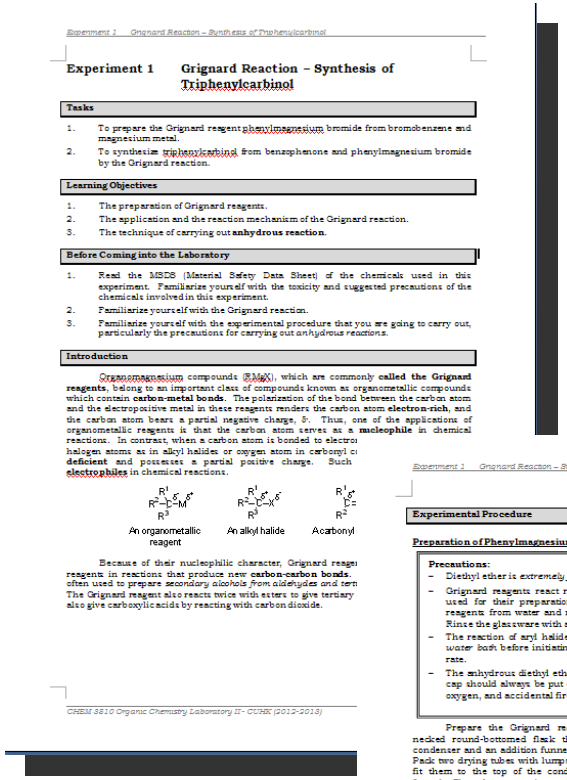
- acquire chemical knowledge through hands-on experiments
- acquire the technical skills to carry out chemical investigations
- acquire the skills to record the experimental details and data precisely and concisely
- acquire the skills to plan (and design) an experiment
- analyze and draw conclusions from the experimental data



To Be Professional and Independent Chemists

PREPARATIONS BEFORE THE LAB SESSION

- Understand the chemical principles and the objectives of the experiment
- Understand the purposes of the experimental procedures
- Perform pre-lab calculations
- Identify the important observations and data that should be taken
- Predict the expected results of the experiment from theory
- Have a good time management plan
- Aware the necessary safety precautions



Experiment 1 Grignard Reaction – Synthesis of Triphenylcarbinol

Experiment 1 Grignard Reaction – Synthesis of Triphenylcarbinol

Tasks

1. To prepare the Grignard reagent phenylmagnesium bromide from bromobenzene and magnesium metal.
2. To synthesize triphenylcarbinol from benzophenone and phenylmagnesium bromide by the Grignard reaction.

Learning Objectives

1. The preparation of Grignard reagents.
2. The application and the reaction mechanism of the Grignard reaction.
3. The technique of carrying out **anhydrous reaction**.

Before Coming into the Laboratory

1. Read the MSDS (Material Safety Data Sheet) of the chemicals used in this experiment. Familiarize yourself with the toxicity and suggested precautions of the chemicals involved in this experiment.
2. Familiarize yourself with the Grignard reaction.
3. Familiarize yourself with the experimental procedure that you are going to carry out, particularly the precautions for carrying out *anhydrous reactions*.

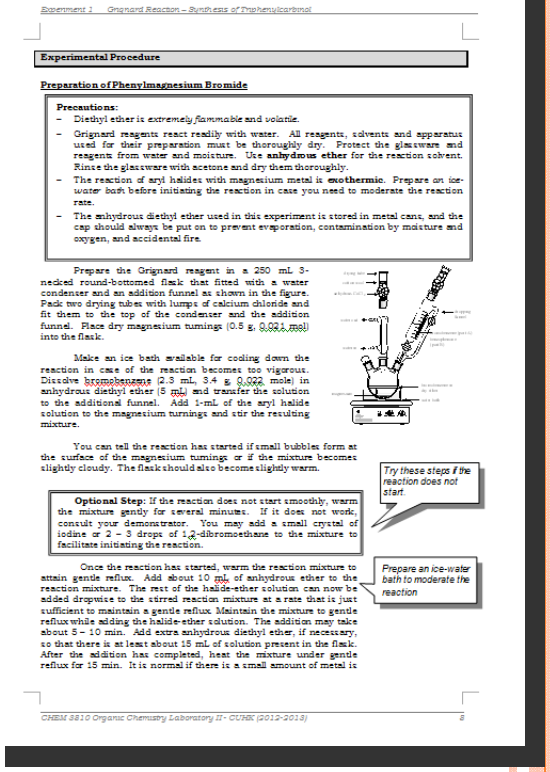
Introduction

Organomagnesium compounds (RMgX), which are commonly **called the Grignard reagents**, belong to an important class of compounds known as organometallic compounds which contain **carbon-metal bonds**. The polarization of the bond between the carbon atom and the electropositive metal in these reagents renders the carbon atom **electron-rich**, and the carbon atom bears a partial negative charge, δ^-. Thus, one of the applications of organometallic reagents is that the carbon atom serves as a **nucleophile** in chemical reactions. In contrast, when a carbon atom is bonded to electro halogen atoms as in alkyl halides or oxygen atom in carbonyl c **deficient** and possesses a partial positive charge. Such **electrophiles** in chemical reactions.

An organometallic reagent | An alkyl halide | A carbonyl

Because of their nucleophilic character, Grignard reage reagents in reactions that produce new **carbon-carbon bonds**. often used to prepare *secondary alcohols from aldehydes* and *terti* The Grignard reagent also reacts twice with esters to give tertiary also give carboxylic acids by reacting with carbon dioxide.

CHEM 3810 Organic Chemistry Laboratory II - CUHK (2012-2013)



Experiment 1 Grignard Reaction – Synthesis of Triphenylcarbinol

Experimental Procedure

Preparation of Phenylmagnesium Bromide

Precautions:

- Diethyl ether is *extremely flammable* and volatile.
- Grignard reagents react readily with water. All reagents, solvents and apparatus used for their preparation must be thoroughly dry. Protect the glassware and reagents from water and moisture. Use **anhydrous ether** for the reaction solvent. Rinse the glassware with acetone and dry them thoroughly.
- The reaction of aryl halides with magnesium metal is **exothermic**. Prepare *an ice-water bath* before initiating the reaction in case you need to moderate the reaction rate.
- The anhydrous diethyl ether used in this experiment is stored in metal cans, and the cap should always be put on to prevent evaporation, contamination by moisture and oxygen, and accidental fire.

Prepare the Grignard reagent in a 250 mL 3-necked round-bottomed flask that fitted with a water condenser and an addition funnel as shown in the figure. Pack two drying tubes with lumps of calcium chloride and fit them to the top of the condenser and the addition funnel. Place dry magnesium turnings (0.5 g, 0.021 mol) into the flask.

Make an ice bath available for cooling down the reaction in case of the reaction becomes too vigorous. Dissolve bromobenzene (2.3 mL, 3.4 g, 0.022 mole) in anhydrous diethyl ether (5 mL) and transfer the solution to the additional funnel. Add 1-mL of the aryl halide solution to the magnesium turnings and stir the resulting mixture.

You can tell the reaction has started if small bubbles form at the surface of the magnesium turnings or if the mixture becomes slightly cloudy. The flask should also become slightly warm.

Try these steps if the reaction does not start.

Optional Step: If the reaction does not start smoothly, warm the mixture gently for several minutes. If it does not work, consult your demonstrator. You may add a small crystal of iodine or 2 – 3 drops of 1,2-dibromoethane to the mixture to facilitate initiating the reaction.

