



# CBMS207

## Physical and Environmental Chemistry I

S1 Day 2017

*Dept of Chemistry & Biomolecular Sciences*

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#### **Disclaimer**

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

Unit Convenor

Ian Jamie

[ian.jamie@mq.edu.au](mailto:ian.jamie@mq.edu.au)

Contact via [ian.jamie@mq.edu.au](mailto:ian.jamie@mq.edu.au)

F7B 236

Anytime

Credit points

3

Prerequisites

CBMS101(Cr) or CBMS102

Corequisites

Co-badged status

Unit description

Environmental issues are of foremost concern in the world today. The environment depends on complex interactions of chemical and physical processes. In this unit these processes are explored through the study of the underlying principles that govern the properties and behaviour of chemical systems. Physical chemistry permeates all of modern chemistry and many adjoining areas such as biomolecular sciences, materials science and environmental science. Using environmental chemistry examples and contexts, we explore the what, why and how fast of chemistry: structure, energy and rate. These topics are examined in terms of the origin, transport and fate of chemicals in the biosphere, atmosphere, hydrosphere and lithosphere.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to

connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.

Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.

By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.

At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.

At the completion of this unit you will be able to demonstrate intermediate chemistry-laboratory skills and an understanding of general laboratory safety procedures.

At the completion of this unit you will be able to collect, record and analyse experimental data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Practicals</a>	20%	Yes	See "Description"
<a href="#">Assignments</a>	20%	No	Week 5, 10
<a href="#">In-Semester Tests</a>	10%	No	Week 6, Week 11
<a href="#">Final Examination</a>	50%	No	Examination Period

### Practicals

Due: **See "Description"**

Weighting: **20%**

**This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)**

Laboratory exercises are designed to provide a concrete example of the abstract topics covered in the course work, and to give you the opportunity to discover the principles and applications for yourself. Laboratory exercises also offer the opportunity to explore the uncertainty inherent in scientific investigations and the limitations of models and theories by allowing comparison with real systems. Practical s are composed of a laboratory session, in which an experiment is

conducted and data acquired (or a workshop in which data are given) and a practical report in which the acquired data is presented, along with manipulations of that data to provide information on a chemical process.

There are six practicals. Pracs 1 & 6 will be due on the day of the practical session. Pracs 2-5 will be due 14 days after the practical session, except if this falls in the mid-semester recess, in which case it will be due at your next practical session.

On successful completion you will be able to:

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
- Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.
- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.
- At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.
- At the completion of this unit you will be able to demonstrate intermediate chemistry-laboratory skills and an understanding of general laboratory safety procedures.
- At the completion of this unit you will be able to collect, record and analyse experimental data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## Assignments

Due: **Week 5, 10**

Weighting: **20%**

Two assignments will be issued.

Assignment questions are issued so that you will have the opportunity to use the information provided in the lectures and textbook to test your extent of understanding of those topics.

On successful completion you will be able to:

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
- Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.
- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.
- At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.
- At the completion of this unit you will be able to collect, record and analyse experimental data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## In-Semester Tests

Due: **Week 6, Week 11**

Weighting: **10%**

Two in-semester tests will be held after the first two major sections, Kinetics and Spectroscopy. The intention of these tests is to allow you to consolidate your learning of those sections of the course so that at the end of semester you will be able to concentrate your preparation for the final exam on the later sections of the course. The tests also provide you with a measure of your understanding of those sections and will direct you to areas that you need to spend more time on. They will be online tests.

On successful completion you will be able to:

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
- Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the

essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.

- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.
- At the completion of this unit you will be able to collect, record and analyse experimental data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## Final Examination

Due: **Examination Period**

Weighting: **50%**

The final examination will be 3 hours in length and will cover all sections of the unit (lectures, tutorials, assignments and laboratory exercises). You will be allowed to take with you a single double-sided A4, handwritten "study sheet".

If you apply for Disruption to Study for your final examination, you must make yourself available for the week of July 24 – 28, 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

On successful completion you will be able to:

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
- Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.
- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.
- At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.

