

CAMI - Science

CAPS - Physics Links Grade 11



TERM 1		
TOPICS	CONTENT, CONCEPTS & SKILLS	CAMI - KEYSTROKES
<u>Vectors in two dimensions</u>		
Resultant of perpendicular vectors	<ul style="list-style-type: none"> ▪ Draw a sketch of the vectors (parallel and perpendicular) on the Cartesian plane. ▪ Add co-linear vectors along the parallel and perpendicular direction to obtain the net parallel component (R_x) and a net perpendicular component (R_y). ▪ Sketch R_x and R_y ▪ Sketch the resultant (R) using either the tail-to-head or tail-to-tail method. ▪ Determine the magnitude of the resultant using the theorem of Pythagoras. ▪ Find resultant vector graphically using the tail-to-head method as well as by calculation (by component method) for a maximum of four force vectors in both 1-Dimension and 2-Dimensions. ▪ Understand what is a closed vector diagram. ▪ Determine the direction of the resultant using simple trigonometric ratios 	1.2.1.1 – 1.2.1.2
Resolution of a vector into its parallel and perpendicular components	<ul style="list-style-type: none"> ▪ Draw a sketch of the vector on the Cartesian plane showing its magnitude and the angle (θ) between the vector and the x-axis. ▪ Use $R_x = R \cos(\theta)$ for the resultant x-component. ▪ Use $R_y = R \sin(\theta)$ for the resultant y-component 	1.2.2

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<p><u>Newton's Laws and Application of Newton's Laws.</u></p>		
<p>Different kinds of forces: weight, normal force, frictional force, applied (push, pull), tension (strings or cables)</p>	<ul style="list-style-type: none"> ▪ Define normal force, N as the force exerted by a surface on an object in contact with it. ▪ Know that the normal force acts perpendicular to the surface irrespective of whether the plane is horizontal or inclined ▪ Define frictional force, f, as the force that opposes the motion of an object and acts parallel to the surface the object is in contact with. ▪ Distinguish between static and kinetic friction forces ▪ Explain what is meant by the maximum static friction, f_{max} ▪ Calculate the value of the maximum static frictional force for objects at rest on a horizontal and inclined planes using: $f_s^{max} = \mu_s N$ <p>Know that static friction</p> $f_s < \mu_s N$ <ul style="list-style-type: none"> ▪ Calculate the value of the kinetic friction force for moving object on horizontal and inclined planes using: $f_k = \mu_k N$ 	<p>1.7.1.1 – 1.7.1.3</p> <p>1.7.1.4</p>
<p>Force diagrams, free body diagrams</p>	<ul style="list-style-type: none"> ▪ Know that a force diagram is a picture of the object(s) of interest with all the forces acting on it (them) drawn in as arrows ▪ Know that in a free-body diagram, the object of interest is drawn as a dot and all the forces acting on it are drawn as arrows pointing away from the dot ▪ Resolve two-dimensional forces (such as the weight of an object with respect to the inclined plane) into its parallel (x) and perpendicular (y) components ▪ The resultant or net force in the x-direction is a vector sum of all the components in the x-direction ▪ The resultant or net force in the y-direction is a vector sum of all the components in the y-direction 	<p>1.7.1.2</p>

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Newton's first, second and third laws	<ul style="list-style-type: none"> ▪ State Newton's first law: An object continues in a state of rest or uniform (moving with constant) velocity unless it is acted upon by an unbalanced (net or resultant) force. ▪ Discuss why it is important to wear seatbelts using Newton's first law ▪ State Newton's second law: When a net force, F_{net}, is applied to an object of mass, m, it accelerates in the direction of the net force. The acceleration, a, is directly proportional to the net force and inversely proportional to the mass: $F_{net} = ma$ ▪ Draw force diagrams for objects that are in equilibrium (at rest or moving with constant velocity) and accelerating (non-equilibrium) ▪ Draw free body diagrams for objects that are in equilibrium (at rest or moving with constant velocity) and accelerating (non-equilibrium) ▪ Apply Newton's laws to a variety of equilibrium and non-equilibrium problems including a single object moving on a horizontal/ inclined plane (frictionless and rough), vertical motion (lifts, rockets etc.) and also two-body systems such as two masses joined by a light (negligible mass) string. ▪ Understand apparent weight ▪ State Newton's third law: When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A ▪ Identify action-reaction pairs e.g. donkey pulling a cart, a book on a table ▪ List the properties of action- reaction pairs 	<p>1.7.2.1</p> <p>1.7.2.2.1 – 1.7.2.2.2</p> <p>1.7.2.3</p>