Prepare an ice-water bath to moderate the reaction

Once the reaction has started, warm the reaction mixture to attain gentle reflux. Add about 10 mL of anhydrous ether to the reaction mixture. The rest of the halide-ether solution can now be added dropwise to the stirred reaction mixture at a rate that is just sufficient to maintain a gentle reflux. Maintain the mixture to gentle reflux while adding the halide-ether solution. The addition may take about 5 – 10 min. Add extra anhydrous diethyl ether, if necessary, so that there is at least about 15 mL of solution present in the flask. After the addition has completed, heat the mixture under gentle reflux for 15 min. It is normal if there is a small amount of metal is

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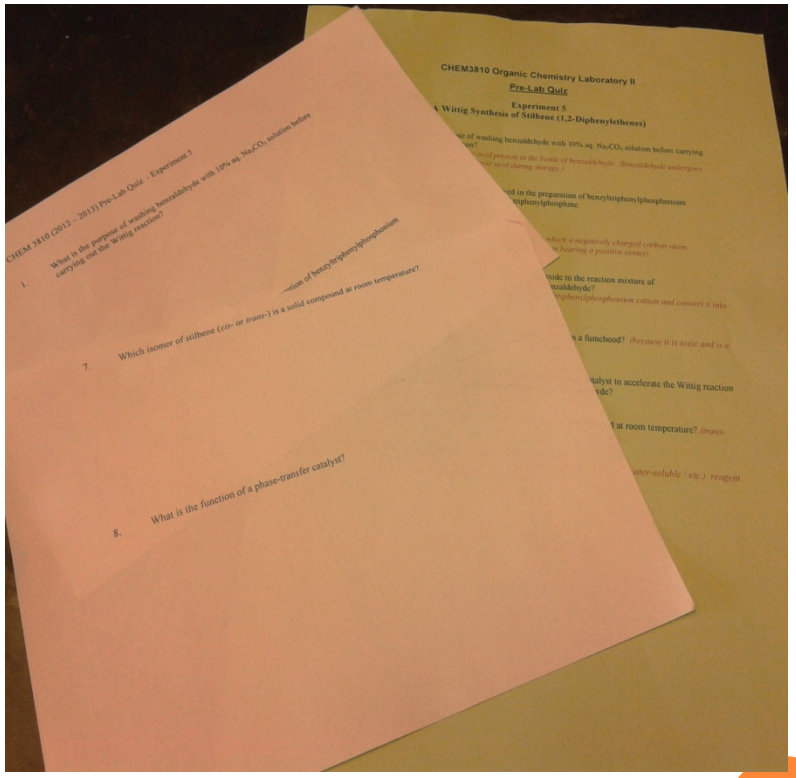
PREPARATIONS BEFORE THE LAB SESSION

- Prepare a flowchart for the experimental procedure
- Draft the data sheet
- Pre-lab quiz

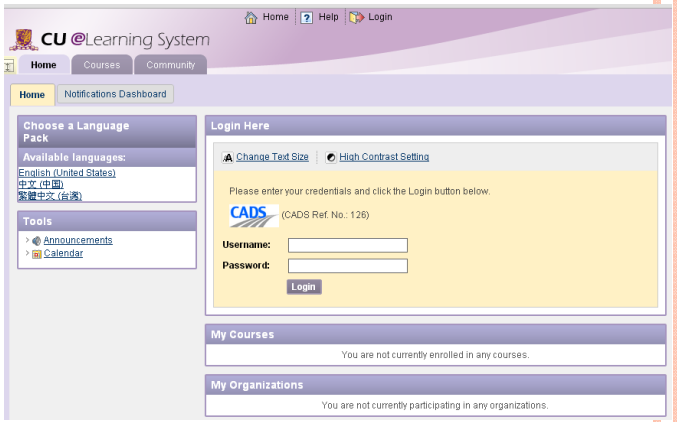
Pre-lab quiz

- 2 - 5% of the total course marks
- Chemical principles, purposes of the procedure, pre-lab calculations, safety issues, etc.
- MC / short questions
- Traditionally, pen/paper quiz, in the first 10 minutes of the lab sessions



STARTING FROM 2012-2013
ON-LINE PRE-LAB QUIZ

Availability of Technologies



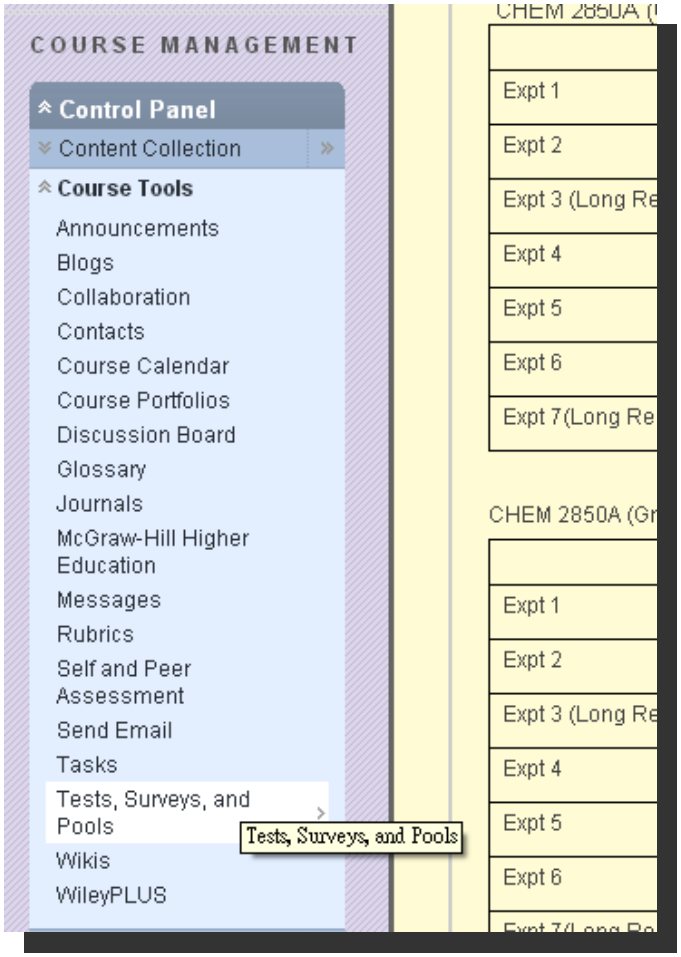
Objectives of Switching to On-Line

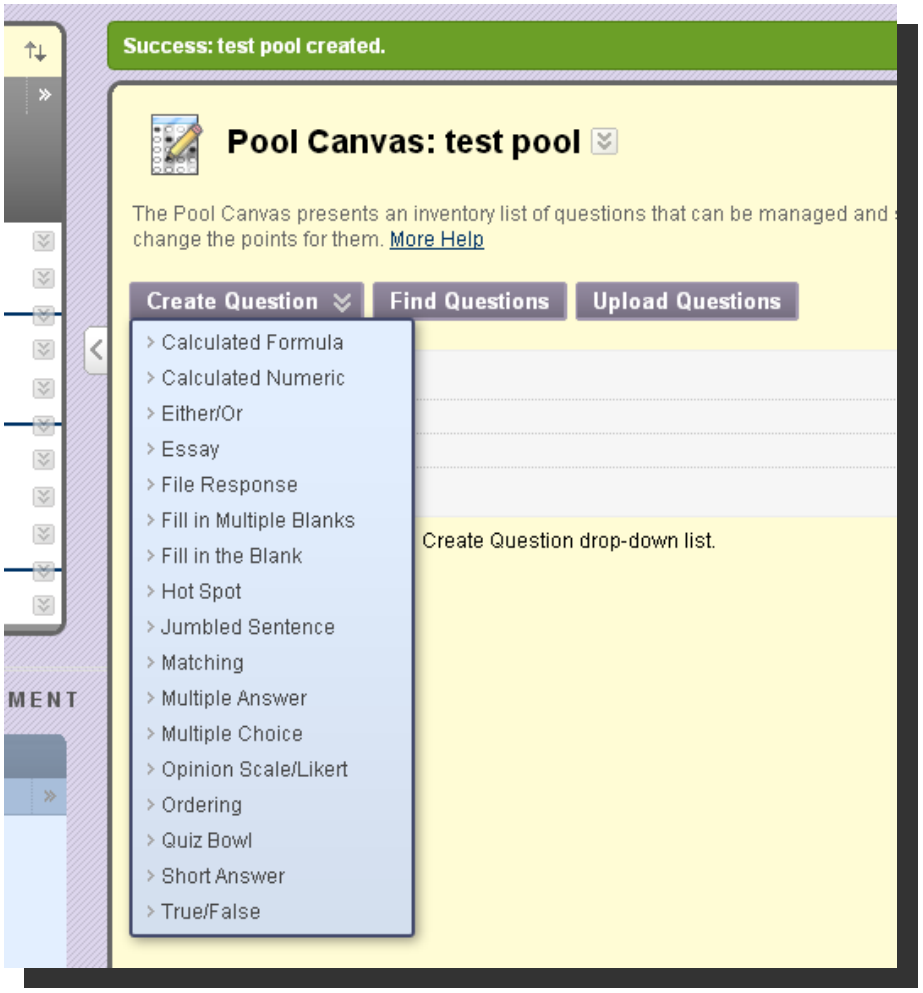
- Streamline the course administrations and conduction
- Provide flexibility to students
- Allow the TAs to know the performance of the students before the students come to the lab

Support

Course Development Grants (2011-2012)

