Physics

Yr 7/8 JSO exam syllabus (Physics)

Australian Curriculum Content Descriptor (V9)	Elaboration of core concepts: Students:	**Content presentation (i & ii):** Read (or watch) the physics classroom tutorials: Lesson 1: Describing motion with words Lesson 2: Describing motion with diagrams Lesson 3: Describing motion with position-time graphs from: 1-D Kinematics: Describing the Motion of Objects **Consolidation of content (i & ii):** Complete the concept builder exercises (note: if you get stuck, click the "help me" button for assistance. Some also have an associated video you can watch) Distance-Displacement Concept Builder Speed-Distance-Time Concept Builder Position Time Graphs Concept Builder Motion Diagrams Concept Builder (just motion diagrams with velocity vectors) **Content presentation (iii to vii):** Read (or watch) the physics classroom tutorials: Lesson 1: Newton's 1st law Lesson 2: Force and its representation From: Newton's Laws of Motion Tutorial
investigate and represent balanced and unbalanced forces, including gravitational force, acting on objects, and relate changes in an object's motion to its mass and the magnitude and direction of forces acting on it (AC9S7U04)	i. Identify that motion can be described using speed and direction ii. Describe constant and changing speed and direction of motion (1D) using speed = distance/time, motion diagrams and position-time graphs iii. Identify that a weight force, directed towards the centre of the Earth and proportional to mass, acts on objects on the surface of the Earth (F = mg) iv. Identify that contact forces act where the external environment touches an object v. Represent forces using vectors (arrows pointing in the direction of the force with length proportional to the size of the force) vi. Recognise that balanced forces imply constant speed and direction of motion vii. Recognise that unbalanced forces imply changing speed and/or direction of motion viii. Interpret the gradient of position-time graphs as the speed and direction (velocity) of a particle.	

	ix. Describe how simple machines such as levers and pulleys are used to change the magnitude of force needed to perform a task while the energy expended remains constant.	Also watch: Force and Motion Misconceptions Video Tutorial **Consolidation of content (iii to vii):** Balanced vs. Unbalanced Forces Interactive (up to master level) Force and Motion (horizontal motion only and vertical motion only) Change of State Concept Builder (master level) Mission NL2: Balanced Forces and the State of Motion
Classify different types of energy as kinetic or potential and investigate energy transfer and transformations in simple systems (AC9S8U05)	Elaboration of core concepts: Students: i. investigating relationships between kinetic and potential energy in systems where the sum of these remains constant as well as where the sum decreases over time due to dissipative forces such as friction or drag. ii. classifying types of energy as associated with movement, such as kinetic energy and thermal energy, or potential energy such as gravitational, elastic or chemical. iii. critiquing and using representations such as flow diagrams to illustrate changes between different forms of energy in a system iv. identifying where heat energy is produced as a by-product of energy transfer, such as	**More content will be added to this section as resources are developed.** An engaging activity that utilises work-energy bar charts: https://universeandmore.com/energy Introduction to power in electrical circuits in the physics classroom: Requirements of a Circuit Power (Putting Charges to Work) Common Misconceptions Regarding Electric Circuits Check your understanding: Light Bulb Anatomy P-V-I-R-Cost-Calculations

	filament light globes, exercise, and battery charging and use v. using electrical circuits and components to demonstrate electrical energy transfer and its transformation into heat, light and sound	

Yr 9/10 JSO exam syllabus (Physics)

The yr 7 & 8 syllabus is assumed knowledge

investigate Newton's laws of motion and quantitatively analyse the relationship between force, mass and acceleration of objects (AC9S10U05)	Elaboration of core concepts: Building on concepts in the yr 7 & 8 syllabus, students: i. Identify that motion can be described using the scalar quantities of distance travelled and speed, as well as the vector quantities of position, displacement, velocity and acceleration, which have magnitude as well as direction. ii. Represent the position, velocity and acceleration of an object using motion diagrams, vectors and position-time,	**Content presentation (i-ii):** Read (or watch) the physics classroom tutorials: Review lessons 1-3 (from year 7 & 8 physics) Lesson 4: Describing motion with velocity-time graphs Lesson 5: Free fall and acceleration due to gravity Lesson 6: Describing motion with equations from: https://www.physicsclassroom.com/Physics-Tutorial/1-D-Kinematics **Check your understanding (i-ii):** Complete the following concept builder exercises. Note that (if you get stuck) there is a link to a short video explaining how to do the questions. Name That Motion

