CAMI - Science

CAPS - Physics Links Grade 10

TERM 1		
TOPICS	**CONTENT, CONCEPTS & SKILLS**	**CAMI - KEYSTROKES**
<u>Transverse pulses on a string or spring</u>		
Pulse, amplitude	• Define a pulse • Define a transverse pulse • Amplitude • Define amplitude as maximum disturbance of a particle from its rest (equilibrium) position • Know that for a transverse pulse the particles of the medium move at right angles to the direction of propagation of the pulse	2.1.1.1.1 – 2.1.1.1.3 2.1.1.2.1.1 – 2.1.1.2.1.2 2.1.1.2.2.1 – 2.1.1.2.2.2
Superposition of Pulses	• Explain that superposition is the addition of the disturbances of the two pulses that occupy the same space at the same time • Define constructive interference • Define destructive interference • Explain (using diagrams) how two pulses that reach the same point in the same medium superpose constructively and destructively and then continue in the original direction of motion • Apply the principle of superposition to pulses	2.1.2.1.1 – 2.1.2.1.3 2.1.2.2.1 – 2.1.2.2.3 2.1.2.3
<u>Transverse waves</u>		
Wavelength, frequency, amplitude, period, wave speed;	• Define a transverse wave as a succession of transverse pulses • Define wavelength, frequency, period, crest and trough of a wave • Explain the wave concepts: in phase and out of phase • Identify the wavelength, amplitude, crests, troughs, points in phase and points out of phase on a drawing of a transverse wave • Know the relationship between frequency and period, i.e. $f = 1/T$ and $T = 1/f$ • Define wave speed as the product of the frequency and wavelength of a wave: $v = f \times \lambda$ • Use the speed equation, to solve problems involving waves	2.2.1.1.1.1 – 2.2.1.1.1.3 2.2.1.1.2.1 – 2.2.1.1.2.3 2.2.1.2.1.1 – 2.2.1.2.1.3 2.2.1.2.2.1 – 2.2.1.2.2.3 2.2.1.3.1.1 – 2.2.1.3.1.3 2.2.1.3.2.1 – 2.2.1.3.2.3 2.2.1.4.1.1 – 2.2.1.4.1.3 2.2.1.4.2.1 – 2.2.1.4.2.3

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Longitudinal waves:		
On a spring	• Generate a longitudinal wave in a spring • Draw a diagram to represent a longitudinal wave in a spring, showing the direction of motion of the wave relative to the direction in which the particles move	2.3.1 2.3.3
Wavelength, frequency, amplitude, period,wave speed.	• Define the wavelength and amplitude of a longitudinal wave • Define compression and rarefaction • Define the period and frequency of a longitudinal wave and the relationship between the two quantities $f = \frac{1}{T}$ • Use the equation for wave speed, to solve problems involving longitudinal waves	` 2.3.2.1 – 2.3.2.3
Sound		
Sound waves	• Explain that sound waves are created by vibrations in a medium in the direction of propagation. The vibrations cause a regular variation in pressure in the medium • Describe a sound wave as a longitudinal wave • Explain the relationship between wave speed and the properties of the medium in which the wave travels (gas, liquid or solid) • Understand that sound waves undergo reflection. • Understand what are echoes • Use the equation for wave speed, to solve problems involving sound waves that also include echoes, sonar and bats	2.4.1.1 – 2.4.1.3 2.4.3.1 – 2.4.3.3
Pitch, loudness, quality (tone)	• Relate the pitch of a sound to the frequency of a sound wave • Relate the loudness of a sound to both the amplitude of a sound wave and the sensitivity of the human ear	2.4.2.1 – 2.4.2.2 2.4.4.1 – 2.4.4.2
Ultrasound	• Describe sound with frequencies higher than 20kHz as ultrasound, up to about 100kHz • Explain how an image can be created using ultrasound based on the fact that when a wave encounters a boundary between two media, part of the wave is reflected, part is absorbed and part is transmitted • Describe some of the medical benefits and uses of ultrasound, e.g. safety, diagnosis, treatment, pregnancy	2.4.3.1 – 2.4.3.3