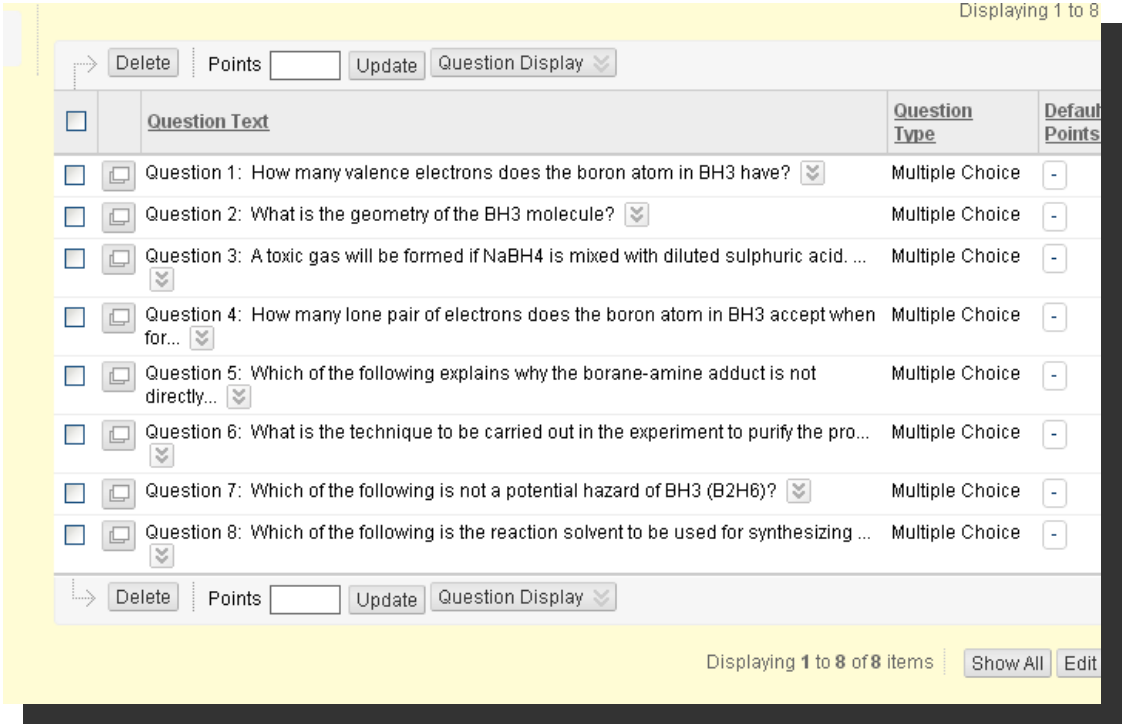
ASSESSMENT TOOLS IN THE NEW BLACKBOARD LEARN SYSTEM





THE QUIZ

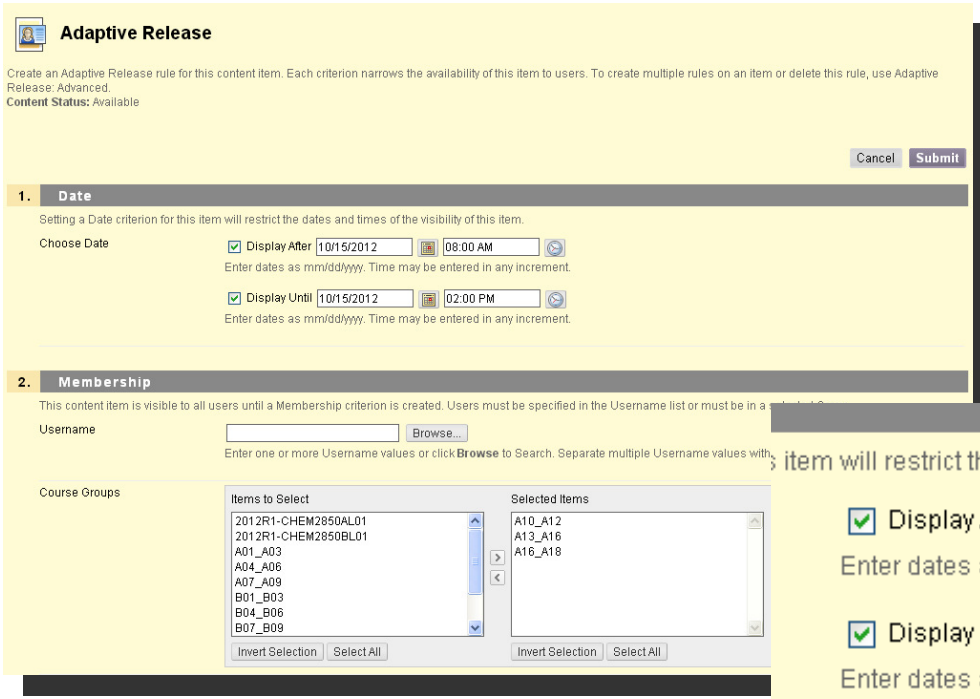
- **Question type :** Multiple choice
- **Question bank :** 8 – 12 MC questions for each experiment
- **Students to answer :** 2 questions randomly picked from the pool by the e-learn platform
- **Ordering of the answer options :** randomized

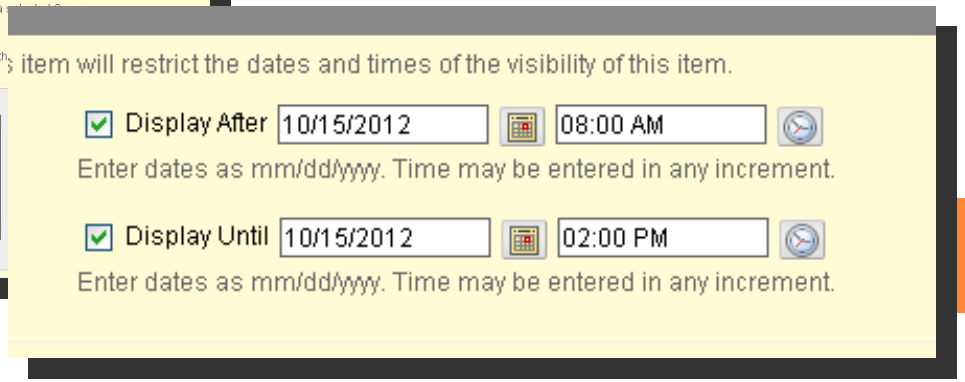


THE QUIZ

- Lab sessions start at 2:30 pm
- Quiz available : 8:00 am – 2:00 pm on the same day
- Adaptive Release – to control