- At the completion of this unit you will be able to demonstrate intermediate chemistry-laboratory skills and an understanding of general laboratory safety procedures.
- At the completion of this unit you will be able to collect, record and analyse experimental data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## Delivery and Resources

### Office Hours

There are no formal office hours for this unit. Dr Jamie is happy to receive students outside of the formal lecture and tutorial times but it is generally wise to organise an appointment in advance.

### Required and Recommended texts and/or materials

**Recommended Text Book:** For those continuing to CBMS307, we recommend that you obtain **Atkins & de Paula "Atkins' Physical Chemistry" 10<sup>th</sup> ed**, Oxford University Press (2014). The 9<sup>th</sup> edition is also acceptable.

For those students not continuing to CBMS307, the smaller text, **Atkins & de Paula "The Elements of Physical Chemistry", 7<sup>th</sup> ed**, Oxford University Press (2005) is suitable. The 5<sup>th</sup> and 6<sup>th</sup> editions are also acceptable.

**Recommended Supplementary Text:** The Library and the University Co-Op Bookshop carries copies of **Monk "Maths for Chemistry: a Chemist's Toolkit of Calculations"**. This text might be of use to you if you wish to revise some mathematics.

**Alternative Text Books:** Raymond Chang "Physical Chemistry for the Chemical and Biological Sciences", 3<sup>rd</sup> ed, University Science Books (2000) is reasonable, and somewhat more readable than "Atkins' Physical Chemistry", but a bit light in the spectroscopy section. Some students find "Physical Chemistry" by Alberty, Silbey and Bawendi provides readable introductions to some topics, but is less helpful when it comes to problem solving. The library also carries older editions without Bawendi as a co-author.

Your first-year textbook and lecture notes may be referred to in the lectures.

Summaries of lecture material, lecture guides or directions to web-based material may also be provided.

You can find a number of textbooks with "Physical Chemistry" in the title in the University library. All cover similar material, but often use different notation. You may find that some of these other books explain certain topics more clearly. Two older books that can provide an alternative introduction to aspects of molecular spectroscopy are "Fundamentals of Molecular Spectroscopy" by C.N. Banwell and "Introduction to Molecular Spectroscopy" by G. M. Barrow.

Text titled "Environmental Chemistry" or similar tend to be too broad with respect to the chemistry, so the depth of the discussions on the Physical Chemistry aspects tends to be restricted. However, good background information on the broader aspects of chemistry in the environmental context can be obtained from these texts.



There also many web resources, but material placed on the web is not necessarily checked for accuracy, so be careful when using it.

## **Technology Used**

It is important that you have a scientific calculator as hand-held calculators will be used in tutorials, practicals, for assignments, tests and, very importantly, in the final examination. Note that text-retrieval calculators are not allowed in the in-semester tests or final examination.

Use will be made of Excel and other data processing and display software. Computers carrying this software are available in the teaching laboratories. It would be wise to anticipate using Word or similar word-processing software to construct your practical reports.

A piece of software from Microsoft called Microsoft Mathematics might be of use. It is a sophisticated graphical calculator, equation solver and data provider. It can solve calculus problems and provide many of the commonly used equations, operations and constants. There is an add-on for Microsoft Windows (2007 and later). Do a web search using the search term "Microsoft Mathematics".

Students can install the Microsoft Office free-of-charge. See [http://students.mq.edu.au/events/2016/06/09/microsoft\\_suite\\_available\\_for\\_free/](http://students.mq.edu.au/events/2016/06/09/microsoft_suite_available_for_free/)

Items of interest, links to other on-line material and lecture notes will be placed on the unit website.

General use computers are provided by the University, but it would be advantageous to have your own computer and internet access. During lab sessions you will be using provided laptops or desktops computers to acquire, process and analyse data. Data processing and analysis will be done primarily with Excel. While it is not required, most students will want to generate their reports using a word processor. In some respects, hand-written reports will be easier to prepare, but it is your decision as to the method that you use.

## **Classes**

**Timetable:** Please check [www.timetables.mq.edu.au](http://www.timetables.mq.edu.au) for the official timetable of the unit.

