Grade 10
Electricity/Electronics Technology (20G)
A Course for Independent Study
## Contents

**Acknowledgements**

**Introduction**

Overview

What Will You Learn in This Course?

How Is This Course Organized?

What Resources Will You Need for This Course?

Who Can Help You With This Course?

How Will You Know How Well You Are Learning?

How Much Time Will You Need to Complete This Course?

When and How Will You Submit Completed Assignments?

How Do You Send In Your Assignments?

What Are the Guide Graphics For?

Module Cover Sheets

**Module 1: Introduction to Electronics**

Module 1 Introduction

Lesson 1: Electricity: Let’s Get Started

Lesson 2: How Electricity Is Produced

Lesson 3: A Brief History of Electronics

Lesson 4: How to Solder

Lesson 5: Practice Solder Board

Lesson 6: Careers in Electronics

Module 1 Summary

**Module 1 Learning Activity Answer Keys**
**Module 2: The Basics of Electricity**

- Module 2 Introduction
- Lesson 1: The Atom and Electronics
- Lesson 2: How a Solderless Circuit Board Works
- Lesson 3: Identifying Electronic Component Parts
- Lesson 4: Schematic Diagrams
- Lesson 5: Metrification and Conversion of SI Units
- Lesson 6: Resistors
- Module 2 Summary

*Module 2 Learning Activity Answer Keys*

**Module 3: Capacitors and Semiconductors**

- Module 3 Introduction
- Lesson 1: Capacitors
- Lesson 2: Semiconductors
- Lesson 3: The Diode
- Lesson 4: Transistors
- Lesson 5: Project 1: The Decision Maker
- Module 3 Summary

*Module 3 Learning Activity Answer Keys*

**Module 4: Ohm’s Law and Circuit Fundamentals**

- Module 4 Introduction
- Lesson 1: Ohm’s Law
- Lesson 2: Watt’s Law
- Lesson 3: Series Circuits
- Lesson 4: Parallel Circuits
- Lesson 5: Capacitors in Series
- Module 4 Summary

*Module 4 Learning Activity Answer Keys*
Acknowledgements

Manitoba Education and Advanced Learning gratefully acknowledges the contributions of the following individuals in the development of *Grade 10 Electricity/Electronics Technology (20G): A Course for Independent Study*.

<table>
<thead>
<tr>
<th>Writer</th>
<th>Development Team</th>
</tr>
</thead>
</table>
| Brad Badiuk | Kinvel High School  
Winnipeg School Division |
| Don Thiessen | Carman Collegiate  
Prairie Rose School Division |
| Bill Sveinson | Daniel McIntyre Collegiate  
Winnipeg School Division |
| Tony Michaluk | Maples Collegiate  
Seven Oaks School Division |
| Raphael Masi | Murdoch MacKay Collegiate  
River East Transcona School Division |

<table>
<thead>
<tr>
<th>Revision Team Member</th>
</tr>
</thead>
</table>
| Gary Yakimowski | Sturgeon Heights Collegiate  
St. James-Assiniboia S.D. |
| Louise Boissonneault | Document Production Services Unit  
Educational Resources Branch |

<table>
<thead>
<tr>
<th>Manitoba Education and Advanced Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Programs Division Staff</td>
</tr>
</tbody>
</table>
| Marianne Fenn | Distance Learning Unit  
Instruction, Curriculum and Assessment Branch |
| Lynn Harrison | Document Production Services Unit  
Educational Resources Branch |
| Myrna Klassen | Distance Learning Unit  
Instruction, Curriculum and Assessment Branch |
| Gilles Landry | Development Unit  
Instruction, Curriculum and Assessment Branch |
| Susan Lee | Distance Learning Unit  
Instruction, Curriculum and Assessment Branch |
| Grant Moore | Document Production Services Unit  
Educational Resources Branch |
| Ken Nimchuk | Learning Support and Technology Unit  
Instruction, Curriculum and Assessment Branch |
| Cheryl Prokopanko | Learning Support and Technology Unit  
Instruction, Curriculum and Assessment Branch |
Introduction
Introduction to the Course

Overview

Welcome to Grade 10 Electricity/Electronics Technology!

As a student enrolled in a distance learning course, you have taken on a dual role—that of a student and a teacher. As a student, you are responsible for mastering the lessons and completing the learning activities and assignments. As a teacher, you are responsible to check your work carefully, noting areas in which you need to improve and motivating yourself to succeed.

