Erindale College

Assessment Period:	**2021 S2**
Course:	**PHYSICS**
Unit:	**Unit 2: Thermal, Nuclear and Electrical (1.0)**
Accreditation:	**T**
Year:	**11**

Unit Goals

- understand how the kinetic particle model and thermodynamics concepts describe and explain heating processes
- understand how the nuclear model of the atom explains radioactivity, fission, fusion and the properties of radioactive nuclides
- understand how charge is involved in the transfer and transformation of energy in electrical circuits
- understand how scientific models and theories have developed and are applied to improve existing, and develop new, technologies
- use science inquiry skills to design, conduct and analyse safe and effective investigations into heating processes, nuclear physics and electrical circuits, and to communicate methods and findings
- use algebraic and graphical representations to calculate, analyse and predict measurable quantities associated with heating processes, nuclear reactions and electrical circuits
- evaluate, with reference to empirical evidence, claims about heating processes, nuclear reactions and electrical technologies
- communicate physics understanding using qualitative and quantitative representations in appropriate modes and genres

Content Description

Science Inquiry Skills

- identify, research, construct and refine questions for investigation; propose hypotheses; and predict possible outcomes
- design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics
- conduct investigations, including using temperature, current and potential difference measuring devices, safely, competently and methodically for the collection of valid and reliable data
- represent data in meaningful and useful ways, including using appropriate Système Internationale (SI) units and symbols; organise and analyse data to identify trends, patterns and relationships; identify sources of random and systematic error and estimate their effect on measurement results; identify anomalous data and calculate the measurement discrepancy between experimental results and a currently accepted value, expressed as a percentage; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments (ACSPH005)
- select, construct and use appropriate representations, including text and graphic representations of empirical and theoretical relationships, flow diagrams, nuclear equations and circuit diagrams, to communicate conceptual understanding, solve problems and make predictions

- select, use and interpret appropriate mathematical representations, including linear and non-linear graphs and algebraic relationships representing physical systems, to solve problems and make predictions
- communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports

Science as a Human Endeavour

- science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility
- development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines
- advances in science understanding in one field can influence other areas of science, technology and engineering
- the use of scientific knowledge is influenced by social, economic, cultural and ethical considerations
- the use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences
- scientific knowledge can enable scientists to offer valid explanations and make reliable predictions
- scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability

Science Understanding - Heating processes

- heat transfer occurs between and within systems by conduction, convection and/or radiation
- the kinetic particle model describes matter as consisting of particles in constant motion, except at absolute zero
- all systems have thermal energy due to the motion of particles in the system
- temperature is a measure of the average kinetic energy of particles in a system
- provided a substance does not change state, its temperature change is proportional to the amount of energy added to or removed from the substance; the constant of proportionality describes the heat capacity of the substance
- change of state involves internal energy changes to form or break bonds between atoms or molecules; latent heat is the energy required to be added to or removed from a system to change the state of the system
- two systems in contact transfer energy between particles so that eventually the systems reach the same temperature; that is, they are in thermal equilibrium
- a system with thermal energy has the capacity to do mechanical work (that is, to apply a force over a distance); when work is done, the internal energy of the system changes
- because energy is conserved, the change in internal energy of a system is equal to the energy added or removed by heating plus the work done on or by the system
- energy transfers and transformations in mechanical systems (for example, internal and external combustion engines, electric motors) always result in some heat loss to the environment, so that the usable energy is reduced and the system cannot be 100 percent efficient

Mathematical representations and relationships - Heating processes

- $Q = mc\Delta T$

  $Q = mL$

  $\eta = \frac{energy\ output}{energy\ input} \times \frac{100}{1}$

View Definitions - Ionising radiation and nuclear reactions

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the nuclear model of the atom describes the atom as consisting of an extremely small nucleus, which contains most of the atom's mass and is made up of positively charged protons and uncharged neutrons surrounded by negatively charged electrons

