



PHYS1020

Electric and Magnetic Interactions

Session 2, In person-scheduled-weekday, North Ryde 2026

School of Mathematical and Physical Sciences

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General Information

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Credit points

10

Prerequisites

PHYS1010

Corequisites

MATH1010 or MATH1015

Co-badged status

Unit description

This unit, following on from PHYS1010, provides an overview of physics primarily for students intending to study physics and astronomy beyond first year, but also suitable for those specialising in any of the sciences. As well as broadening their experience in classical Newtonian physics of matter and waves, and Maxwell's theory of electromagnetism, students are introduced to the main theories underlying modern physics: quantum mechanics, thermal physics, and Einstein's theory of relativity, with an emphasis on understanding the interrelationship between these fundamental ideas. PHYS1020 deals with electromagnetism, circuit theory, waves and diffraction, and the effects of special relativity. Fundamentals of experimental method and data analysis are taught in well-equipped laboratories using examples which support and complement the lecture course.

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:

- ULO1:** demonstrate an understanding of the basic concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- ULO2:** interpret and make predictions about physical situations in terms of electric and

magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.

ULO3: use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.

ULO4: interpret mathematically the basic properties of waves and describe the concept of wave-particle duality.

ULO5: perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.

ULO6: identify, record and explain sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis.

General Assessment Information

SGTAs and your Problem Solving Portfolio

SGTA attendance and engagement is very strongly recommended as it structures your self-led learning in the unit and creates the most efficient workflow for you to learn the material at the appropriate level.

Timing: Each week, during the scheduled SGTA time. SGTAs start in Week 1, and each one is 1 hour and 50 minutes long.

Weighting: The Problem Solving Portfolio, which is based on your self-led study working, your practice SGTA problems and quizzes, and self-reflection on your learning process and success, will be worth 20% of your mark for the unit.

Format: The Problem Solving Portfolio will be submitted electronically via iLearn in Week 9 and will represent a snapshot of your learning journey.

Your Problem Solving Portfolio is your record of your learning process in PHYS1020 and you will develop it as a natural record of your engagement in all non-laboratory aspects of the unit. It will represent a record of the approximately 65 hours of self-led study expected in the unit, plus any SGTA work you choose to include. You can record this portfolio in an exercise book or in electronic form, as you prefer, but it should be mostly hand-written. You will submit an electronic snapshot of your portfolio at the end of Week 9, which will be assessed and contribute 20% to your final result.

Each week you are scheduled for a 1 hour 50 min SGTA class. In this class you will work in small groups and progress through sets of problems related to the lecture content of that week. These problems will be posted on iLearn at the start of the week so you can look at them after the lectures, but before your SGTA class, and start thinking about how to solve them. Worked solutions to these problems will be posted at the end of the week. Your portfolio can include your solutions, and your self assessment of your relative success at these each week.

Within each SGTA there will be a formative 10 min quiz, which you will complete individually

under exam-type conditions. This quiz will consist of shortened exam-style questions on the week's topics, which will help you self-assess how you are progressing with your understanding of the content. We'll review each quiz as a group, and this feedback will assist you in modifying your approach to problem solving and learning the content of the unit. Your quizzes can be included in your portfolio, along with your self-assessment of your progress.

Between SGTA classes, during your approximately 65 hours of self-led study time, you should practice further problems (from the textbook, past exam papers, or other sources) and record these in your portfolio.

Your unit learning portfolio will be assessed against a rubric that covers aspects of consistent engagement in the unit, including steady progression in learning the content and developing your problem-solving skills in physics.

Regular attendance and participation in SGTAs is a critically important way for students to keep up with, and master, the material covered in lectures, as well as to develop their physics problem-solving skills.

Laboratory Work

Timing: During your scheduled laboratory session. See the lab schedule on iLearn for dates.

Weighting: Your laboratory work will be worth a total of 30% of your mark for the unit.

Format: Laboratory work will be recorded in a laboratory notebook.