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Electromagnetic Radiation		
Dual (particle/wave) nature of EM radiation	• Explain that some aspects of the behaviour of EM radiation can best be explained using a wave model and some aspects can best be explained using a particle model	2..5.2.1
Nature of EM radiation	• Describe the source of electromagnetic waves as an accelerating charge • Use words and diagrams to explain how an EM wave propagates when an electric field oscillating in one plane produces a magnetic field oscillating in a plane at right angles to it, which produces an oscillating electric field, and so on • State that these mutually regenerating fields travel through space at a constant speed of $3x10^8$m/s, represented by c	2.5.2.1
EM spectrum	• Given a list of different types of EM radiation, arrange them in order of frequency or wavelength • Given the wavelength of EM waves, calculate the frequency and vice versa, using the equation: $c = f\lambda$ • Give an example of the use of each type of EM radiation, i.e. gamma rays, X-rays, ultraviolet light, visible light, infrared, microwave and radio and TV waves • Indicate the penetrating ability of the different kinds of EM radiation and relate it to energy of the radiation • Describe the dangers of gamma rays, X-rays and the damaging effect of ultra- violet radiation on skin • Discuss radiation from cell- phones	2.5.3.1 – 2.5.3.2 2.5.4.1 – 2.5.4.2
Nature of EM as particle - energy of a photon related to frequency and Wavelength	• Define a photon • Calculate the energy of a photon using $E = hf = \frac{hc}{\lambda}$ Where h = 6.63 $x10^{-34}$ J.s is Planck's constant, $c=3x10^8$ $m.s^{-1}$ is the speed of light in a vacuum and λ is the wavelength	2.5.2.1 – 2.5.2.2
Waves, legends and folklores		
Detection of waves associated with natural disasters	• Discuss qualitatively animal behavior related to natural disasters across at most two different cultural groups and within current scientific studies	

TERM 2		
TOPICS	**CONTENT, CONCEPTS & SKILLS**	**CAMI - KEYSTROKES**
Magnetism		
Magnetic field of permanent magnets	• Explain that a magnetic field is a region in space where another magnet or ferromagnetic material will experience a force (non- contact) • Know that an electric field is a region in space where an electric charge will experience an electric force. Know that the gravitational field is a region in space where a mass will experience a gravitational force. Compare the magnetic field with the electric and gravitational fields	3.1.1
Poles of permanent magnets, attraction and repulsion, magnetic field lines.	• Describe a magnet as an object that has a pair of opposite poles, called north and south. Even if the object is cut into tiny pieces, each piece will still have both a N and a S pole • Apply the fact that like magnetic poles repel and opposite poles attract to predict the behavior of magnets when they are brought close together • Show the shape of the magnetic field around a bar magnet and a pair of bar magnets placed close together, e.g. using iron filings or compasses. Sketch magnetic field lines to show the shape, size and direction of the magnetic field of different arrangements of bar magnets	3.1.2
Earth's magnetic field, compass	• Explain how a compass indicates the direction of a magnetic field • Compare the magnetic field of the Earth to the magnetic field of a bar magnet using words and diagrams • Explain the difference between the geographical North pole and the magnetic North pole of the Earth • Give examples of phenomena that are affected by Earth's magnetic field e.g. Aurora Borealis (Northern Lights), magnetic storms • Discuss qualitatively how the earth's magnetic field provides protection from solar winds	3.1.3

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Electrostatics		
Two kinds of charge	• Know that all materials contain positive charges (protons) and negative charges (electrons) • Know that an object that has an equal number of electrons and protons is neutral (no net charge) • Know that positively charged objects are electron deficient and negatively charged objects have an excess of electrons • Describe how objects (insulators) can be charged by contact (or rubbing) - tribo-electric charging	3.2.1.1 – 3.2.1.2
Charge conservation	• Know that the SI unit for electric charge is the coulomb • State the principle of conservation of charge as: The net charge of an isolated system remains constant during any physical process. e.g. two charges making contact and then separating. • Apply the principle of conservation of charge • Know that when two identical conducting objects having charges Q_1 and Q_2 on insulating stands touch, that each has the same final charge on seperation. final charge: after separation $Q = \frac{Q_1 + Q_2}{2}$ NO TE: This equation is only true of identically sized conductors on insulated stands	3.2.2
Charge quantization	• State the principle of charge quantization • Apply the principle of charge quantization	3.2.2
Force exerted by charges on each other -descriptive Attraction between charged and uncharged objects (polarisation)	• Recall that like charges repel and opposite charges attract • Explain how charged objects can attract uncharged insulators because of the polarization of molecules inside insulators	3.2.3.1 – 3.2.3.2