In this course, you will study and learn the basics of electricity and electronics, including the following specific topics:

- How electricity plays a vital role in our lives
- The importance of electricity and electronics
- Important electronics terms
- Proper procedures for using tools and equipment
- Careers and jobs in the electronics field
- Health and safety issues when working with electronics
- How to read and interpret schematic diagrams
- How to use appropriate terminology for electricity or electronics
- How to design and/or build circuits to an acceptable standard capable of producing a desired output
- How to demonstrate the safe use and knowledge of meters and hand tools used in the electrical industry
- How to read and interpret meter readings
- How to test and evaluate the integrity of electrical and electronic components
- How to find out about post-secondary programs in the electrical and electronics fields

Electronics play a huge part in our everyday lives. You may not realize it, but just about everywhere you go and everything you do involves using electronics in some shape or form. For example, when you are travelling to and from school, the vehicle you are in is made up of various forms of electronics to make your automobile work. Listening to music on a radio, CD player, MP3 media player, or a computer involves electronics, and that music is recorded with electronic devices. While driving, you can see hydro lines carrying electricity to houses and other buildings. It’s everywhere! In this day and age of technology, our lives are driven greatly by electronics.
We rarely stop to think of the role the electronic devices we use play in our lives. When we use that cordless phone or mobile phone to call up our friends, when we log onto the computer to check our email, and when we watch our favourite shows on television, we are using electronics. It is amazing when you actually consider all the electronic devices we use on a daily basis. You may be forced to notice it when the power in your area goes out and all of a sudden everything goes dark and there’s not much to do! Electronics seem to make our lives a whole lot easier and much more exciting.

Electronic devices seem to be constantly evolving and improving. The record player evolved to a cassette tape player, then the CD player, and now a hard disc or solid state form of electronic equipment called an MP3 player. Video recording went from the VCR to the DVD player, and now we are able to pause and instantly replay live television using a hard disk or Personal Video Recorder (PVR) device. Sound systems for home entertainment grew from stereo systems with two speaker outputs to surround sound systems with up to six different channels of sound output.

Electronics are used everywhere—in our homes, for law enforcement and rescue units, for government business, all the way to traffic signals and emergency response systems. We have become so dependent on them, it would now be extremely difficult for us to live without them. But if you went back in time only 200 years, there would be no electronics whatsoever.

What Will You Learn in This Course?

In each lesson, you will read a few pages and then complete a learning activity and/or assignment. Some lessons may require you to do some investigative research or observation work in the community. The course is made up of the following five modules:

Module 1: Introduction to Electronics
Module 2: The Basics of Electricity
Module 3: Capacitors and Semiconductors
Module 4: Ohm’s Law and Circuit Fundamentals
Module 5: Magnetism and Induction
How Is This Course Organized?

Each module in this course is made up of several lessons, which are organized as follows:

- **Introduction**: Each lesson begins by outlining what you will be learning.
- **Power Words**: Throughout this course you will be introduced to words that will increase your electronics vocabulary. These words are called “power words.” Each power word will be in bold and the definition for each word can be found in the glossary at the end of the booklet. You should be able to define and/or explain these words when you have completed this course.
- **Lesson**: The main body of the lesson is made up of the content that you need to learn. It contains explanations, diagrams, and fully completed examples.
- **Summary**: Each lesson ends with a brief review of what you just learned.
- **Learning Activities**: Most lessons have a learning activity. These include questions that you should complete in order to help you practise or review what you have just learned. Once you have completed a learning activity, you should check your answers with the answer key provided at the end of the module.
- **Assignments**: Assignments are found at the end of lessons. You will mail or electronically submit all of your completed assignments to your tutor/marker for assessment.
- **Projects**: You will be completing and sending in two hand-in projects. The two projects must be mailed to your tutor/marker for assessment.

What Resources Will You Need for This Course?

You do not need a textbook for this course. All the content is provided directly within the course. You will, however, need access to a variety of resources.

**Grade 9/10 Electronics Video**

You will have the opportunity to view the Grade 9/10 Electronics video, which is available on the distance learning unit website at <www.edu.gov.mb.ca/k12/dl/iso/av.html>. If you need a copy of the video on DVD, please contact the ISO Office.
Grade 10 Electricity Kit

You will need the Grade 10 Electricity Kit to complete this course. If you have not ordered it, contact the Manitoba Text Book Bureau at <www.mtbb.mb.ca> or telephone 1-866-771-6822. Please note that there are two options when purchasing the Grade 10 Electricity Kit. If you took the Grade 9 course, you may already have the seven items from the tool kit, or you may have access to them at home/school for another reason. If you have access to these seven items, you would order kit #13193. If you require all the supplies for this course, you would order kit #13194.

If items in the kit are not in working order, contact the Manitoba Text Book Bureau for replacement parts.

Each student needs to purchase his or her own Grade 10 Electricity Kit, as group submissions for projects and assignments will not be accepted. A list outlining all components found in the Grade 10 Electricity Kit can be found on the following two pages.

Other Supplies/Requirements

- Safe work area with 120-volt, 15-amp power supply
- Calculator
- 9-volt batteries

Variations in Components and Tools

Components and tools in the Electricity Kit might or might not be identical to those described or shown in the course and video. This is common in the electronics industry, where manufacturers often modify components and tools in order to improve them. It is also possible the kit suppliers have had to purchase the components and parts from new manufacturers, which may account for a change from time to time.