Laboratory work entails hands-on practical activities that are undertaken during scheduled laboratory classes. There is an online induction module and safety quiz that needs to be completed in Week 1. It contains important work health and safety information. Students will also need to enrol in groups on iLearn so as to know which experiment to prepare for and complete in week 2. Lab books will be handed out in week 2. It is mandatory to complete the online module – you cannot do subsequent lab sessions until you do. The next nine lab sessions involve experimental work and will be assessed. Preparation is required for each of these lab sessions and you will find the Prelab activities in the Laboratory Resources section of iLearn. All laboratory work will be documented in the lab book provided to you. The teaching staff will assist you throughout each lab session, providing feedback, allocating “points” for pre-lab work, for demonstrating particular skills during class, and for the documentation in your lab book. The points will be recorded in your lab book after each class so that you can track your progress. You can earn up to 20 “points” for your work each lab session, and your final mark for the Laboratory work will be determined from these points. To achieve full marks you would need to attend all lab sessions and achieve 20 points in all nine practical lab sessions. Your laboratory work accounts for 30% of your final mark for the unit. **A limited number of catch-up labs will be offered for students who miss a lab session; it is NOT necessary to apply for Special Consideration if you miss a lab class.** The catch up classes will be held during the mid-session break, and towards the end of semester. A student can request no more than three catch up labs, via an online form on iLearn. Further details will be made available in the Lab Resources section of iLearn and during the first Lab session.

Final Examination

Timing: University Examination Period

Weighting: 50% of your mark for the unit.

Format: The Final Examination will be an invigilated written test.

You are expected to present yourself for examination at the time and place designated in the University Examination Timetable (<https://iexams.mq.edu.au/>).

The final examination will be three hours long and will cover content from the entire unit.

The use of calculators in examinations for this unit is permitted but, in accordance with the Faculty's policy, calculators with a full alphabet on the keyboard are not allowed.

If you receive [Special Consideration](#) for the final exam, a supplementary exam will be scheduled after the end of the normal exam period. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period, and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Late Assessment Submissions

For any late submission of assessments, please notify the convenor and apply for Special Consideration as soon as possible: <https://connect.mq.edu.au> (see below for more details). Unless a Special Consideration request has been submitted and approved, late submissions / late work will not be accepted:

- **Problem-Solving Portfolio** – Late submissions of the Problem-Solving Portfolio will not be accepted without Special Consideration.
- **Laboratory Work** - Laboratory Work not completed by the end of Week 13 will not receive marks without Special Consideration. You do not need to apply for special consideration to request to make up a missed lab session.

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through <https://connect.mq.edu.au>.

Assessment Tasks

Name	Weighting	Hurdle	Due	Groupwork/Individual	Short Extension	AI Approach
Problem-solving portfolio	20%	No	09/10/2026	Individual	Yes	Open
Final Exam	50%	No	As advised through the Exams Timetable.	Individual	No	Observed
Laboratory work	30%	No	30/10/2026	Individual	No	Observed

Problem-solving portfolio

Assessment Type ¹: Portfolio

Indicative Time on Task ²: 10 hours

Due: **09/10/2026**

Weighting: **20%**

Groupwork/Individual: Individual

Short extension ³: Yes

AI Approach: Open

A set of SGTA-style problem that focus on problem-solving skills

On successful completion you will be able to:

- demonstrate an understanding of the basic concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- interpret and make predictions about physical situations in terms of electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
- use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.
- interpret mathematically the basic properties of waves and describe the concept of wave-particle duality.

Final Exam

Assessment Type ¹: Examination

Indicative Time on Task ²: 20 hours

Due: **As advised through the Exams Timetable.**

Weighting: **50%**

Groupwork/Individual: Individual

Short extension ³: No

AI Approach: Observed

You will undertake a final examination during the formal examination period.

On successful completion you will be able to:

- demonstrate an understanding of the basic concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- interpret and make predictions about physical situations in terms of electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
- use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.
- interpret mathematically the basic properties of waves and describe the concept of wave-particle duality.

Laboratory work

Assessment Type ¹: Experiential task

Indicative Time on Task ²: 10 hours

Due: **30/10/2026**

Weighting: **30%**

Groupwork/Individual: Individual

Short extension ³: No

AI Approach: Observed

Assessment of in-lab record of experimental activities, as well as any prelab work.

On successful completion you will be able to:

- perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.
- identify, record and explain sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis.

¹ If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- [Academic Success](#) for academic skills support.

² Indicative time-on-task is an estimate of the time required for completion of the assessment

task and is subject to individual variation.

³ An automatic short extension is available for some assessments. Apply through the [Service Connect Portal](#).

Delivery and Resources

Required and Recommended Texts and/or Materials

Textbook

Matter and Interactions by Ruth Chabay and Bruce Sherwood.

Either Volume 2 (Paperback) or the combined Volume (hardbound). Note that Volume 1 is the required text for PHYS1010 in semester 1.