- nuclear stability is the result of the strong nuclear force, which operates between nucleons over a very short distance and opposes the electrostatic repulsion between protons in the nucleus
- some nuclides are unstable and spontaneously decay, emitting alpha, beta and/or gamma radiation over time until they become stable nuclides
- each species of radionuclide has a specific half-life
- alpha, beta and gamma radiation have sufficient energy to ionise atoms
- Einstein's mass/energy relationship, which applies to all energy changes, enables the energy released in nuclear reactions to be determined from the mass change in the reaction
- alpha and beta decay are examples of spontaneous transmutation reactions, while artificial transmutation is a managed process that changes one nuclide into another
- neutron-induced nuclear fission is a reaction in which a heavy nuclide captures a neutron and then splits into two smaller radioactive nuclides, with the release of neutrons and energy
- a fission chain reaction is a self-sustaining process that may be controlled to produce thermal energy, or uncontrolled to release energy explosively
- nuclear fusion is a reaction in which light nuclides combine to form a heavier nuclide, with the release of energy
- more energy is released per nucleon in nuclear fusion than in nuclear fission because a greater percentage of the mass is transformed into energy

Mathematical representations and relationships - Ionising radiation and nuclear reactions

- $N = N_o \left(\frac{1}{2}\right)^n$

$$\Delta E = \Delta m c^2$$

View Definitions - Electrical circuits

- electrical circuits enable electrical energy to be transferred efficiently over large distances and transformed into a range of other useful forms of energy including thermal and kinetic energy, and light
- electric current is carried by discrete charge carriers; charge is conserved at all points in an electrical circuit
- energy is conserved in the energy transfers and transformations that occur in an electrical circuit
- the energy available to charges moving in an electrical circuit is measured using electric potential difference, which is defined as the change in potential energy per unit charge between two defined points in the circuit
- energy is required to separate positive and negative charge carriers; charge separation produces an electrical potential difference that can be used to drive current in circuits
- power is the rate at which energy is transformed by a circuit component; power enables quantitative analysis of energy transformations in the circuit
- resistance for ohmic and non-ohmic components is defined as the ratio of potential difference across the component to the current in the component
- circuit analysis and design involve calculation of the potential difference across, the current in, and the power supplied to, components in series, parallel and series/parallel circuits

Mathematical representations and relationships - Electrical circuits

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$$I = \frac{q}{t}$$
$$V = \frac{W}{q}$$
$$R = \frac{V}{I}$$
$$P = \frac{W}{t} = VI$$
$$V_t = V_1 + V_2 + .. V_n$$
$$R_t = R_1 + R_2 + .. R_n$$
$$I_t = I_1 + I_2 + .. I_n$$
$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + .. \frac{1}{R_n}$$

Assessment Tasks

Name	Due Date	Weighting
Assignment 1	5 August - 13 August	20%
Exam 1	2 September	30%
Assignment 2	28 October - 4 November	20%
Exam 2	11 November	30%

Specific Unit Information

Students are expected to bring a scientific calculator to every class.

Assignment 1 will consist of a practical completed in the double on 5th August, followed by a report due on the 13th August.

Assignment 2 will consist of a practical completed in the double on the 28th October, followed by a report due on the 4th November.

If you are absent on the day of the practical, you must have appropriate documentation to support your absence (e.g. a medical note) and arrange an alternative time to complete the task.

Exams will be conducted in class, during the double.

School Assessment Information

For penalties for late and non-submission of work

See BSSS Policy and Procedure Manual 4.3.10 for further information.

For academic integrity

See BSSS Policy and Procedure Manual 4.3.12 for further information.

For appeals processes

See BSSS Policy and Procedure Manual 7.2 for further information.

For moderation procedures (internal and external)

See BSSS Policy and Procedure Manual 5 for further information.

For meshing procedures

See BSSS Policy and Procedure Manual 5.4.1 for further information.

For method of unit score calculation

See BSSS Policy and Procedure Manual 4.3.6.2 for further information.

For procedures for calculating course scores

See BSSS Policy and Procedure Manual 4.3.13.2 for further information.