	velocity-time and acceleration-time graphs iii. Identify non-contact forces acting on an object or system of objects, including the weight force (quantitatively), electrostatic and magnetic forces (qualitatively) iv. Identify forces acting at points of contact between an object and its environment, including normal forces, tension, friction, rolling resistance and drag. v. Represent the forces acting on an object using free body (vector) diagrams and graphs vi. Apply Newton's 1st law to a system on which balanced forces act vii. Apply Newton's 2nd law ($F_{net} = ma$) to a system on which unbalanced forces act viii. Apply Newton's 3rd law to identify pairs of forces that are equal in magnitude, opposite in direction and act on different objects	Graph That Motion Match That Graph **Content presentation (iii-vii):** Read (or watch the associated videos for) the physics classroom tutorials: Review lessons 1 & 2 (from year 7 & 8 physics) Lesson 3: Newton's 2nd law of motion Lesson 4: Newton's 3rd law of motion Newton's Laws of Motion Tutorial **Check your understanding (iii-vii):** Balanced vs. Unbalanced Forces (Wizard level) Force and Motion (horizontal and vertical motion) Change of State Concept Builder (Wizard level) Force Diagrams - Newton's Laws Recognizing Forces (note: in this particular activity it is assumed that there is air resistance if the object is moving. This is fine, if you note that air resistance acting on dense objects moving at low speeds is almost zero, so in other physics questions you encounter you may be expected to ignore it). Match That Free-Body Diagram Which One Doesn't Belong? Mission NL9: Force Analysis - Newton's Laws Newtons Second Law - Concept Builders Net Force Ranking Tasks Mission NL12: Newton's Third Law

	Extension: ix. Analyse motion under constant acceleration using the equations $v = u + at$, $s = ut + \frac{1}{2}at^2$ and $v^2 = u^2 + 2as$ x. Use Newton's 2nd law, motion diagrams, vector diagrams and graphs to reason about the motion of a system on which unbalanced forces act in two dimensions xi. Identify that a given change in velocity can be achieved by a large force acting briefly or a small force acting over a longer time. xii. Elastic forces can be modelled using a force that is proportional to the displacement of a system from equilibrium (Hooke's law: $F = kx$)	**Content presentation (Extension: ix-xii):** Once you have mastered the content on "the Physics Classroom", you really can't do better than Flipping Physics. Mr. P focuses on teaching physics using *real phenomena* and *real data*. Physics is all about describing the real world. AP Physics 1 Videos One dimensional motion: Acceleration playlist: Videos 4-12 Freefall playlist: All videos are good, but later ones cover more challenging problems. Newton's laws of motion: Watch: - Newton's 3 laws of motion playlist - Understanding forces, tension, equilibrium and friction playlist - Hooke's law: https://www.flippingphysics.com/hookes-law.html
Use wave and particle models to describe energy transfer through different mediums and	Elaboration of core concepts: i. Sound and other mechanical waves transfer energy via vibrations in a	**Content presentation (i):** Read (or watch) the physics classroom tutorials: Lesson 0: Vibrations Lesson 1: The nature of a wave

examine the usefulness of each model for explaining phenomena (AC9S9U04)	medium. Sound waves in air are longitudinal, while mechanical waves in solids can be either longitudinal or transverse ii. The speed of a wave is equal to $v = f\lambda$ iii. Period and frequency are related as $T = \frac{1}{f}$ iv. Light can be absorbed or scattered, reflected and refracted. Extension:	Lesson 2: The properties of a wave From: Vibrations and Waves - Physics Tutorial Lesson 1: The nature of a sound wave Lesson 2: Sound properties and their perception From: Sound Waves and Music - Physics Tutorial **Consolidation of content (i):** Complete the concept builder exercises (note: if you get stuck, click "help me" for assistance. Some also have an associated video you can watch) Frequency and Period - Concept Builders Wave Basics Wave Characteristics Wavelength Waves: Case Studies Wave Properties **Content presentation (ii):** Read (or watch) the physics classroom tutorials: Lesson 2: Colour and vision From: Light Waves and Color - Physics Tutorial Lesson 1: Reflection and its importance Lesson 2: Image formation in plane mirrors From: Physics Tutorial: Reflection and the Ray Model of Light Lesson 1: Refraction at a boundary From: Physics Tutorial: Refraction and the Ray Model of Light **Consolidation of content (ii):**

	iii. Snell's law $n_1 \sin\theta_1 = n_2 \sin\theta_2$ for refraction and total internal reflection, iv. Wave diffraction and interference (qualitative) v. Resonance and standing waves in strings and pipes vi. The energy carried by a wave (power) is larger for larger amplitudes. vii. The intensity of a wave decreases as $I = \frac{P}{4\pi r^2}$ for a point source of waves, where P is the power of the source, r is the distance from the source. viii. The energy of light quanta is proportional to frequency $E = hf$	Spectrum - Electromagnetic and Visible Light Color Addition and Subtraction Law of Reflection - Concept Builders Who Can See Who Law Enforcement - Refraction **Content presentation (iii - extension):** Read (or watch) the physics classroom tutorials: Lesson 2: The mathematics of refraction Lesson 3: Total internal reflection Lesson 4: Interesting refraction phenomena From: Physics Tutorial: Refraction and the Ray Model of Light Lesson 3: Behaviour of sound waves Lesson 4: Resonance and standing waves Lesson 5: The physics of musical instruments From: https://www.physicsclassroom.com/class/sound **Consolidation of content (iii - extension):** Snell's law and total internal reflection https://www.physicsclassroom.com/mop/Refraction-and-Lenses/Snells-Law/Mission-RL4 Total Internal Reflection Interference and standing waves Wave Interference
Apply the law of	Elaboration of core concepts:	**More content will be added to this section as resources**