Web Resources

More information on the required text as well as additional resource material can be found at <http://www.matterandinteractions.org/>

There are also other high quality learning resources on the web which we would recommend to you to use in your studies. The HyperPhysics site hosted by the Department of Physics and Astronomy at Georgia State University is widely acclaimed and used. The site also has mathematics learning resources on the maths used in physics.

<http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html> (Mechanics, and, Electricity & Magnetism).

Increasingly there are excellent web-based interactive simulations available – some are in the on-line resources that support the textbook. We encourage you to conduct your own web searches for others, and to develop your own critical judgment of which sites provide high quality resources that assist your learning. Two that we recommend to you are:

- <http://www.explorellearning.com/> The Explorelearning Gizmos: follow links to Grade 9-12, Physics, Motion and Force; and Electricity & Magnetism. You will have to register to use this site.
- http://phet.colorado.edu/simulations/index.php?cat=Featured_Sims The University of Colorado, Boulder, Physics Education Technology (PhET) Simulations: follow the links to Motion; Energy, Work & Power; and Electricity, Magnets and Circuits. This site also contains maths resources, for example vector addition.

Technology Used and Required

Lecture notes, SGTA (Small Group Teaching Activity) questions and answers, weekly exercises, and other resources will be posted on the PHYS1020 iLearn site.

Learning and Teaching Strategy

This unit is taught through lectures and SGTA (Small Group Teaching Activities) and through undertaking laboratory experiments. We strongly encourage students to attend lectures because they provide a much more interactive and effective learning experience than studying a text book; **this is the most efficient way to learn the material to sufficient level**. The lecturer is

able to interpret the physics that you will be learning, showing you the relationships between different components/concepts and emphasising the key physics principles involved. Questions during and outside lectures are strongly encouraged in this unit - please do not be afraid to ask, as it is likely that your classmates will also want to know the answer. You should aim to read the relevant sections of the textbook before and after lectures and discuss the content with classmates and lecturers.

This unit includes an experimental (skills) component. The experiments are stand-alone investigations and may include topics not covered by the lecture content of this course - they are an important part of the learning for this unit and the skills learned are essential for a well-rounded physics graduate.

You should aim to spend an average of 3 hours per week understanding the material and working on the SGTA problems and exercises. Attempting SGTA questions and weekly exercises is one of the key learning activities for this unit. It is by applying knowledge learned from lectures and textbooks to solve problems that you are best able to test and develop your skills and understanding of the material.

As mentioned, there are many useful web resources on this material and we encourage you to seek out youtube videos on electromagnetism and other resources. However, while reading over the lecture notes and reading the textbook are very important, reading notes and watching physics videos are passive learning activities. It is critical that a substantial portion of your study time in physics is devoted to active learning strategies by attempting numerous problems from the text, SGTA, assignments and past exams. It is simply impossible to become adept in this subject by *watching* physics problems, you must *do* physics problems.

Unit Schedule

Lectures:

There are two lectures per week, as timetabled. Lectures follow the chapters from Volume II of the textbook Matter and Interactions.

Week 1: The electric field

Week 2: Electric fields in matter

Week 3: Electric fields of distributed charges

Week 4: Electric potential

Week 5: Electric field and circuits

Week 6: Circuit elements

Week 7: Magnetic field

Week 8: Magnetic force

Week 9: Patterns of field in space

Week 10: Faraday's law

Week 11: Electromagnetic radiation

Week 12: Waves and particles

Week 13: Revision

SGTAs

You should attend the timetabled SGTA (Small Group Teaching Activity) each week.

Labs

Refer to the Laboratory Practical section.

Policies and Procedures

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

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Assessment Procedure](#)
- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

Students seeking more policy resources can visit [Student Policies \(https://students.mq.edu.au/support/study/policies\)](https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit [Policy Central \(https://policies.mq.edu.au\)](https://policies.mq.edu.au) and use the [search tool](#).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/admin/other-resources/student-conduct>

Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) 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 connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

Student Support

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

Academic Success

[Academic Success](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Ask a Study Coach](#)
- [Access StudyWISE](#)
- [Upload an assignment to Studiosity](#)
- [Complete the Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

Student Services and Support

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study
- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)
- [Student Advocacy](#) provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the [Service Connect Portal](#), or contact [Service Connect](#).

IT Help

For help with University computer systems and technology, visit <https://students.mq.edu.au/support/technology/service-desk>.

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.

Unit information based on version 2026.02 of the [Handbook](#)