Achievement Standards for PHYSICS T - Year 11

	*A student who achieves an **A** grade typically*	*A student who achieves a **B** grade typically*	*A student who achieves a **C** grade typically*	*A student who achieves a **D** grade typically*	*A student who achieves an **E** grade typically*
Concepts, Models & Applications	• critically analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • evaluates the nature, functions, limitations and applications of theories and models using evidence, in unfamiliar contexts • analyses evidence with reference to models and/or theories, and develops evidence-based conclusions and evaluates limitations	• analyses the fundamental properties and functions of system components, processes and interactions, and the effects of factors across a range of scales • analyses the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • assesses evidence with reference to models and/or theories, and develops evidence-based conclusions and discusses limitations	• explains the fundamental properties and functions of system components, processes and interactions and the effects of factors across a range of scales • explains the nature, functions, limitations and applications of theories and models using evidence, in familiar contexts • explains evidence with reference to models and/or theories, and develops evidence-based conclusions and identifies limitations	• describes the fundamental properties and functions, and with some description of system components, processes and interactions, and the effects of factors across a range of scales • describes the nature, functions, limitations and applications of theories and models with supporting evidence • describes evidence, and develops conclusions with some reference to models and/or theories	• identifies the fundamental properties and functions of system and identifies components, processes and interactions, and the effects of factors across a range of scales • identifies the nature, functions, applications, and some possible limitations of theories and models, with some evidence • identifies evidence, and asserts conclusions with little or no reference to models and/or theories
Contexts	• critically analyses epistemology, role of peer review, collaboration and technology in developing knowledge • critically analyses the influence of social, economic, ethical and cultural factors on Science	• analyses epistemology, role of peer review and technology in developing knowledge • analyses the influence of social, economic, ethical and cultural factors on Science	• explain epistemology, role of peer review and technology in developing knowledge • explains the influence of social, economic, ethical and cultural factors on Science	• describes the role of peer review in developing knowledge • describes the influence of social, economic, ethical and cultural factors on Science	• identifies that scientific knowledge has changed over time • identifies the influence of social, economic, ethical and cultural factors on Science
Inquiry Skills	• designs, conducts and improves safe, ethical and original inquiries individually and collaboratively, that collect valid, reliable data in response to a complex question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and analyses errors • analyses processes and claims, and provides a critique based on evidence, and critically analyses alternatives • reflects on own thinking and evaluates planning, time management, use of appropriate work strategies • communicates concisely, effectively and accurately, demonstrating scientific literacy in a range of modes, styles, representations, and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• designs, conducts and improves safe, ethical inquiries individually and collaboratively, that collect valid, reliable data in response to a question • analyses causal and correlational relationships, anomalies, reliability and validity of data and representations, and discusses errors • assesses processes and claims, and provides a critique with reference to evidence, and analyses alternatives • reflects on their own thinking and analyses planning, time management, use of appropriate work strategies • communicates clearly and accurately, demonstrating scientific literacy in a range of modes, styles, representations and genres for specific audiences and purposes, with appropriate evidence and accurate referencing	• plans and conducts safe, ethical inquiries individually and collaboratively, that collect valid data in response to a familiar question • explains causal and correlational relationships, anomalies, reliability and validity of data and representations, and cites common errors • explains processes and claims, and identifies alternatives with reference to reliable evidence • reflects on their own thinking and explains planning, time management, use of appropriate work strategies • communicates accurately demonstrating scientific literacy, in a range of modes, styles, representations, and genres for specific purposes, with appropriate evidence and mostly consistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data in response to a simple question with varying success • describes trends, relationships and anomalies in data, identifies anomalies, and some possible sources of error • describes processes and claims, and identifies the need for improvements with some reference to evidence • reflects on their own thinking, with reference to planning and the use of appropriate work strategies • communicates demonstrating some scientific literacy, in a range of modes, representations, and genres with some evidence and inconsistent referencing	• follows a procedure to conduct safe, ethical inquiries individually and collaboratively, to collect data with little or no connection to a question • identifies trends and relationships in data, with little or no reference to sources of error • identifies processes and the need for some improvements, with little or no reference to evidence • reflects on their own thinking with little or no reference to planning, time management, and use of work strategies • communicates demonstrating limited scientific literacy, in a range of modes and representations, with inconsistent and inaccurate referencing