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<u>Electric circuits</u>		
emf, Terminal Potential Difference (terminal pd)	• Define potential difference in terms of work done and charge. V = W/Q • Know that the voltage measured across the terminals of a battery when no current is flowing through the battery is called the emf • Know that the voltage measured across the terminals of a battery when current is flowing through the battery is called terminal potential difference (terminal pd). • Know that emf and pd are measured in volts (V) • Do calculations using V = W/Q	3.3.1.1 – 3.3.1.5 3.3.2.1.1 – 3.3.2.1.7
Current	• Define current, I, as the rate of flow of charge. It is measured in ampere (A), which is the same as coulomb per second • Calculate the current flowing using the equation $I = \frac{Q}{\Delta t}$ • Indicate the direction of the current in circuit diagrams (conventional)	3.3.2.2.1 – 3.3.2.2.7
Measurement of voltage (pd) and current	• Draw a diagram to show how to correctly connect an ammeter to measure the current through a given circuit element • Draw a diagram to show how to correctly connect a voltmeter to measure the voltage across a given circuit element	3.3.3.1 – 3.3.3.6
Resistance	• Define resistance • Explain that resistance is the opposition to the flow of electric current • Define the unit of resistance; one ohm (W) is one volt per ampere. • Give a microscopic description of resistance in terms of electrons moving through a conductor colliding with the particles of which the conductor (metal) is made and transferring kinetic energy. • State and explain factors that affect the resistance of a substance • Explain why a battery in a circuit goes flat eventually by referring to the energy transformations that take place in the battery and the resistors in a circuit	3.3.4.1 – 3.3.4.2

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Resistors in series	• Know that current is constant through each resistor in series circuit. • Know that series circuits are called voltage dividers because the total potential difference is equal to the sum of the potential differences across all the individual components. • Calculate the equivalent (total) resistance of resistors connected in series using: $R_s = R_1 + R_2 + \dots$	3.3.5.1.1 – 3.3.5.1.3
Resistors in parallel	• Know that voltage is constant across resistors connected in parallel • Know that a parallel circuit is called a current divider because the total current in the circuit is equal to the sum of the branch currents • Calculate the equivalent (total) resistance of resistors connected in parallel using: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	3.3.5.2.1 – 3.3.5.2.3 3.3.5.3.1 – 3.3.5.3.2 3.3.5.4
	• Know that for two resistors connected in parallel, the total resistance can be calculated using: $R_p = \frac{product}{sum} = \frac{R_1 R_2}{R_1 + R_2}$	

TERM 3		
TOPICS	**CONTENT, CONCEPTS & SKILLS**	**CAMI - KEYSTROKES**
<u>Vectors and scalars</u>		
Introduction to vectors & scalars.	• List physical quantities for example time, mass, weight, force, charge etc. • Define a vector and a scalar quantity • Differentiate between vector and scalar quantities • Understand that F represents the force factor, whereas F represents the magnitude of the force factor • Graphical representation of vector quantities. • Properties of vectors like equality of vectors, negative vectors, addition and subtraction of vectors using the force vector as an example. N.B. This is to be done <u>in one dimension only</u>. • Define resultant vector • Find resultant vector graphically using the tail-to-head method as well as by calculation for a maximum of four force vectors in one dimension only	1.1.1.1 – 1.1.1.2 1.1.1.3.1 – 1.1.1.3.3
<u>Motion in one dimension:</u>		
Reference frame, position, displacement and distance.	• Describe the concept of a frame of reference • Explain that a frame of reference has an origin and a set of directions e.g. East and West or up and down • Define one dimensional motion • Define position relative to a reference point and understand that position can be positive or negative • Define distance and know that distance is a scalar quantity • Define displacement as a change in position • Know that displacement is a vector quantity that points from initial to final position • Know and illustrate the difference between displacement and distance • Calculate distance and displacement for one dimensional motion	1.3.1.1.1 – 1.3.1.1.2