People in the electronics industry often face this challenge. It will give you the chance to practice your critical thinking skills to work around it. Troubleshooting skills are an essential part of working in the electronics industry and of life in general. If your components or tools are slightly different from the ones shown in the course or video, be assured that they work in the same way but they just look slightly different.
Online Resources

Visit <www.careercruising.com>. The user ID and password to access this website is provided in Assignment 1.4.

Optional Resources

1. Access to a **computer with Internet** would be beneficial but is not compulsory.
2. Access to a **word processor**, such as Microsoft Word, which will let you write your assignments, that you can later attach to your email to send in for assessment.
3. Access to a computer and **an email account**, which allows you to email your assignments to the Independent Study option office. Instructions on how to email assignments to your tutor/marker are found later in this introduction.
### MTBB #13194
**Electricity Kit with Tool Kit**

<table>
<thead>
<tr>
<th>Tool Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>digital multimeter (DMM)</td>
</tr>
<tr>
<td>wire strippers</td>
</tr>
<tr>
<td>needle-nose pliers</td>
</tr>
<tr>
<td>diagonal/side cutters</td>
</tr>
<tr>
<td>soldering iron</td>
</tr>
<tr>
<td>soldering iron stand w/cleaning sponge</td>
</tr>
<tr>
<td>safety glasses</td>
</tr>
<tr>
<td>solder</td>
</tr>
</tbody>
</table>

### MTBB #13193
**Electricity Kit without Tool Kit**

Students need access to the Tool Kit items but have access to these items either at home or at school.

These are the same seven items that are found in the Grade 9 Electricity Kit.

### Project Kit 1

**electrolytic capacitor**
- 1 green LED
- 1 red LED
- 2 – 1.0 uF electrolytic capacitors
- 1 – 50 k ohm trimmer resistor (a smaller version of a potentiometer)
- 2 – 33 k resistors (orange, orange, orange, gold)
- 2 – 430 ohm resistors (yellow, orange, brown, gold)
- 3 – 2W3906 transistors
- 9-volt battery clip
- project circuit board
- solder
- 2 touch wires

**Project Kit 1**

**electrolytic capacitor**
- 1 green LED
- 1 red LED
- 2 – 1.0 uF electrolytic capacitors
- 1 – 50 k ohm trimmer resistor (a smaller version of a potentiometer)
- 2 – 33 k resistors (orange, orange, orange, gold)
- 2 – 430 ohm resistors (yellow, orange, brown, gold)
- 3 – 2W3906 transistors
- 9-volt battery clip
- project circuit board
- solder
- 2 touch wires

### Project Kit 2

**1 – 0.047 uF capacitor**
- 1 – 10 k ohm resistor
- 1 – 100 ohm resistor
- 1 – 555 timer chip (I.C.)
- 1 – 4017 chip (I.C.)
- 5 green LEDs
- 2 – IC sockets
- 2 braided wires
- 2 touch pad circuit boards
- 9-volt battery clip

**Project Kit 2**

**1 – 0.047 uF capacitor**
- 1 – 10 k ohm resistor
- 1 – 100 ohm resistor
- 1 – 555 timer chip (I.C.)
- 1 – 4017 chip (I.C.)
- 5 green LEDs
- 2 – IC sockets
- 2 braided wires
- 2 touch pad circuit boards
- 9-volt battery clip