**Lectures and Tutorials:** There will be some overlap between the lectures and tutorials, in that the lectures are expected to be interactive and have time for problem solving.

All of the material presented in the lectures is important and you should not assume that all examinable material is given in the textbook. On the other hand, do not assume that all examinable material is to be found in the lecture notes.

**Workshops and Laboratory Work:** The practical sessions commence in Week 2. The practicals are held in E7B 348/349/350. You will be allocated to an "A" or "B" Week group after Week 2, after which which your will attend mostly fortnightly, with some variation due to the mid-semester recess and end-of-semester scheduling requirements. The wet-labs will generally be considered to two-week exercises.. The first week is the "at-bench" component (running the experiment,



collecting data) and as much data processing as possible. The second week is used to continue your data analysis and complete the write-up. It may be possible to arrange for you to have access to the instruments and/or data, but it will not be possible for you to continue “wet-work” in the second week.

Before commencing a new experiment you are **required to complete the prelab questions**. All questions are to be answered on the worksheet provided with the prac notes and are to be signed-off by the demonstrator at the start of the lab class. A random subset of these questions is to be answered online as a iLearn quiz, to be completed no later than **one hour before** the commencement of the class. A delay in starting the experimental work due to poor pre-lab preparation may have a detrimental effect on your ability to perform the laboratory work satisfactorily. You should attempt the pre-lab exercises well in advance of each practical class. You are advised to read each experiment carefully.

The practical component is a "hurdle" requirement. You must complete the laboratory component of CBMS207 to a satisfactory level to be able to pass the unit overall. That is, the aggregate mark for your practical component must be 50% or greater to allow a pass mark to be awarded for the unit overall. Without appropriate medical or other permitted reasons for absence, an unattended practical session will result in a grade of zero being given for that practical as no practical report can be submitted. One missed practical, for valid reasons, will be allowed, in which case the mark given will be the average taken over the other practicals (including zero-mark practicals). If a practical was attended and a serious attempt made at both the laboratory component and the report, but the mark received was less than 50%, the report may be rewritten and resubmitted. The maximum mark then to be given will then be no greater than a credit-level mark. Students unable to attend laboratory classes due to illness or misadventure (as defined in the Handbook of Undergraduate Studies) and who are unable to catch up in another session must provide formal documentary evidence to the University as soon as possible after the absence. You will need to submit a “special consideration form”, information on which is given below.

It may be possible to rearrange your schedule if sufficient advance notice is given and if the reason for the rearrangement is reasonable. If the absence can be anticipated, such as for religious observance days and the like, it is your responsibility to discuss this with your lecturer *in advance* of the absence.

Some practical work may be undertaken before the corresponding material has been covered in lectures. The notes have been written with this in mind and some allowance will be made in the marking of reports.

**Due Date and Penalty for Late Submission:** Pracs 1 and 6 will be submitted in the day of your practical session. Pracs 2 to 5 will be due 14 days after the practical session, except if this falls in the mid-semester recess, in which case it will be due at your next practical session. You are permitted, and encouraged, to submit your reports early, especially towards the end of semester.

Penalties for late submission will accumulate at the rate of 10% per overdue day.

## Unit Schedule

### CBMS207 Schedule

This schedule may be altered according to circumstances.

**Lectures:** Check the times and rooms on the MQ Timetable page as these may have change after construction of this Unit Guide

Attend both lectures. Commence in Week 1

Wednesday, E5A 110, 10-11

Thursday, E3A 166, 9-10

Weeks 1-4: Kinetics

Weeks 5-9: Spectroscopy (Quantum Chemistry)

Weeks 10-11: Thermodynamics

Weeks 12-13: Transport and Fate of Chemicals in the Environment, Revision

**Tutorials:** Check the times and rooms on the MQ Timetable page as these may have change after construction of this Unit Guide

Commence in Week 2

*Choose one of*

Wednesday, C5A 232, 11-12

Thursday, E6A 131, 11-12

#### **Practicals:**

Commence in Week 2

*Choose one of*

Wednesday, E7B 347, 2-6 pm

Thursday, E7B 347, 2-6 pm

The following schedule may be changed to accommodate unforeseen circumstances. Changes will be notified via iLearn announcements and in lectures.