TERM 2		
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Geometrical optics:		
Refraction	<ul style="list-style-type: none"> ▪ Revision: explain reflection ▪ Revision: State the law of reflection ▪ Define the speed of light as being constant when passing through a given medium and having a maximum value of $c=3 \times 10^8 \text{ m.s}^{-1}$ in a vacuum. ▪ Define refraction ▪ Define refractive index as $n = \frac{c}{v}$ ▪ Define optical density ▪ Know that the refracted index is related to the optical density. ▪ Explain that refraction is a change of wave speed in different media, while the frequency remains constant ▪ Define Normal ▪ Define angle of incidence ▪ Define angle of refraction ▪ Sketch ray diagrams to show the path of a light ray through different media 	<p>2.6.2.1.1 – 2.6.2.1.3</p> <p>2.6.1.2.1 – 2.6.1.2.3</p> <p>2.6.1.3.1 – 2.6.1.3.3</p> <p>2.6.2.2.1 – 2.6.2.2.3</p> <p>2.6.3.1 – 2.6.3.2</p>
Snell's Law	<ul style="list-style-type: none"> ▪ State the relationship between the angles of incidence and refraction and the refractive indices of the media when light passes from one medium into another (Snell's Law) $n_1 \sin \theta_1 = n_2 \sin \theta_2$ ▪ Apply Snell's Law to problems involving light rays passing from one medium into another ▪ Draw ray diagrams showing the path of light when it travels from a medium with higher refractive index to one of lower refractive index and vice versa 	<p>2.6.3.1 – 2.6.3.3</p> <p>2.6.2.2.3</p>
Critical angles and total internal reflection	<ul style="list-style-type: none"> ▪ Explain the concept of critical angle ▪ List the conditions required for total internal reflection ▪ Use Snell's Law to calculate the critical angle at the surface between a given pair of media ▪ Explain the use of optical fibers in endoscopes and telecommunications 	<p>2.6.4.1 – 2.6.4.3</p>

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<u>2D and 3D Wavefronts</u>		
Diffraction	<ul style="list-style-type: none"> ▪ Define a wavefront as an imaginary line that connects waves that are in phase (e.g. all at the crest of their cycle) ▪ State Huygen's principle. ▪ Define diffraction as the ability of a wave to spread out in wavefronts as they pass through a small aperture or around a sharp edge ▪ Apply Huygen's principle to explain diffraction qualitatively. Light and dark areas can be described in terms of constructive and destructive interference of secondary wavelets ▪ Sketch the diffraction pattern for a single slit ▪ Understand that <div style="text-align: center; margin: 10px 0;"> $\text{degree of diffraction} \propto \frac{\lambda}{w}$ </div> <p style="text-align: center; margin: 0;">where w = slit width</p> ▪ Understand that diffraction of light demonstrates the wave nature of light 	<p style="margin: 0;">2.7.1.1 – 2.7.1.3</p> <p style="margin: 0;">2.7.2.1 – 2.7.2.3</p>

TERM 3

TOPICS	CONTENT, CONCEPTS & SKILLS	CAMI - KEYSTROKES
Electrostatics		
Coulomb's Law	<ul style="list-style-type: none"> ▪ State Coulomb's Law, which can be represented mathematically as: $F = \frac{kQ_1Q_2}{r^2}$ ▪ Solve problems using Coulomb's Law to calculate the force exerted on a charge by one or more charges in one dimension (1D) and two dimensions (2D). 	3.2.4
Electric field	<ul style="list-style-type: none"> ▪ Describe an electric field as a region of space in which an electric charge experiences a force. The direction of the electric field at a point is the direction that a positive test charge (+1C) would move if placed at that point ▪ Draw electric field lines for various configurations of charges ▪ Define the magnitude of the electric field at a point as the force per unit charge $E = F/q$ E and F are vectors ▪ Deduce that the force acting on a charge in an electric field is $F = qE$ ▪ Calculate the electric field at a point due to a number of point charges, using the equation $E = \frac{kQ}{r^2}$ to determine the contribution to the field due to each charge 	3.2.5