(continued)
<table>
<thead>
<tr>
<th><strong>MTBB #13194</strong></th>
<th><strong>MTBB #13193</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity Kit with Tool Kit</strong></td>
<td><strong>Electricity Kit without Tool Kit</strong></td>
</tr>
<tr>
<td>Experiment Kit</td>
<td>Experiment Kit</td>
</tr>
<tr>
<td>1 solderless circuit board</td>
<td>1 solderless circuit board</td>
</tr>
<tr>
<td>2 solid hook-up wires</td>
<td>2 solid hook-up wires</td>
</tr>
<tr>
<td>1 photocell</td>
<td>1 photocell</td>
</tr>
<tr>
<td>9-volt battery clip</td>
<td>9-volt battery clip</td>
</tr>
<tr>
<td>2 LEDs (red)</td>
<td>2 LEDs (red)</td>
</tr>
<tr>
<td>diode (1N4005)</td>
<td>diode (1N4005)</td>
</tr>
<tr>
<td>SPST slide switch</td>
<td>SPST slide switch</td>
</tr>
<tr>
<td>potentiometer (10 k)</td>
<td>potentiometer (10 k)</td>
</tr>
<tr>
<td>100 uF electrolytic capacitor</td>
<td>100 uF electrolytic capacitor</td>
</tr>
<tr>
<td>1000 uF electrolytic capacitor</td>
<td>1000 uF electrolytic capacitor</td>
</tr>
<tr>
<td>2N3904 WPN transistor</td>
<td>2N3904 WPN transistor</td>
</tr>
<tr>
<td>silicon controlled rectifier (SCR)</td>
<td>silicon controlled rectifier (SCR)</td>
</tr>
<tr>
<td>7 segment display (common anode)</td>
<td>7 segment display (common anode)</td>
</tr>
<tr>
<td>1 – 100 ohm resistor</td>
<td>1 – 100 ohm resistor</td>
</tr>
<tr>
<td>1 – 220 ohm resistor</td>
<td>1 – 220 ohm resistor</td>
</tr>
<tr>
<td>1 – 1 k ohm resistor</td>
<td>1 – 1 k ohm resistor</td>
</tr>
<tr>
<td>1 – 330 ohm resistor</td>
<td>1 – 330 ohm resistor</td>
</tr>
<tr>
<td>1 – 5.6 k ohm resistor</td>
<td>1 – 5.6 k ohm resistor</td>
</tr>
<tr>
<td>1 extra LED</td>
<td>1 extra LED</td>
</tr>
<tr>
<td><strong>Practice Solder Kit</strong></td>
<td><strong>Practice Solder Kit</strong></td>
</tr>
<tr>
<td>1 spool of solder</td>
<td>1 spool of solder</td>
</tr>
<tr>
<td>330 ohm resistor</td>
<td>330 ohm resistor</td>
</tr>
<tr>
<td>1 piece of printed circuit board</td>
<td>1 piece of printed circuit board</td>
</tr>
<tr>
<td>3 solid hook-up wires</td>
<td>3 solid hook-up wires</td>
</tr>
<tr>
<td>LED</td>
<td>LED</td>
</tr>
<tr>
<td>SPST switch</td>
<td>SPST switch</td>
</tr>
<tr>
<td>9-volt battery clip</td>
<td>9-volt battery clip</td>
</tr>
<tr>
<td><strong>Miscellaneous Resistor Bag</strong></td>
<td><strong>Miscellaneous Resistor Bag</strong></td>
</tr>
<tr>
<td>100 ohms</td>
<td>100 ohms</td>
</tr>
<tr>
<td>330 ohms</td>
<td>330 ohms</td>
</tr>
<tr>
<td>1000 ohms</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>220 ohms</td>
<td>220 ohms</td>
</tr>
<tr>
<td>5.6 k ohms</td>
<td>5.6 k ohms</td>
</tr>
<tr>
<td>6.8 k ohms</td>
<td>6.8 k ohms</td>
</tr>
<tr>
<td>6.8 ohms</td>
<td>6.8 ohms</td>
</tr>
<tr>
<td>10 k ohms</td>
<td>10 k ohms</td>
</tr>
<tr>
<td>1 M ohms</td>
<td>1 M ohms</td>
</tr>
<tr>
<td>20 k ohms</td>
<td>20 k ohms</td>
</tr>
</tbody>
</table>

It should be noted that manufacturers periodically change the design of their product and, as a result, the items in your kit may differ in some way from the illustrations in this document. This applies only to appearance and does not affect the use or strength of any of the items.
Inventory Time!
Let’s go through your kit and make sure you have the following tools and equipment.

Basic Electronics Tools

Diagonal/side cutters

Needle-nose pliers

Wire strippers

Soldering iron with holder and cleaning sponge

Note: Parts and tools in the kit might not be identical to those described in the course or on the video.
Solder (rosin core)

Safety glasses

Solderless circuit board

Digital multimeter (DMM)

**Note:** Parts and tools in the kit might not be identical to those described in the course or on the video.
Experiment Kit

Project Kits 1 and 2

Practice Solder Kit

Miscellaneous Resistor Bag

**Note:** Parts and tools in the kit might not be identical to those described in the course or on the video.
Who Can Help You with This Course?

Taking an independent study course is different from taking a course in a classroom. Instead of relying on the teacher to tell you to complete a learning activity or an assignment, you must tell yourself to be responsible for your learning and for meeting deadlines. There are, however, people who can help you be successful in this course: your tutor/marker and your learning partner.

Your Tutor/Marker

Tutor/markers are experienced educators who tutor Independent Study Option (ISO) students and mark assignments and examinations. When you are having difficulty with something in this course, contact your tutor/marker, who is there to help you. Your tutor/marker’s name and contact information were sent to you with this course. You can also obtain this information in the Who Is My Tutor/Marker? section of the distance learning website at <www.edu.gov.mb.ca/k12/dl/iso/assistance.html>.

Your Learning Partner

A learning partner is someone you choose who will help you learn. It may be someone who knows something about electricity/electronics, but it doesn’t have to be. A learning partner could be someone else who is taking this course, a teacher, a parent or guardian, a sibling, a friend, or anybody else who can help you. Most importantly, a learning partner should be someone with whom you feel comfortable, and who will support you as you work through this course.

Your learning partner can help you keep on schedule with your coursework, read the course with you, check your work, look at and respond to your learning activities, or help you make sense of assignments. You may even study for your examination with your study partner. If you and your learning partner are taking the same course, however, your assignment work should not be identical.
How Will You Know How Well You Are Learning?

You will know how well you are learning in this course by how well you complete the learning activities, assignments, projects, and examination.

Learning Activities

The learning activities in this course will help you to review and practise what you have learned in the lessons. You will not submit the completed learning activities to your tutor/marker. Instead, you will complete the learning activities and compare your responses to those provided in the Learning Activity Answer Key found at the end of each module.