MQ Week	Week starting	Lecture 1- Wednesday	Lecture 2- Thursday	Tutorial	Assignment / In-Semester Tests	Wednesday Practical	Thursday Practical
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1	27-Feb-17	Introductions; Empirical Kinetics	Empirical Kinetics			-	-
2	6-Mar-17	Molecular Basis of Kinetics	Molecular Basis of Kinetics	Kinetics		Data Analysis W/ S	Data Analysis W/S
3	13-Mar-17	Reaction Mechanisms	Reaction Mechanisms	Kinetics		Kin 1 (Wed A)	Kin 1 (Thu A)
4	20-Mar-17	Photochemistry	Collision Theory	Kinetics		Kin 1 (Wed B)	Kin 1 (Thu B)
5	27-Mar-17	Principles of Spectroscopy	Principles of Spectroscopy	Spectroscopy	Assignment 1 Due	Kin 2 (Wed A)	Kin 2 (Thu A)
6	3-Apr-17	Rotational Spectroscopy	Rotational Spectroscopy	Spectroscopy	In-Semester Test 1	Kin 2 (Wed B)	Kin 2 (Thu B)
7	10-Apr-17	Vibrational Spectroscopy - Diatomics	Rotational Fine Structure & Polyatomics	Spectroscopy		Infrared (Wed A)	Infrared (Thu A)
	17-Apr-17	Recess	Recess	Recess		Recess	Recess
	24-Apr-17	Recess	Recess	Recess		Recess	Recess
8	1-May-17	Rotational Fine Structure & Polyatomics	UV-Visible Spectroscopy	Spectroscopy		Infrared (Wed B)	Infrared (Thu B)
9	8-May-17	UV-Visible Spectroscopy	NMR Spectroscopy	Spectroscopy		UV-Vis (Wed A)	UV-Vis (Thu A)
10	15-May-17	Thermodynamics	Thermodynamics	Thermodynamics	Assignment 2 Due	UV-Vis (Wed B)	UV-Vis (Thu B)
11	22-May-17	Thermodynamics	Thermodynamics	Thermodynamics	In-Semester Test 2		
12	29-May-17	Transport and Fate	Transport and Fate	Transport and Fate		Thermo W/ S (Wed A&B)	Thermo W/S (Thu A & B)
13	5-Jun-17	Transport and Fate	Revision	Transport and Fate		Thermo W/ S (Wed A&B)	Thermo W/S (Thu A & B)

## Learning and Teaching Activities

### Practicals

Laboratory exercises are designed to provide a concrete example of the abstract topics covered in the course work, and to give you the opportunity to discover the principles and applications for yourself. Laboratory exercises also offer the opportunity to explore the uncertainty inherent in scientific investigations and the limitations of models and theories by allowing comparison with real systems.

## Lectures/Tutorials

You are required to attend the lecture, tutorials and laboratory classes. You are expected to be active participants in all these fora. This means that you are expected to ask questions during lectures and, particularly, at tutorials and laboratory classes. Learning is an active process, and as such, you must engage with the material. This means reading the text book (and beyond) before and after lectures, attempting the assignment questions and other questions, discuss the concepts with your classmates and lecturers. Do not be afraid to ask questions – your classmates will probably want to ask the same thing.

## Assignments

Assignment questions are issued so that you will have the opportunity to use the information provided in the lectures and textbook to test your degree of understanding of those topics. The assignments are designed to help you learn the material during the semester, rather than trying to cram on the day before the examination. They are relatively low risk (a small component of the aggregate score) but they are very valuable for you as measures of your understanding of the topics.

## In-Semester Tests

The in-semester tests are designed to help you learn the material during the semester, rather than trying to cram on the day before the examination. They are relatively low risk (a small component of the aggregate score) but they are very valuable for you as measures of your understanding of the topics.