  who can access and do the quiz
  when they can see and do the quiz

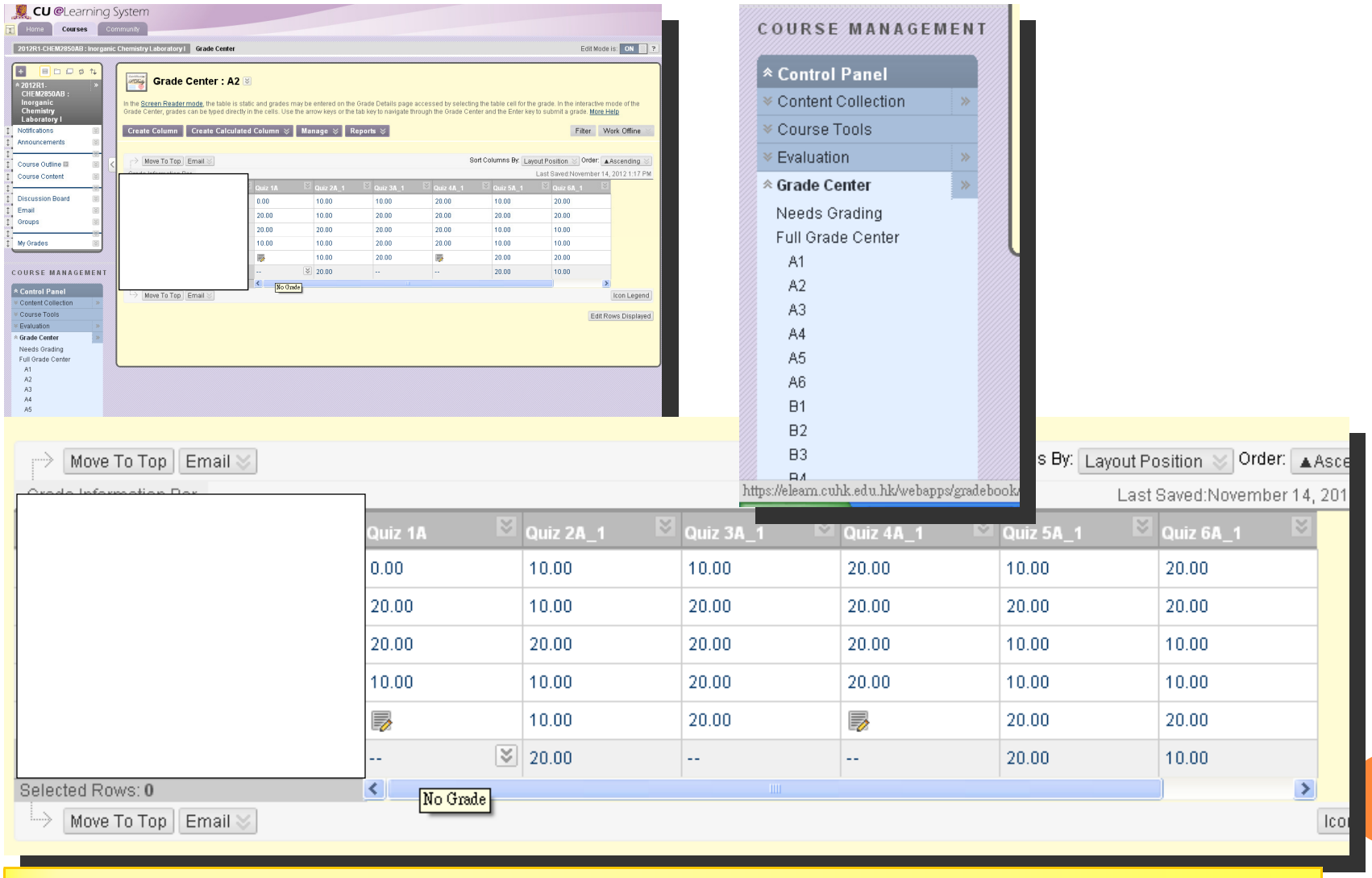




- Each student can only complete the quiz once
- They can do the paper version in the lab if they missed the online version

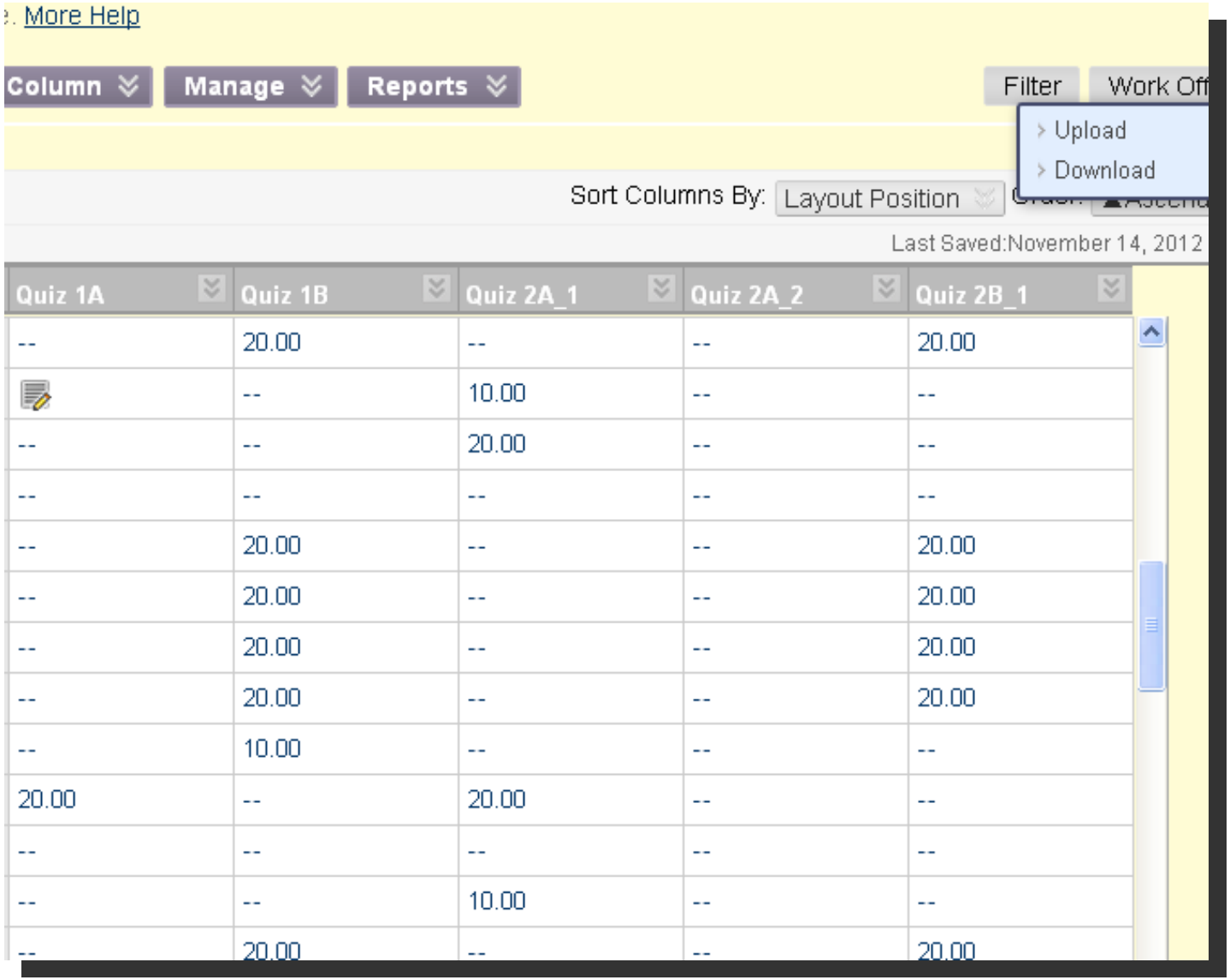
THE QUIZ RESULTS

Retrieve the quiz results from the Grade Center *(Create Smart Views Shortcuts)*



The results are provided to the TAs at the beginning of the lab sessions

DOWNLOAD THE STUDENTS' MARKS FOR PROCESSING AND GRADING



COURSES PARTICIPATED IN 2012-2013

1st Semester

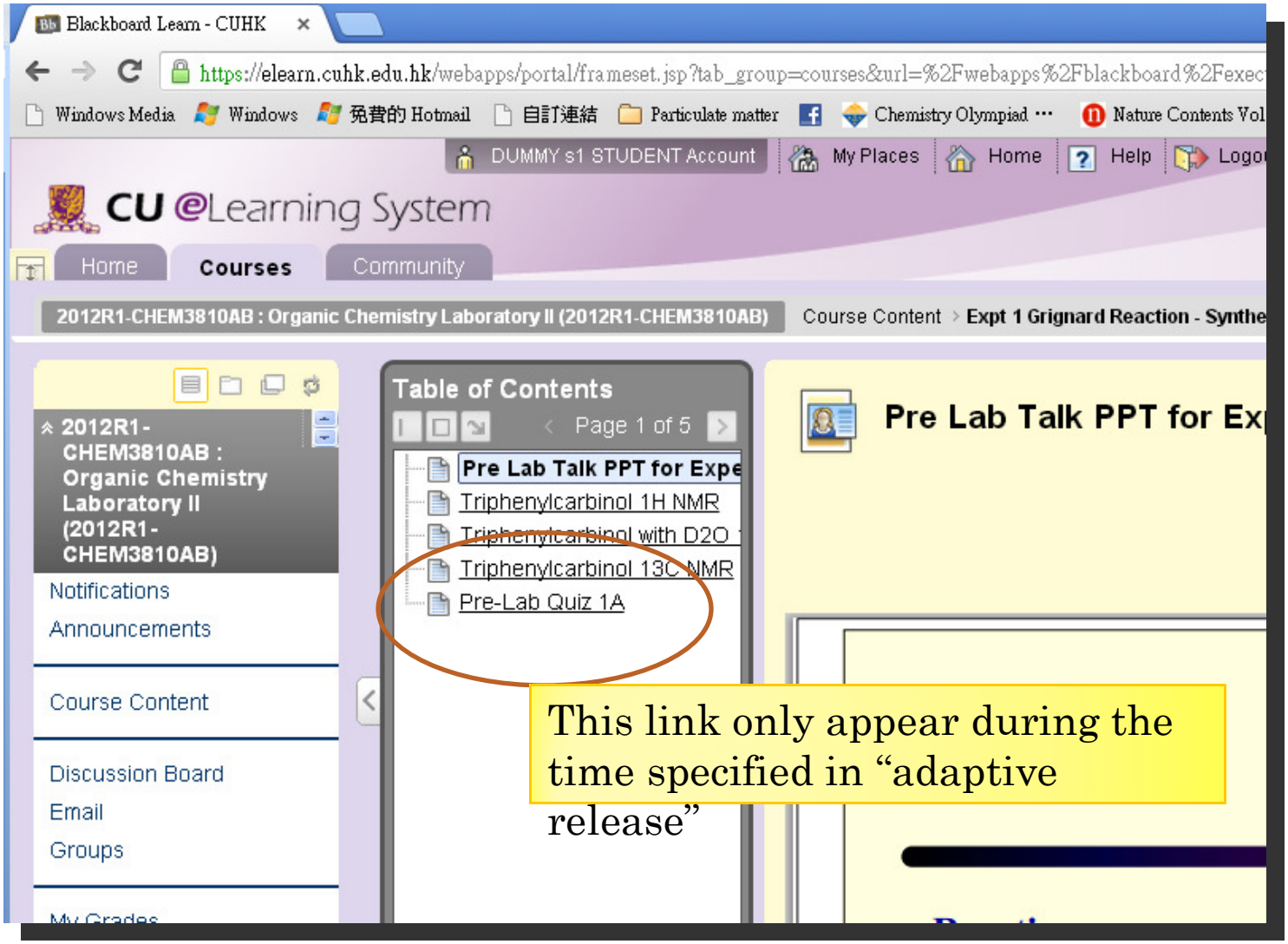
- CHEM 2850 – Inorganic Chemistry Laboratory I
  (Compulsory course for 1st year students – 3-year curriculum)
- CHEM 3810 – Organic Chemistry Laboratory II
  (Compulsory course for 2nd year students – 3-year curriculum)