Make sure you complete the learning activities. Doing so will not only help you to practise what you have learned, but will also prepare you to complete your assignments and the examination successfully. Many of the questions on the examination will be similar to the questions in the learning activities. Remember that you do not mail learning activities to your tutor/marker.

Assignments

Each module in this course contains assignments, which you will complete and submit to your tutor/marker for assessment. The assignments are worth a total of 55% of your final course mark. There are two types of assignments in this course: the written question format, and eight hands-on experiments that involve lab reports.

The tutor/marker will mark your assignments and return them to you. Remember to keep all marked assignments until you have finished the course so that you can use them to study for your examination.

Projects

You will be completing and sending in two hand-in projects by mail, one at the end of Module 3 and one at the end of Module 5. Each student is to complete the two projects, as group submissions will not be accepted. Each project is worth 15 percent of the final grade for the course. Therefore, the two projects are worth 30 percent of the total mark for the course.
Final Examination

The final exam covers the entire course and is worth **15%** of the final mark. The final exam must be written under the supervision of a proctor. When you start Module 5, you need to make arrangements to write the exam. When you reach this point, do one of the following:

**Requesting Your Examination**

To write your examination, you need to make the following arrangements:

- **If you are attending school**, ask your school’s ISO school facilitator to request your examination. Do this at least **three weeks before** you are ready to write your examination. For more information on examination procedures, please contact your ISO school facilitator or visit the Grading and Evaluation section of the distance learning website at <www.edu.gov.mb.ca/k12/dl/iso/assignments.html>.

- **If you are not attending school**, check the Examination Request Form for options available to you. The form was mailed to you with this course. **Three weeks before** you are ready to write the examination, fill in the Examination Request Form and mail, fax, or email it to

  ISO Office  
  555 Main Street  
  Winkler MB  R6W 1C4  
  Fax: 1-204-325-1719  
  Toll-Free Telephone: 1-800-465-9915  
  Email: distance.learning@gov.mb.ca

How Much Time Will You Need to Complete This Course?

Learning through independent study has several advantages over learning in the classroom. You are in charge of how you learn and can choose how quickly you will complete the course. You can read as many lessons as you wish in a single session. You do not have to wait for your teacher or classmates. From the date of your registration, you have a maximum of **12 months** to complete this course, but the pace at which you proceed is up to you. Read the next few pages to get a recommendation on how to pace yourself.
Chart A: Semester 1

If you want to start the course in September and complete it in January, you can follow the timeline suggested below.

<table>
<thead>
<tr>
<th>Module</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>End of September</td>
</tr>
<tr>
<td>Module 2</td>
<td>End of October</td>
</tr>
<tr>
<td>Module 3</td>
<td>End of November</td>
</tr>
<tr>
<td>Module 4</td>
<td>Middle of December</td>
</tr>
<tr>
<td>Module 5</td>
<td>Beginning of January</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Middle of January</td>
</tr>
</tbody>
</table>

Chart B: Semester 2

If you want to start the course in January and complete it in June, you can follow the timeline suggested below.

<table>
<thead>
<tr>
<th>Module</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>End of January</td>
</tr>
<tr>
<td>Module 2</td>
<td>End of February</td>
</tr>
<tr>
<td>Module 3</td>
<td>End of March</td>
</tr>
<tr>
<td>Module 4</td>
<td>Middle of April</td>
</tr>
<tr>
<td>Module 5</td>
<td>Middle of May</td>
</tr>
<tr>
<td>Final Exam</td>
<td>End of May</td>
</tr>
</tbody>
</table>
Chart C: Full School Year (Not Semestered)

If you want to start the course in September and complete it in June, you can follow the timeline suggested below.

<table>
<thead>
<tr>
<th>Module</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
<td>Middle of October</td>
</tr>
<tr>
<td>Module 2</td>
<td>Middle of December</td>
</tr>
<tr>
<td>Module 3</td>
<td>End of February</td>
</tr>
<tr>
<td>Module 4</td>
<td>Middle of April</td>
</tr>
<tr>
<td>Module 5</td>
<td>Middle of May</td>
</tr>
<tr>
<td>Final Exam</td>
<td>End of May</td>
</tr>
</tbody>
</table>

Timelines

Do not wait until the last minute to complete your work, since your tutor/marker may not be available to mark it immediately. It may take a few weeks for your tutor/marker to assess your work and return it to you or your school.

If you need this course to graduate this school year, remember to schedule and complete your final examination by May 31.
When and How Will You Submit Completed Assignments?

When to Submit Assignments

While working on this course, you will submit completed assignments to your tutor/marker five times. The following chart shows you exactly what assignments you will be submitting.