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

Assessment Policy [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://mq.edu.au/policy/docs/assessment/policy_2016.html)

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public [http://www.mq.edu.au/policy/docs/complaint\\_management/procedure.html](http://www.mq.edu.au/policy/docs/complaint_management/procedure.html)

Disruption to Studies Policy (in effect until Dec 4th, 2017): [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html)

Special Consideration Policy (in effect from Dec 4th, 2017): <https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration>

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of

Conduct: [https://students.mq.edu.au/support/student\\_conduct/](https://students.mq.edu.au/support/student_conduct/)

## Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit <ask.mq.edu.au>.

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## Learning Skills

Learning Skills (<mq.edu.au/learningskills>) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at <ask.mq.edu.au>

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

## Learning outcomes

- Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.
- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.
- At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.
- At the completion of this unit you will be able to demonstrate intermediate chemistry-laboratory skills and an understanding of general laboratory safety procedures.
- At the completion of this unit you will be able to collect, record and analyse experimental data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## Assessment tasks

- Practicals
- Assignments
- Final Examination

## Learning and teaching activities

- Laboratory exercises are designed to provide a concrete example of the abstract topics covered in the course work, and to give you the opportunity to discover the principles and applications for yourself. Laboratory exercises also offer the opportunity to explore the uncertainty inherent in scientific investigations and the limitations of models and theories by allowing comparison with real systems.
- You are required to attend the lecture, tutorials and laboratory classes. You are expected to be active participants in all these fora. This means that you are expected to ask questions during lectures and, particularly, at tutorials and laboratory classes. Learning is an active process, and as such, you must engage with the material. This means reading the text book (and beyond) before and after lectures, attempting the assignment questions and other questions, discuss the concepts with your classmates and lecturers. Do not be afraid to ask questions – your classmates will probably want to ask the same thing.

- Assignment questions are issued so that you will have the opportunity to use the information provided in the lectures and textbook to test your degree of understanding of those topics. The assignments are designed to help you learn the material during the semester, rather than trying to cram on the day before the examination. They are relatively low risk (a small component of the aggregate score) but they are very valuable for you as measures of your understanding of the topics.
- The in-semester tests are designed to help you learn the material during the semester, rather than trying to cram on the day before the examination. They are relatively low risk (a small component of the aggregate score) but they are very valuable for you as measures of your understanding of the topics.

## Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

### Learning outcome

- At the completion of this unit you will be able to demonstrate intermediate chemistry-laboratory skills and an understanding of general laboratory safety procedures.

### Assessment tasks

- Practicals
- In-Semester Tests
- Final Examination

### Learning and teaching activities

- Laboratory exercises are designed to provide a concrete example of the abstract topics covered in the course work, and to give you the opportunity to discover the principles and applications for yourself. Laboratory exercises also offer the opportunity to explore the uncertainty inherent in scientific investigations and the limitations of models and theories by allowing comparison with real systems.
- You are required to attend the lecture, tutorials and laboratory classes. You are expected to be active participants in all these fora. This means that you are expected to ask questions during lectures and, particularly, at tutorials and laboratory classes. Learning is an active process, and as such, you must engage with the material. This means reading



the text book (and beyond) before and after lectures, attempting the assignment questions and other questions, discuss the concepts with your classmates and lecturers. Do not be afraid to ask questions – your classmates will probably want to ask the same thing.

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## Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

### Learning outcomes

- Upon completion of this unit you will be able to solve problems in kinetics, quantum mechanics (spectroscopy), thermodynamics and chemical transport, by identifying the essential parts of, and formulating a strategy for solving, them. You will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.
- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.
- At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.
- At the completion of this unit you will be able to demonstrate intermediate chemistry-laboratory skills and an understanding of general laboratory safety procedures.
- At the completion of this unit you will be able to collect, record and analyse experimental

data, describing the numerical significance of experimental results and the source and significance of uncertainty in scientific investigations.