conservation of energy to analyse system efficiency in terms of energy inputs, outputs, transfers and transformations (AC9S9U05)	Students: i. Identify that a system (a particular group of objects) possesses stores of energy ii. Identify that energy can be stored in the form of motion as kinetic energy and/or thermal energy iii. Identify that energy can be stored in the form of potential energy due to forces (interactions) between objects in the system. iv. Energy can be transferred to or from a system via work (where a force acts over a distance) or heat (energy flow due to a temperature difference). v. If no energy is transferred to the system, then energy can be moved between different stores in the system but the total energy stored in the system is constant. vi. If energy is transferred to or from the system, then the change in the energy stored in the system is equal to the amount of energy transferred or removed. vii. Use representations such as energy flow diagrams, work-energy bar charts	**are developed.** Read (or watch) the unit on energy from Khan Academy: Energy | High school physics | Science | Khan Academy Play the Energy Bar Charts game on the Universe and More: https://universeandmore.com/energy Energy skate park Phet resource: Energy skate park Simple introduction to energy skate park: https://www.youtube.com/watch?v=XUCN3GjXE74 More in depth (includes calculations of kinetic energy and application of conservation of mechanical energy): https://www.youtube.com/watch?v=ZvqJP_wJjEo A great resource on energy from the Perimeter Institute of Theoretical physics: A Deeper Understanding of Energy

	and Sankey diagrams to describe energy transfers and transformations viii. An unwanted by-product of many processes is the transformation of energy into thermal energy in the system or the environment. Processes in which a smaller fraction of energy is transformed into thermal energy are more efficient. ix. Thermal energy can be transferred by conduction, convection or radiation. x. Evaluate the advantages and disadvantages of using renewable and non-renewable sources of energy to generate electricity, including efficiency, economic and technological considerations Extension (quantitative aspects of the above content) xi. The kinetic energy of a particle of mass m and speed v is KE = 12mv2 xii. The change in the potential energy stored in the system consisting of Earth and a mass m when the mass moves from vertical position y_i to vertical position y_f is $\Delta PE = mg(y_f - y_i)$	**Content presentation (extension: x-xiii):** Read (or watch) the material on work, energy and power at the physics classroom: Work, Energy, and Power OR (Higher level) Read the OpenStax chapter on energy here: Ch. 7 Introduction to Work, Energy, and Energy Resources - College Physics 2e | OpenStax

	xiii. The work done on (i.e. transferred to) a system by a force is equal to $W = Fs$ where s is the displacement of the system in the direction of the force at the point at where the force is applied. xiv. Power is the rate at which energy is being transferred to/from a system or transformed to other forms within a system. It has units of J/s. xv. The heat transferred to (or from) a system due to a temperature difference is given by $Q = mC(T_{env} - T_{sys})$ where m is the mass of the system, C is the specific heat capacity and where T_{env} and T_{sys} are the temperatures of the environment and system respectively. xvi. The energy released when a substance freezes or condenses (or is absorbed when it melts or vaporises) is: $Q_L = mL$ where m is the mass of substance, L is the specific latent heat of fusion or vaporisation.	
Electrical circuits (as an example of energy transformation and	i. Identify the elements of a complete circuit	**Content presentation (i-v):** Read (or watch) the lessons in the Physics classroom on circuits, and complete the “check your understanding”

transfer from AC9S9U05)	ii. Construct circuits and draw circuit diagrams that contain several components to show the flow of electricity through a complete circuit iii. Measure and compare voltage and current at different points in series and parallel circuits iv. Investigate the relationship between voltage, current, and resistance for an ohmic device v. Analyse energy transformations in circuits Extension vi. Current flows in response to a potential difference. If two points in a circuit are at the same electrical potential, no current will flow between those points. vii. Any points in a circuit that are connected directly are at the same potential. viii. The resistance of a circuit element is defined as R = V/I where V is the electrical potential difference (i.e.	questions as you go: The Physics Classroom Tutorial: Electric Circuits **Consolidation of content (i-v):** Complete the concept builders: Light Bulb Anatomy (this is important for correctly understanding how light bulbs work in a circuit) Electric Current Know Your Potential - Concept Builders Ohm's Law - Voltage, Current, and Resistance Electric Power - Concept Builder Series Versus Parallel Circuits Play "Crack the circuit": https://universeandmore.com/crack-the-circuit/ **Consolidation of content (vi-xi):** Equivalent Resistance Series-Circuits - ΔV=I•R Calculations Parallel-Circuits - ΔV=I•R Calculations

	voltage) across the element and I is the current flowing through it. ix. The sum of the potential changes around any complete loop in a circuit add to zero (Kirchoff's loop rule) x. The sum of the currents flowing into a junction equals the sum of the currents flowing out of the junction (Kirchoff's junction rule) xi. Calculate the current flowing and voltage across circuit elements at different points in series and parallel circuits.	