<table>
<thead>
<tr>
<th>Submission</th>
<th>Assignments You Will Submit</th>
</tr>
</thead>
</table>
| 1          | Module 1: Introduction to Electronics  
Module 1 Cover Sheet  
Assignments 1.1 to 1.4 |
| 2          | Module 2: The Basics of Electricity  
Module 2 Cover Sheet  
Assignments 2.1 to 2.8 |
| 3          | Module 3: Capacitors and Semiconductors  
Module 3 Cover Sheet  
Assignments 3.1 to 3.5  
Project 1: The Decision Maker |
| 4          | Module 4: Ohm’s Law and Circuit Fundamentals  
Module 4 Cover Sheet  
Assignments 4.1 to 4.5 |
| 5          | Module 5: Magnetism and Induction  
Module 5 Cover Sheet  
Assignment 5.1  
Project 2: Brain Meter |

How to Submit Assignments

In this course, you have the choice of submitting your assignments either by mail or electronically. The two projects and Assignment 1.3 must be submitted by mail.

- **Mail:** Each time you mail something, you must include the print version of the applicable Cover Sheet (found at the end of this Introduction).
Electronic submission: Each time you submit something electronically, you must include the electronic version of the applicable Cover Sheet (found in the Student Downloads section of the distance learning website at <www.edu.gov.mb.ca/k12/dl/downloads/index.html>) or you can scan the Cover Sheet located at the end of this Introduction.

Complete the information at the top of each Cover Sheet before submitting it along with your assignments.

Submitting Your Assignments by Mail

If you choose to mail your completed assignments, please photocopy/scan all the materials first so that you will have a copy of your work in case your package goes missing. You will need to place the applicable module Cover Sheet and assignments in an envelope, and address it to

ISO Tutor/Marker
555 Main Street
Winkler MB R6W 1C4

Your tutor/marker will mark your work and return it to you by mail.

Submitting Your Assignments Electronically

Assignment submission options vary by course. Sometimes assignments can be submitted electronically and sometimes they must be submitted by mail. Specific instructions on how to submit assignments were sent to you with this course. You can also obtain this information in the Grading and Evaluation section of the distance learning website at <www.edu.gov.mb.ca/k12/dl/iso/assignments.html>.

If you choose to submit your assignments electronically, make sure you have saved electronic copies before you send them. That way, you can refer to your assignments when you discuss them with your tutor/marker. Also, if the original assignments are lost, you will be able to resubmit them.

Your tutor/marker will mark your work and return it to you electronically.

The Independent Study Option office does not provide technical support for hardware-related issues. If troubleshooting is required, consult a professional computer technician.
What Are the Guide Graphics For?

Module Focus/Specific Learning Outcomes (SLOs): Note that these SLOs are addressed within the lesson.

Power Words: This icon indicates key “power” words that you will learn in the module.

Learning Activity: Complete a learning activity. This will help you to review or practise what you have learned and to prepare you for an assignment or an examination. You will not submit learning activities to your tutor/marker. Instead, you will compare your responses to those provided in the Learning Activity Answer Key found at the end of the applicable module.

Check Your Work: Check your responses against those provided in the Learning Activity Answer Key found at the end of the applicable module.

Video: View a video.

Stop/Caution: Use caution when conducting this learning activity or experiment.

Assignment: Complete an assignment. You will submit your completed assignments to your tutor(marker) for assessment in accordance with the chart found in the course Introduction.

Tech Project: Complete a project that you must send in to your tutor/ marker.

Mail or Electronic Submission: Mail or electronically submit your completed assignments to your tutor/ marker for assessment at this time.

Learning Partner: Ask your learning partner to help you with this task.

Note: Take note of and remember this important information or reminder.

Examination: Write your final examination at this time.
Grade 10 Electricity/Electronics Technology (20G)

Module 1
Introduction to Electronics

- Introduction
- Lesson 1: Electricity: Let’s Get Started
- Lesson 2: How Electricity Is Produced
- Lesson 3: A Brief History of Electronics
- Lesson 4: How to Solder
- Lesson 5: Practice Solder Board
- Lesson 6: Careers in Electronics
- Module 1 Summary
Module 1: Introduction to Electronics

Module Focus

After working through this module, you should be able to

- have a basic understanding of what electricity is.
- understand the way in which it is generated and transmitted.
- learn to measure electricity with a multimeter.
- create some electricity of your own.
- understand the hazards of working with electricity.
- understand a brief history of electricity.
- learn how to solder.
- practise using a solder board.
- engage in career exploration.

Introduction

In this module, you will learn about what electricity is and how it is transmitted and generated. You will also learn how to measure with a multimeter, learn about the hazards of electricity, and learn and practise how to solder. You will also explore the various careers in electricity and electronics.

Power Words

electrical outlet  batteries  static electricity  lightning  conductor  turbine  transformer

insulator  satellites  electrolyte  insulator  potential energy  AC  electric shock

volts  electrodes  current  generator  DC  mechanical energy

rotors  hydroelectricity  multimeter  electrochemical reaction
Module 1 Assignments

In Module 1, you will complete the following four assignments, which you will send to your tutor/marker at the end of the module.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Assignment Number</th>
<th>Assignment Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assignment 1.1</td>
<td>Electricity: Let’s Get Started</td>
</tr>
<tr>
<td>2</td>
<td>Assignment 1.2</td>
<td>The Hazards of Working with Electricity</td>
</tr>
<tr>
<td>5</td>
<td>Assignment 1.3</td>
<td>Practice Soldering Project</td>
</tr>
<tr>
<td>6</td>
<td>Assignment 1.4</td>
<td>Careers in Electronics</td>
</tr>
</tbody>
</table>
Lesson 1: Electricity: Let’s Get Started

What Is It?