2nd Semester

- CHEM 2820 – Organic Chemistry Laboratory I
  (Compulsory course for 1st year students – 3-year curriculum)
- CHEM 3820 – Organic Chemistry Laboratory III
  (Compulsory course for 2nd year students – 3-year curriculum)

Enrolment of each course: ~ 65 - 75

STUDENTS' VIEW



Take Test: Pre-Lab Quiz 1A

Description	
Instructions	
Timed Test	This Test has the time limit of 10 minutes. This Test will save and submit automatically when the time expires. Warnings appear when **half the time**, **5 minutes**, **1 minute**, and **30 seconds** remain.
Multiple Attempts	Not allowed. This Test can only be taken once.
Force Completion	Once started, this Test must be completed in one sitting.
	This Test does not allow backtracking. Changes to the answer after submission are prohibited.

Remaining Time: **9 minute, 55 seconds.**

Question Completion Status:

⚠ Moving to the next question prevents changes to this answer. Question **1** of **2**

Question 1

10 points Save Answer

In the experiment, which of the following steps are exothermic?

(i) Reaction of magnesium with bromobenzene

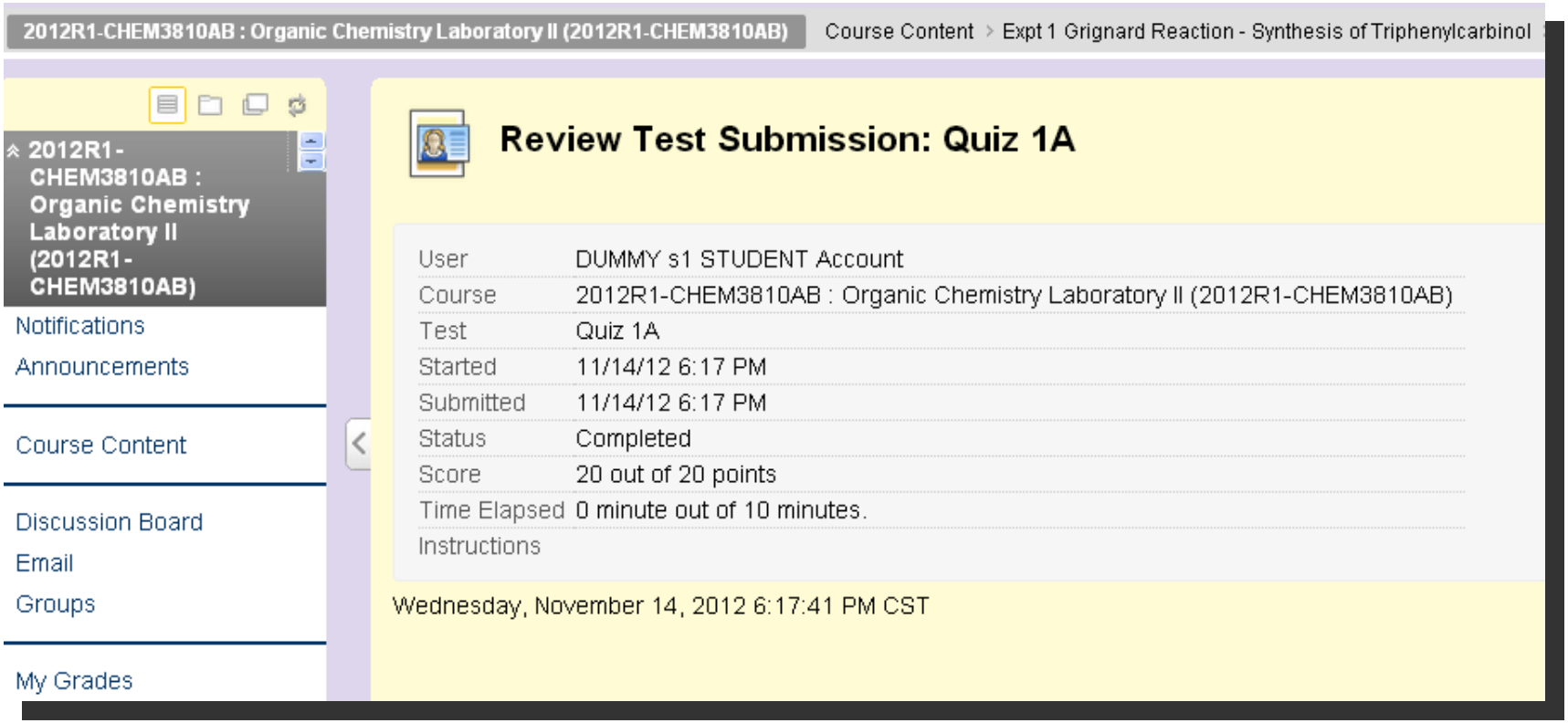
(ii) Reaction of phenylmagnesium bromide with benzophenone

(iii) Addition of ammonium chloride to the magnesium salt of triphenylcarbinol

- A. **(i) and (ii) only**
- B. **(i) and (iii) only**
- C. **(ii) and (iii) only**
- D. **(i), (ii) and (iii)**

⚠ Moving to the next question prevents changes to this answer. Question **1** of **2**

FEEDBACKS TO STUDENTS



DO STUDENTS LIKE DOING THE QUIZ ONLINE?

No. of students completed the quiz on Blackboard Learn

CHEM 2850 – Inorganic Chemistry Laboratory I

(1st year students – 3-year curriculum, Class size = 67)

Experiments	1	2	3	4	5	6
No. of students *(%)*	48 *(72%)*	55 *(82%)*	55 *(82%)*	58 *(87%)*	60 *(90%)*	58 *(87%)*

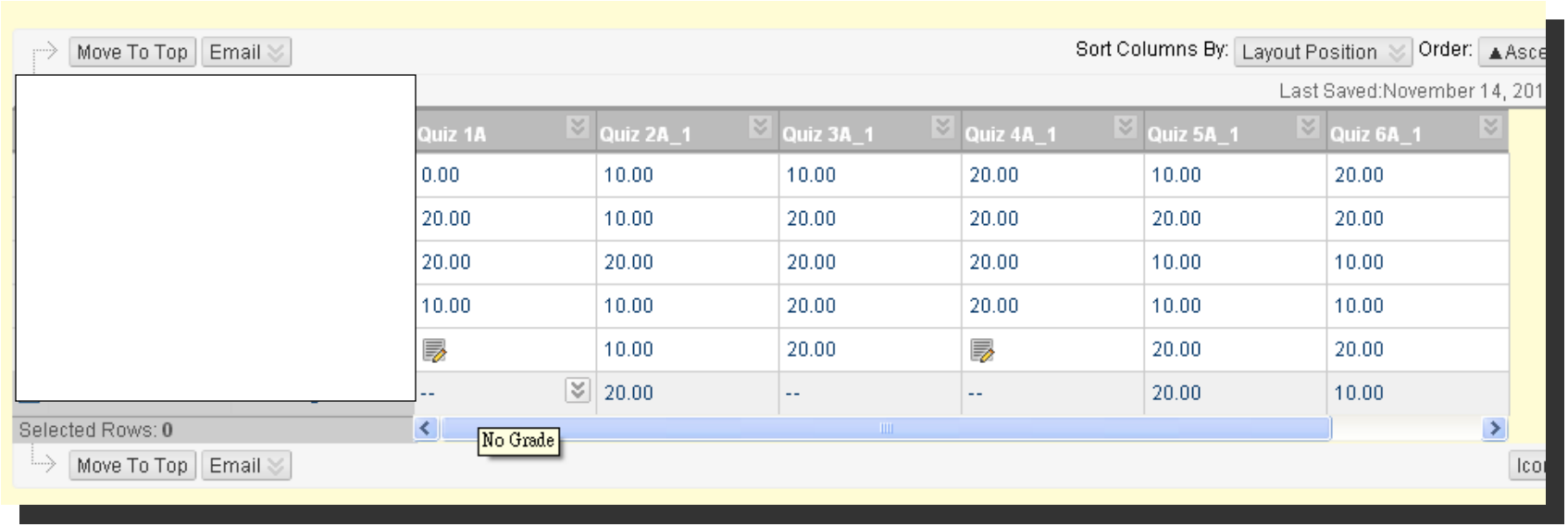
CHEM 3810 – Organic Chemistry Laboratory II