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<u>Electromagnetism</u>		
Magnetic field associated with current carrying wires	<ul style="list-style-type: none"> ▪ Provide evidence for the existence of a magnetic field (B) near a current carrying wire ▪ Use the Right Hand Rule to determine the magnetic field (B) associated with: (i) a straight current carrying wire, (ii) a current carrying loop (single) of wire and (iii) a solenoid ▪ Draw the magnetic field lines around (i) a straight current carrying wire, (ii) a current carrying loop (single) of wire and (iii) a solenoid ▪ Discuss qualitatively the environmental impact of overhead electrical cables 	<p>3.4.1.1</p> <p>3.4.1.2</p>
Faraday's Law.	<ul style="list-style-type: none"> ▪ State Faraday's Law. ▪ Use words and pictures to describe what happens when a bar magnet is pushed into or pulled out of a solenoid connected to a galvanometer ▪ Use the Right Hand Rule to determine the direction of the induced current in a solenoid when the north or south pole of a magnet is inserted or pulled out ▪ Know that for a loop of area A in the presence of a uniform magnetic field B, the magnetic flux (ϕ) passing through the loop is defined as: $\phi = BA \cos \theta$ where θ is the angle between the magnetic field B and the normal to the loop of area A ▪ Know that the induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux ▪ Calculate the induced emf and induced current for situations involving a changing magnetic field using the equation for Faraday's Law: $\epsilon = -N \frac{\Delta \phi}{\Delta t}$ where $\phi = BA \cos \theta$ is the magnetic flux 	<p>3.4.2.1 – 3.4.2.2</p> <p>3.4.3.1 – 3.4.3.2</p>

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Electric circuits		
Ohm's Law	<ul style="list-style-type: none"> ▪ Determine the relationship between current, voltage and resistance at constant temperature using a simple circuit ▪ State the difference between Ohmic and non-Ohmic conductors, and give an example of each ▪ Solve problems using the mathematical expression of Ohm's Law, $R=V/I$, for series and parallel circuits 	*3.3.1.1- 3.3.1.5 *3.3.2.1.1 – 3.3.2.1.7 *3.3.2.2.1 – 3.3.2.2.7 *3.3.3.1 – 3.3.3.6 *3.3.4.1 – 3.3.4.2 3.3.5.1.1 – 3.3.5.1.3 3.3.5.2.1 – 3.3.5.2.3 3.3.5.3.1 – 3.3.5.3.2 3.3.5.4 3.3.6.1.1 – 3.3.6.7.5 3.3.7.1 – 3.3.7.3
Power, Energy	<ul style="list-style-type: none"> ▪ Define power as the rate at which electrical energy is converted in an electric circuit and is measured in watts (W) ▪ Know that electrical power dissipated in a device is equal to the product of the potential difference across the device and current flowing through it i.e. $P=IV$ ▪ Know that power can also be given by $P=I^2R$ or $P=V^2/R$ ▪ Solve circuit problems involving the concept of power ▪ Know that the electrical energy is given by $E = Pt$ and is measured in joules (J) ▪ Solve problems involving the concept of electrical energy ▪ Know that the kilowatt hour (kWh) refers to the use of 1 kilowatt of electricity for 1 hour ▪ Calculate the cost of electricity usage given the power specifications of the appliances used as well as the duration if the cost of 1 kWh is given 	3.3.8.1.1 – 3.3.8.1.8 3.3.8.2.1 – 3.3.8.2.8 3.3.8.3.1 – 3.3.8.3.8 3.3.8.4.1 – 3.3.8.4.6 3.3.8.5.1 – 3.3.8.5.6 3.3.8.6.1 – 3.3.8.6.6 3.3.8.7.1 – 3.3.8.7.6 3.3.8.8.1.1 – 3.3.8.8.1.3 3.3.8.8.2.1 – 3.3.8.8.2.2 3.3.8.8.3.1 – 3.3.8.8.3.2 3.3.8.8.4.1 – 3.3.8.8.4.2 3.3.8.8.5

* - Background information