If you look around your house, you will see many electrical outlets where you can plug in all your appliances, gizmos, and gadgets. On the other hand, some of our electrical devices don’t use the electricity that flows from these outlets. Instead, they use batteries, which can produce varying amounts of electricity, depending on how many batteries there are and the configuration that they are in.

One of the most obvious examples of electricity is during a thunderstorm. At this time, you will often see huge bolts of electricity that flash and come down from the sky. Lightning is one of nature’s most awesome displays, and also one of the deadliest. Bolt temperatures are hotter than the surface of the Sun (27,000 degrees Celsius) and it is the shockwaves produced by the rapid heating of the air around the bolt that gives us thunder.

On a much smaller scale, you can get a shock from static electricity. Almost all of us are familiar with static electricity because we can see and feel it, especially in the winter. On dry winter days, static electricity can build up in our bodies and cause a spark to jump from our bodies to a piece of metal or another person’s body. We can see, feel, and hear the sound of the spark when it jumps.

It is easy to create electricity from sunlight using a solar cell. You’ve probably seen calculators that have solar cells—calculators that never need batteries and in some cases don’t even have an off button. As long as you have enough light, they seem to work forever. You may have seen larger solar panels on the roofs of houses. These panels generate electricity for people to use as long as the sun is shining. Although these larger panels aren’t as common as solar-powered calculators, they are not that hard to spot if you know where to look. Satellites also...
have large arrays of solar panels, where they are used to power the electrical systems.

So what is this mysterious stuff that we call electricity? Where does it come from, and why is it able to do so many different things?

What Can Electricity Do?

The electricity that we get from power outlets and batteries can power all different kinds of devices. The fact is that electricity can be used in many different ways to do many different things.

For example:

- Electric motors can turn electricity into motion.
- Light bulbs and LEDs turn electricity into light.
- Computers use electricity to store and transmit information.
- Telephones use electricity to make communication possible.
- TVs use electricity to transmit moving pictures onto screens.
- Speakers turn electricity into sound waves and music we can hear.
- Stun guns and tasers turn electricity into weapons.
- Some furnaces and stoves turn electricity into heat.
- Radios turn electricity into waves that can travel great distances.

Be Safe!

Get this! Your whole body needs electricity in tiny amounts to make it work. And when your body encounters large amounts of electricity, it is very dangerous. The amount of electricity flowing in a lamp is enough to seriously hurt you!

It is now time for you to complete your first learning activity.

The purpose of this learning activity (along with all the other learning activities in the course) is to help you prepare to complete your assignments and write your final exam. **You will not mail any of your learning activities to your tutor/marker for assessment.**

For some learning activities, there are no correct or incorrect answers. For that reason, you will not find an answer key for every learning activity.
Learning Activity 1.1

Electricity

Check your answers in the Learning Activity Answer Keys found at the end of this module.

1. List three items in your home that you need to plug in.
2. List five items in your home that use electricity, but you don’t need to plug in.

How to Measure a Battery

The first thing you need to do is get out your digital multimeter (DMM) from your electronics tool kit.

In this section, you will be measuring your 9-volt battery and watching a video presentation on how to use the multimeter.

Caution: You will be working with your digital multimeter to test your battery. It is very important that you follow the instructions carefully every time you use the meter or any other equipment in this course. If you’re ever not sure about something, ask your learning partner or tutor/marker.

Using Your Multimeter

One of the most commonly used tools in electronics is the digital multimeter or DMM. A DMM allows you to measure and compare electronic output values. Most DMMs will measure voltage, amperes, continuity, and resistance. These four measurement terms will be discussed in detail as you work through the course. Just remember that your DMM is a fairly sensitive measuring tool. You have to make sure to take good care of it and use it properly if you want it to last a long time.
The meter in your tool kit should look similar to the one in the course pictures. From time to time, some of the settings on the meters may change position on the dial. When using your meter, always make sure you find and select the correct function symbol for the task you are performing. The symbols are the same, but their placement on the meter may vary.

Without the DMM measuring tool, it would be nearly impossible to work with electricity and electronics. It is now time to view the Grade 9/10 Electronics video found at <www.edu.gov.mb.ca/k12/dl/iso/av.html> or on DVD. Watch the section on the digital multimeter. After you have watched the video, come back to this page and continue on from here.

To measure battery voltage, set your DMM to the feature or function known as voltage direct current or VDC. It is important to learn about this function because your 9-volt battery needs to be tested to see if it has enough electrical energy to run your projects and experiments.