(2nd year students – 3-year curriculum, Class size = 72)

Experiments	1	2	3	4	5	6
No. of students (%)	38 (53%)	43 (60%)	45 (63%)	39 (54%)	42 (58%)	42 (58%)

IMPROVEMENTS UNDERWAY: DETAILS OF STUDENTS' ANSWERS

From the Grade Center / Smart Views

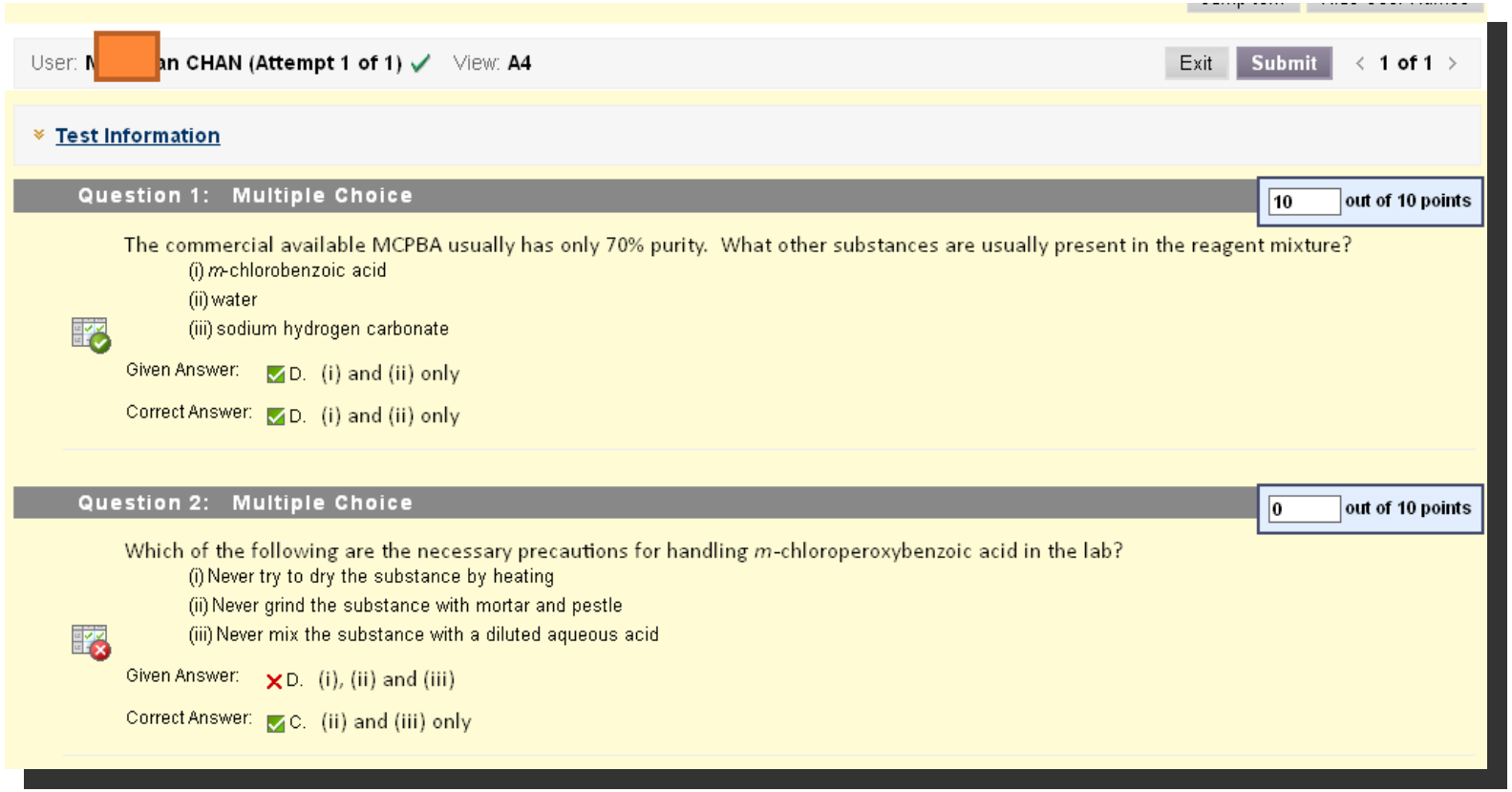


From this report, TAs don't know about:

- which question that the students have answered.
- which answer that the students have chosen, if they answered the questions incorrectly.

IMPROVEMENTS UNDERWAY: DETAILS OF STUDENTS' ANSWERS

From the Grade Center / Smart Views



User: [redacted]an CHAN (Attempt 1 of 1) ✓ View: A4 Exit Submit < 1 of 1 >

Test Information

Question 1: Multiple Choice 10 out of 10 points

The commercial available MCPBA usually has only 70% purity. What other substances are usually present in the reagent mixture?

(i) *m*-chlorobenzoic acid

(ii) water

(iii) sodium hydrogen carbonate

Given Answer: ☑ D. (i) and (ii) only

Correct Answer: ☑ D. (i) and (ii) only

Question 2: Multiple Choice 0 out of 10 points

Which of the following are the necessary precautions for handling *m*-chloroperoxybenzoic acid in the lab?

(i) Never try to dry the substance by heating

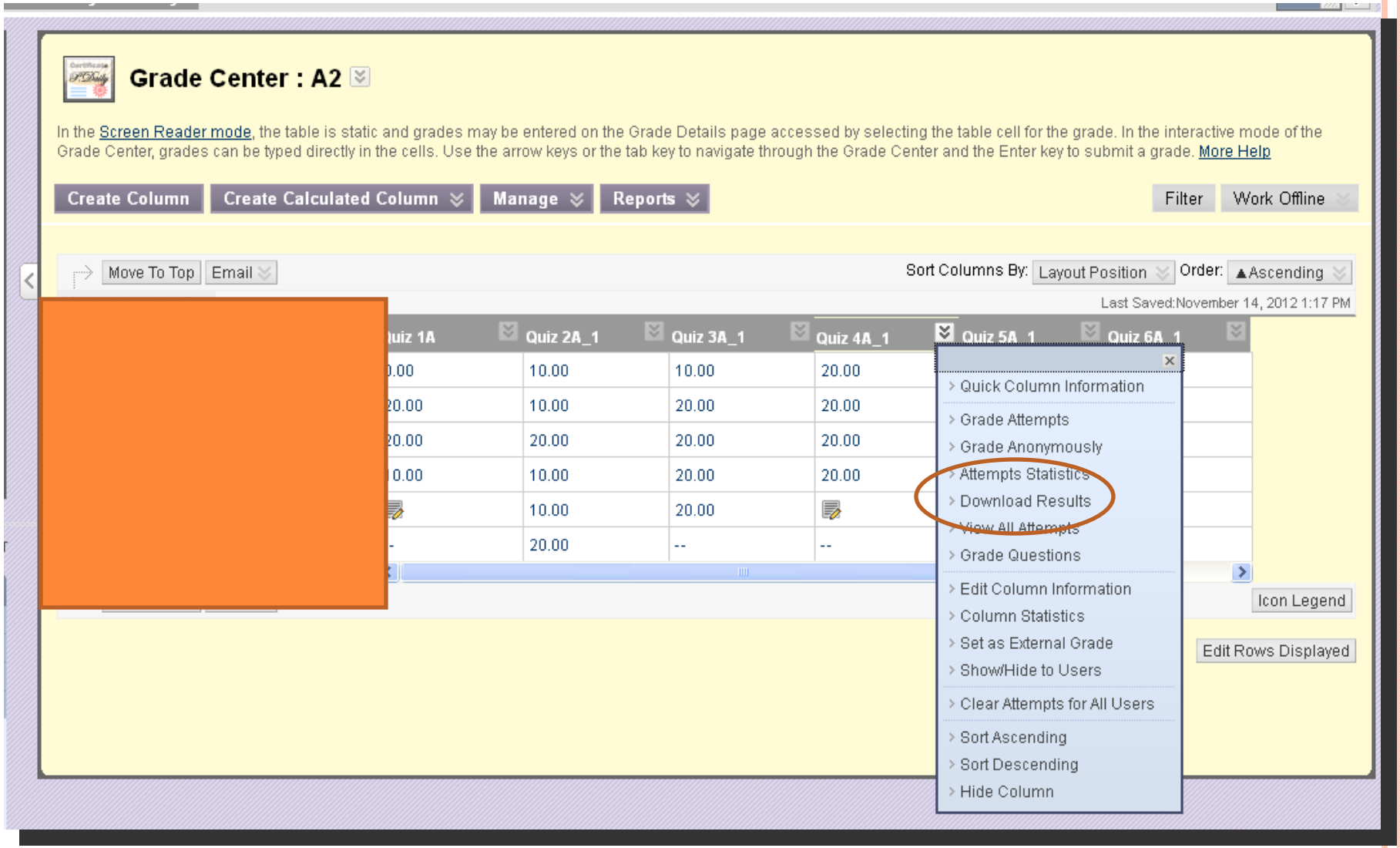
(ii) Never grind the substance with mortar and pestle