## Assessment tasks

- Practicals
- Assignments
- In-Semester Tests
- Final Examination

## Learning and teaching activities

- Laboratory exercises are designed to provide a concrete example of the abstract topics covered in the course work, and to give you the opportunity to discover the principles and applications for yourself. Laboratory exercises also offer the opportunity to explore the uncertainty inherent in scientific investigations and the limitations of models and theories by allowing comparison with real systems.
- You are required to attend the lecture, tutorials and laboratory classes. You are expected to be active participants in all these fora. This means that you are expected to ask questions during lectures and, particularly, at tutorials and laboratory classes. Learning is an active process, and as such, you must engage with the material. This means reading the text book (and beyond) before and after lectures, attempting the assignment questions and other questions, discuss the concepts with your classmates and lecturers. Do not be afraid to ask questions – your classmates will probably want to ask the same thing.
- Assignment questions are issued so that you will have the opportunity to use the information provided in the lectures and textbook to test your degree of understanding of those topics. The assignments are designed to help you learn the material during the semester, rather than trying to cram on the day before the examination. They are relatively low risk (a small component of the aggregate score) but they are very valuable for you as measures of your understanding of the topics.

## Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

## Learning outcomes

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
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- The in-semester tests are designed to help you learn the material during the semester, rather than trying to cram on the day before the examination. They are relatively low risk (a small component of the aggregate score) but they are very valuable for you as measures of your understanding of the topics.

## Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

### Learning outcomes

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measures of your understanding of the topics.

## Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

### Learning outcomes

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## Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## Learning outcomes

- By the unit's conclusion you will be able to discuss the use of models in developing theory and be able to critical analyse the strengths and weaknesses of the models used in the context of this unit.



- At the completion of this unit you will be able to communicate conclusions based on experiments in the form of written reports.
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## Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

## Learning outcomes

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
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## Assessment task

- Practicals

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## Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

## Learning outcomes

- At the completion of this unit you will be able to explain the underlying molecular and quantum processes relating to kinetics, quantum mechanics (spectroscopy) and thermodynamics, and their application to environmental areas. You will be able to connect these chemistry concepts to climate forcing, ozone depletion, transport and transformation of chemicals in the environment.
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## Assessment tasks

- Practicals
- Final Examination

## Learning and teaching activities

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## Changes from Previous Offering

There are no significant changes from the previous offering.

## Assessment Description

For many of your assessment items, you will be given a **Grade** rather than a **Mark**. This means that you will have a good indication of your achievements in the unit, but won't be tempted to look for "one mark more".

The Grades range from High Distinction to Fail, and are defined in the Handbook as follows:

Grade	Mark	Description
HD High Distinction	85-100	Work of outstanding quality. This may be demonstrated in areas such as criticism, logical argument, interpretation of materials or use of methodology. This grade may also be awarded to recognise a high order of originality or creativity in student performance
D Distinction	75-84	Work of superior quality in the same areas of performance as above. This grade may also be awarded to recognise particular originality or creativity in student performance
Cr Credit	65-74	Work of predominantly good quality, demonstrating a sound grasp of content together with efficient organisation, selectivity and use of techniques
P Pass	50-64	Satisfactory achievement of unit objectives
F Fail	0-49	Failure to achieve unit objectives.

## Unit Website and Facebook Group

### Unit web Site

The official CBMS207 website is on iLearn ([ilearn.mq.edu.au](http://ilearn.mq.edu.au))

You will be asked for a username and password. Your username is your student number.

If you have trouble logging in follow the help instructions given on the web page before contacting your lecturer academic staff. You may also contact the Help Desk:

Phone: 9850-HELP (4357)

Freecall: 1800 063 191

Email: <http://help.mq.edu.au/>

An unofficial Facebook group has been set up. The group name is “**CBMS207**”, with the e-mail address of **CBMS207@groups.facebook.com** and URL of “**www.facebook.com/groups/CBMS207**”. You are encouraged to use this for discussions relating the CBMS207 and exchanging information, but note that the group will be monitored by the unit convenor and also note that all official information and material will be placed on the iLearn site or conducted through your official Macquarie University email address. You will need to be invited into the group, so please send an e-mail to the group address or to the unit convenor. Include in the e-mail the e-mail address that you use to log into Facebook so that the invitation can be extended

to you.