The correct setting on the multimeter dial is shown in the picture on the left. It is important to know the purpose of each setting. A white dot on a multimeter dial indicates the correct position for the selection knob. Look for the white dot on the multimeter. If you were to choose the wrong function, you could damage the DMM.

All meters are different but they have the same symbols. There are five symbols that you will be referring to and they are on all meters regardless of the make and model.
Testing Your 9-Volt Battery

The negative and positive posts of the battery are clearly indicated on the battery itself. This should help you to be sure which test lead from the meter goes on which post of the battery.

It is safe to say that when using the meter the black probe is always negative and the red probe is positive. Some components, like the resistor, do not have a negative and positive side. But when measuring things that do, like your battery, you have to be sure to place the correct post on the correct pole.

Now, if you haven’t already done so, turn the meter on by pressing the power button. The meter should turn on and the small screen should have a bunch of zeros on it.

Next, take the battery and find the negative and positive posts, as indicated on the side of the battery.

Place the meter selection dial to read *voltage direct current* or VDC.

Take the two test probes and place the black one on the negative post of the battery and the red one on the positive post. Watch the display screen for your reading.
Learning Activity 1.2

Reading Your Micrometer

Write down the value that the screen indicates in the space below.

1. I read the battery with my DMM and the meter indicated the battery has ___________ volts DC.

Check your answer in the Learning Activity Answer Keys found at the end of this module.

Congratulations! You have successfully measured your battery’s voltage level. Now, you can turn the meter off by pressing the power button one more time.

Troubleshooting

If your DMM won’t turn on, there is a possibility that the battery inside the meter is dead. Ask an adult to help you change the battery. The worst case is that you misused the meter. Once a DMM is damaged, you only have one option—purchase a new one. It is too expensive to repair a DMM.

Make sure you double- and triple-check the Function dial before you test anything.

Storing Your Meter

Whenever you are finished with your meter, it is a good idea to wrap the wires around the meter and snap the probes back into the side. This way your meter is safe and stored properly for the next time you need to use it.
Cool Electronics

Now that you have learned about electricity, how to measure it, and the many things that it can do, let’s see if we can make some electricity on our own. Here’s an experiment you can try. It may be a good idea to have your learning partner assist you in this experiment.

The Lemon Battery

You may have already heard of this experiment, but successfully creating one of these devices is not always easy.

Batteries are made from two different metals and an acidic solution. Copper and zinc work well as the two metals, and the citric acid of a lemon will provide the acidic solution. (This lemon battery will not be able to run most light bulbs.)

Here is a list of things that you will need to do this experiment.

- **A lemon**: A fresh, juicy lemon works best.
- **A nail**: Galvanized nails are coated in zinc. Use a 2-inch galvanized nail (available from a hardware store).
- **A penny**: Any copper coin will work. (Canadian pennies from 1960–2001 should all work.)
Let’s create the battery:

- Push a galvanized nail into one side of the lemon. (The nail and penny cannot touch.)
- Put a penny into a cut on the opposite end of the lemon.

This is a single cell of a battery. The zinc nail and the copper penny are called the **electrodes**. The lemon juice is called the **electrolyte**. All batteries have a “+” and “−” terminal. You can create a battery anytime you have two dissimilar metals and an electrolyte.

Electric current is the flow of **electrons**. **Conductors** allow electrons to flow through them. Most metals (copper, iron) are good conductors of electricity. Electrons will flow from the “−” (negative) electrode of a battery, through a conductor, towards the “+” (positive) electrode of a battery. **Volts** (voltage) is the measure of force moving the electrons or making them want to move. (High voltage is dangerous, but in this experiment the voltage is low.) We will go into exactly what electricity is and how it flows in greater detail in Module 2.

Connect the **multimeter** to our lemon battery. Put the meter selection knob to the Volts DC setting. The meter will tell us how many volts are being generated. Note the amount of voltage shown on the meter for use in Learning Activity 1.3. Unfortunately this battery will not produce enough **current** (flowing electrons) to light a bulb.
Learning Activity 1.3

Testing Volts

Record your results below.

1. The voltage that my lemon battery produced was _______ volts DC.

   ![Image of a lemon battery being tested](image)

   You might want to try using a different fruit or even a potato and see what kind of voltage you can get, if any. It goes without saying that once you put the nail and penny into the lemon, or any other fruit or vegetable, do not eat it! You will have to dispose of it.

   **(Optional activity)**

   2. I also tried using a _______________ as a battery and the Volts DC on the meter read _______________.

   Check your answers in the Learning Activity Answer Keys found at the end of this module.
Improving Your Battery

The quality of the copper and zinc can be a problem for a battery like this. Pennies, in particular, are rarely made of pure copper.

If you can, try substituting a piece of copper wire (common house wire) for the penny. Experiment with different lengths and configurations of electrodes. Other sources of zinc and copper may be found in the plumbing supply department of a hardware store.

It is now time for you to complete Assignment 1.1: Electricity: Let’s Get Started on the following pages. This assignment (along with all other assignments) is worth marks. You will mail them to your tutor/marker, along with your Module 1 Cover Sheet, when you have finished this module.