(iii) Never mix the substance with a diluted aqueous acid

Given Answer: ✗ D. (i), (ii) and (iii)

Correct Answer: ☑ C. (ii) and (iii) only

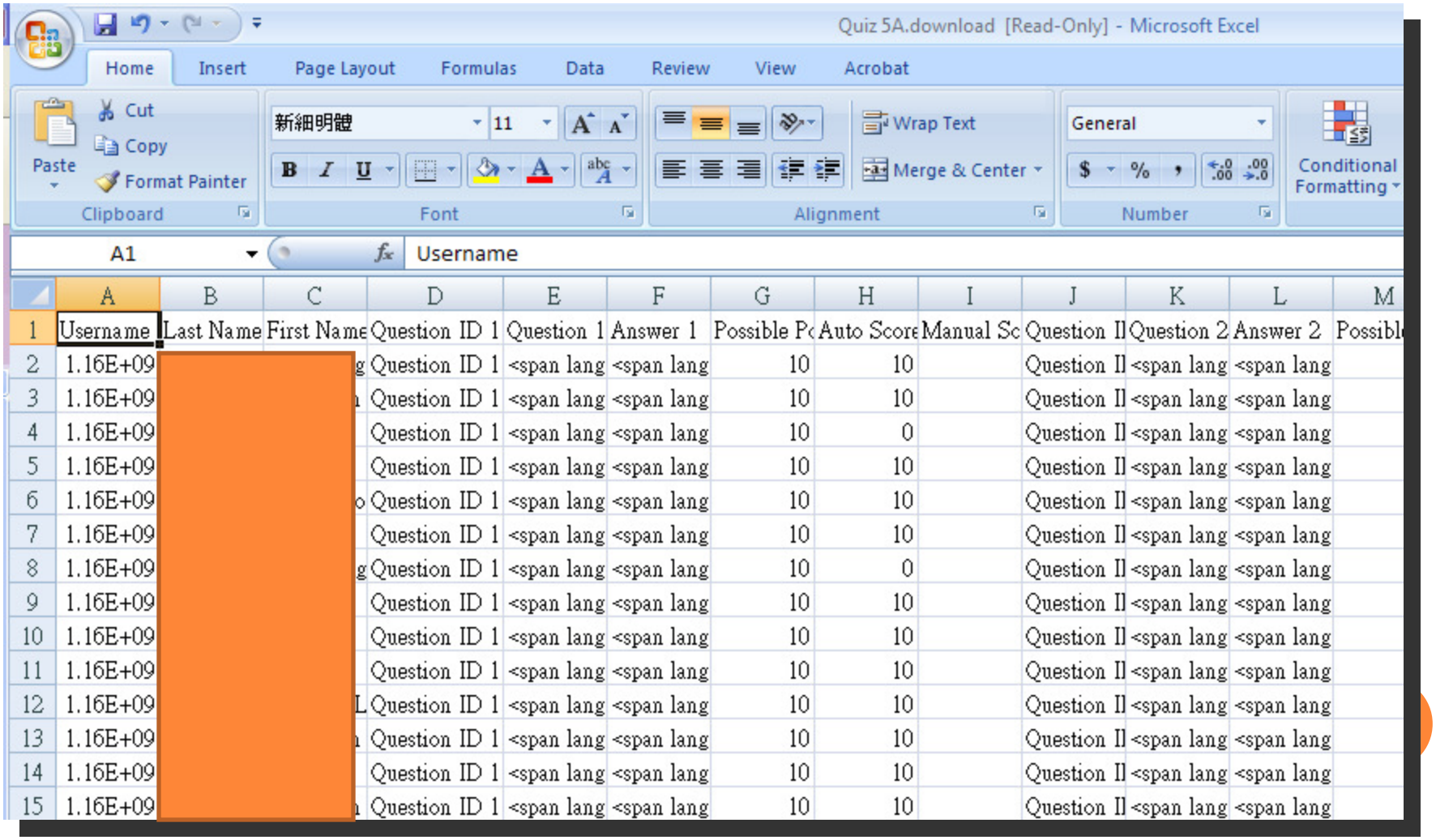
IMPROVEMENTS UNDERWAY: DETAILS OF STUDENTS' ANSWERS



IMPROVEMENTS UNDERWAY: DETAILS OF STUDENTS' ANSWERS

Results Summary in Excel Format

Not Reader Friendly



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Username	Last Name	First Name	Question ID 1	Question 1	Answer 1	Possible P	Auto Score	Manual Sc	Question II	Question 2	Answer 2	Possibl
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10	1.16E+09			Question ID 1	<span lang	<span lang	10	10		Question II	<span lang	<span lang	
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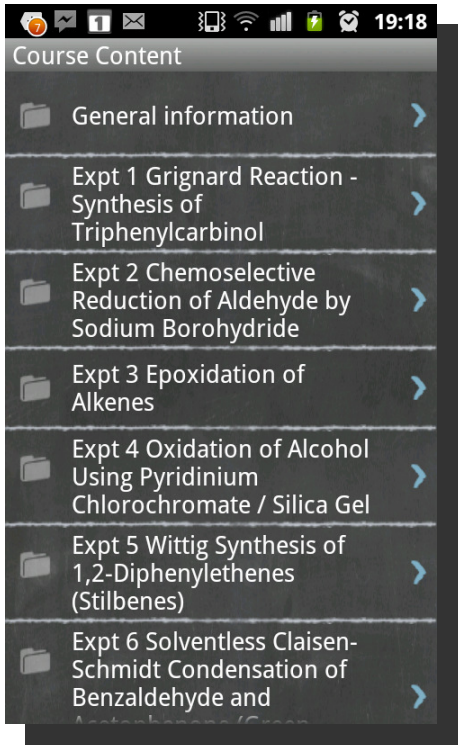
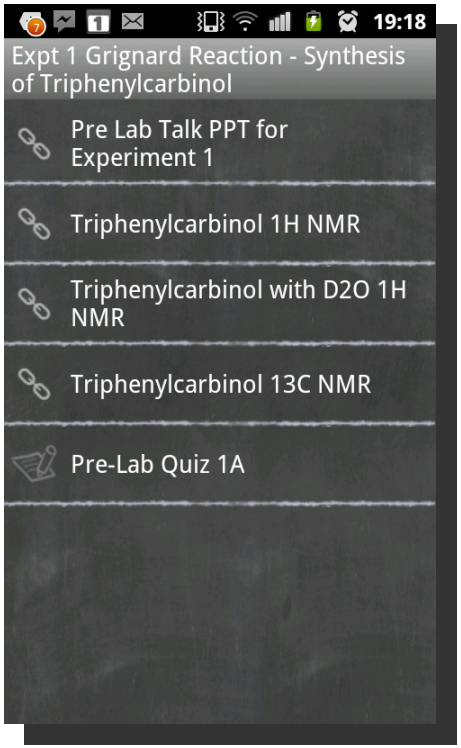
IMPROVEMENTS NEEDED: INTEGRATION WITH BLACKBOARD MOBILE