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Average speed, average velocity, acceleration	• Define average speed as the distance travelled divided by the total time and know that average speed is a scalar quantity • Define average velocity as the displacement (or change in position) divided by the time taken and know that average velocity is a vector quantity. Use $\bar{v}$ as a symbol for average velocity • Calculate average speed and average velocity for one dimensional motion. • Convert between different units of speed and velocity, e.g. $m.s^{-1}$, $km.h^{-1}$ • Define average acceleration as the change in velocity divided by the time taken • Differentiate between positive acceleration, negative acceleration and deceleration • Understand that acceleration provides no information about the direction of motion; it only indicates how the motion (velocity) changes	1.3.2.1.1 – 1.3.2.1.2 1.3.2.2.1 – 1.3.2.2.2 1.3.3.1.1 – 1.3.3.1.3 1.3.3.2.1 – 1.3.3.2.3 1.3.3.3.1 – 1.3.3.3.3
Instantaneous speed and velocity and the equations of motion.		
Instantaneous velocity, instantaneous speed,	• Define instantaneous velocity as the displacement (or change in position) divided by an infinitesimal (very small) time interval • Know that instantaneous velocity is a vector quantity • Define instantaneous speed as the magnitude of the instantaneous velocity	1.3.2.1.1 – 1.3.2.1.2 1.3.2.2.1 – 1.3.2.2.2 1.3.3.1.1 – 1.3.3.1.3 1.3.3.2.1 – 1.3.3.2.3 1.3.3.3.1 – 1.3.3.3.3
Description of motion in words, diagrams, graphs and equations.	• Describe in words and distinguish between motion with uniform velocity and uniformly accelerated motion • Describe the motion of an object given its position vs time, velocity vs time and acceleration vs time graph • Determine the velocity of an object from the gradient of the position vs time graph • Know that the slope of a tangent to a position vs. time graph yields the instantaneous velocity at that particular time • Determine the acceleration of an object from the gradient of the velocity vs time graph • Determine the displacement of an object by finding the area under a velocity vs time graph	1.3.4.1.1.1 – 1.3.4.1.1.3 1.3.4.1.2.1 – 1.3.4.1.2.2 1.3.4.1.3

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	• Use the kinematics equations to solve problems involving motion in one dimension (horizontal only) $v_f = v_i + a\Delta t$ $\Delta x = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$ $v_f^2 = v_i^2 + 2a\Delta x$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ • Demonstrate an understanding of motion of a vehicle and safety issues, such as the relationship between speed and stopping distance	1.3.4.2.1.1 – 1.3.4.2.1.3 1.3.4.2.2.1 – 1.3.4.2.2.3 1.3.4.2.3 1.3.4.2.4 1.3.4.2.5

TERM 4		
TOPICS	**CONTENT, CONCEPTS & SKILLS**	**CAMI - KEYSTROKES**
Energy:		
Gravitational potential Energy	• Define gravitational potential energy of an object as the energy it has because of its position in the gravitational field relative to some reference point • Determine the gravitational potential energy of an object using $E_P = mgh$	1.5.1.1.1 – 1.5.1.1.3 1.5.1.2.1 – 1.5.1.2.3 1.5.1.3 1.5.1.4
Kinetic energy	• Define kinetic energy as the energy an object possess as a result of its motion • Determine the kinetic energy of an object using $E_K = \frac{1}{2}mv^2$	1.5.2.1 – 1.5.2.8
Mechanical energy (E_M)	• Define mechanical energy as the sum of the gravitational potential and kinetic energy Use equation: $E_M = E_K + E_P$	1.5.3.1.1 – 1.5.3.1.2 1.5.3.2 – 1.5.3.5
Conservation of mechanical energy (in the absence of dissipative forces).	• State the law of the conservation of energy • State that in the absence of air resistance, the mechanical energy of an object moving in the earth's gravitational field is constant (conserved) • Apply the principle of conservation of mechanical energy to various contexts viz. objects dropped or thrown vertically upwards, the motion of a pendulum bob, roller coasters and inclined plane problems Use equation: $E_{K1} + E_{P1} = E_{K2} + E_{P2}$	1.5.4.1 – 1.5.4.3