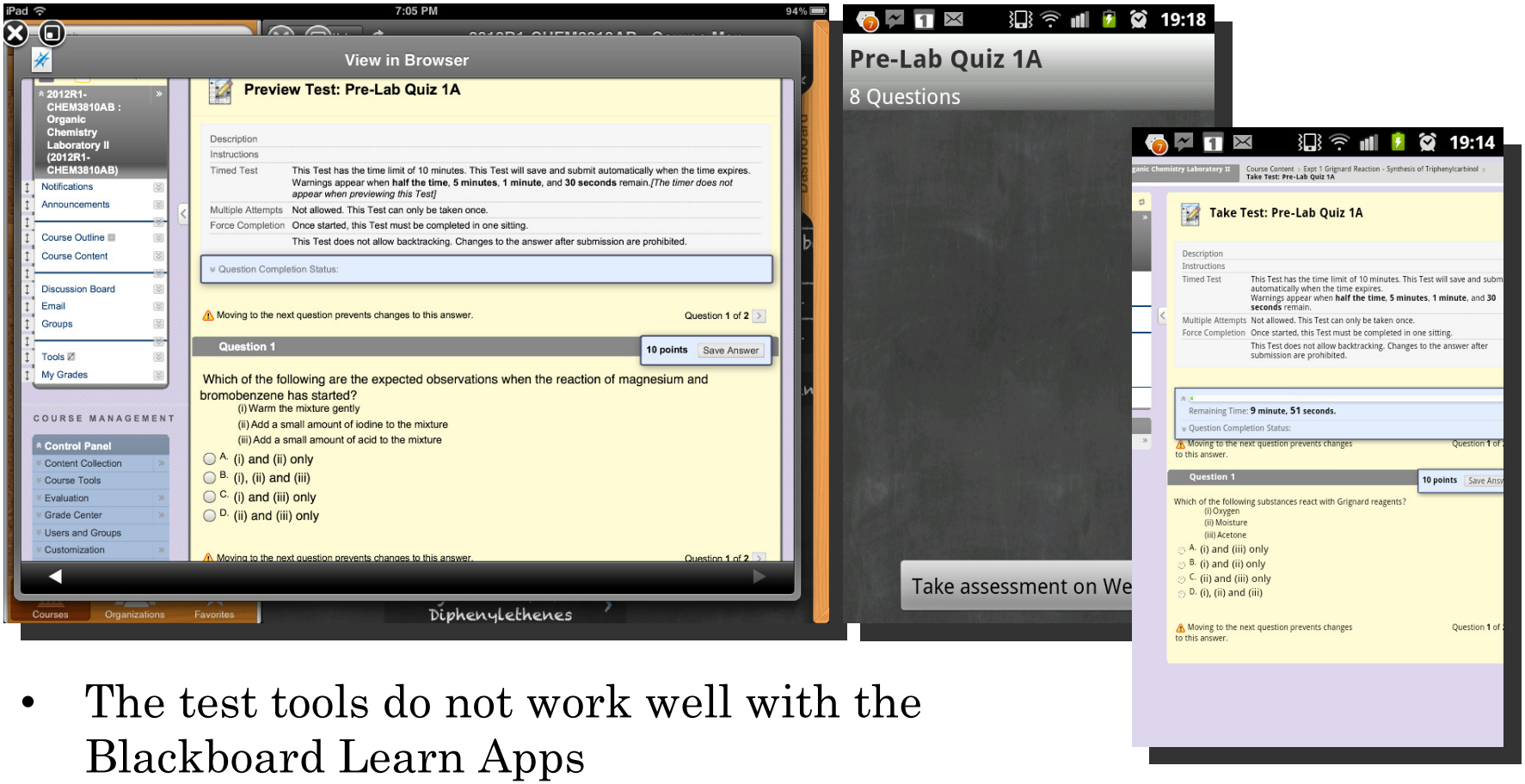


Android Phone

IMPROVEMENTS NEEDED: INTEGRATION WITH BLACKBOARD MOBILE

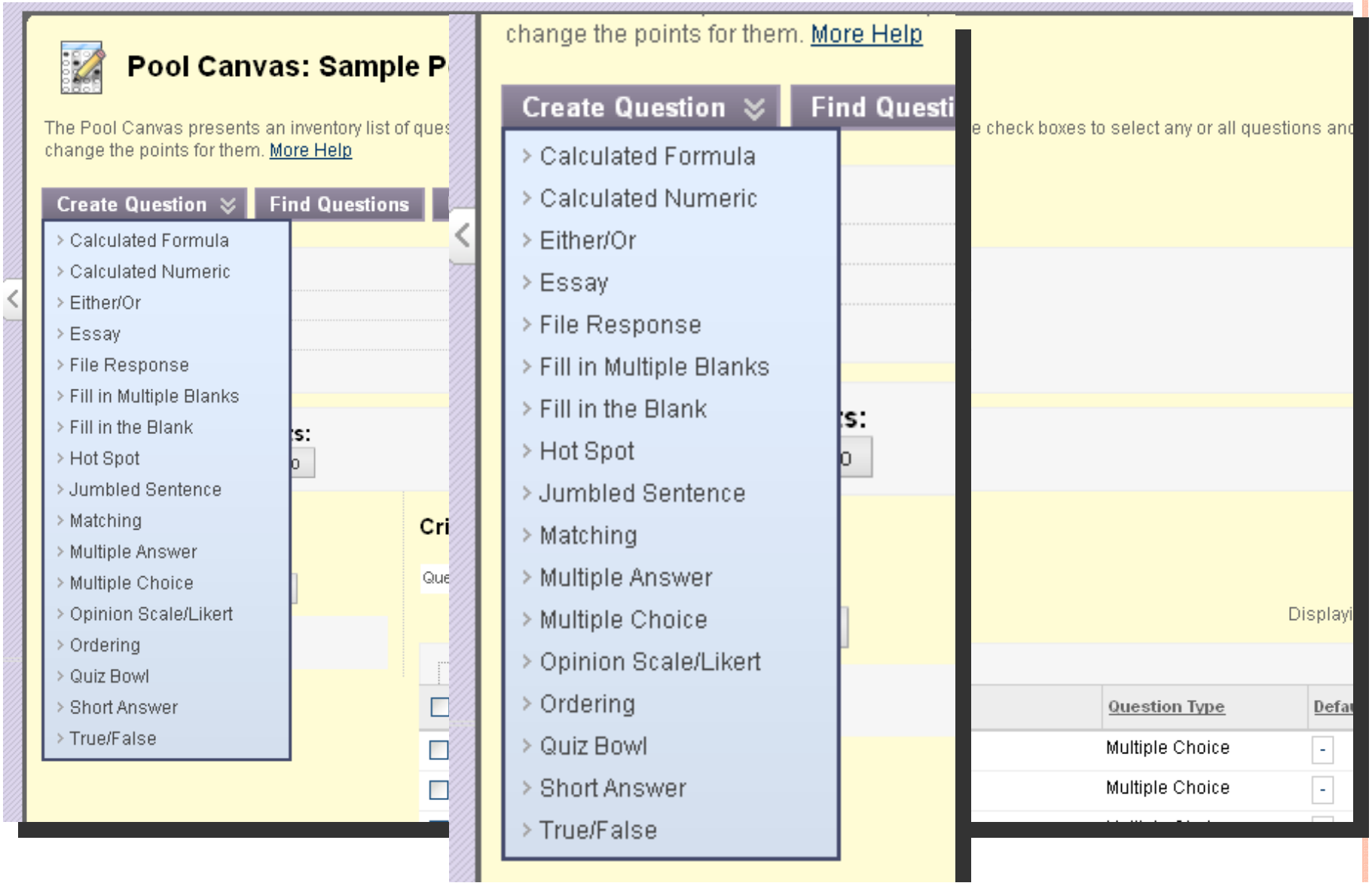
Blackboard Mobile for iPad

IMPROVEMENTS NEEDED: INTEGRATION WITH BLACKBOARD MOBILE



- The test tools do not work well with the Blackboard Learn Apps
- Redirect to the Web browser on iPad / iPhone / Android phones

FURTHER EXPLORATION – OTHER QUESTIONS TYPES?



SWITCHING THE QUIZ TO ONLINE : ADVANTAGES AND LIMITATIONS

Advantages

- Streamline the conduction of the quiz.
- Save some precious class time.
- Provide some flexibility to students.
- Encourage students to read the lab manual before they come. *(If they gave a wrong answer in the quiz, they may immediately look for the correct answer from the lab manual.)*

Limitations

- Feedbacks from TAs become more indirect and less timely.
- Difficult to control cheating *(sharing quiz questions and answers)*.
- Extra workload for Instructors and TAs to setup and maintain the online quiz system.
- The varieties of question types are less flexible.

POSSIBILITIES OF ADOPTION TO OTHER COURSES / ASSESSMENT METHODS?

- In-Class Quiz?
- In-Class Response System (like Clicker / uReply)?
- Pre-Lecture Reading Assignment?
- Post-Lecture Quiz?

- Thank You -