Vicphysics Teachers' Network Inc.

PHYSCON 2023
Small Group Discussion Support Material

These templates were completed as part of the Small Group Discussion Session at PHYSCON 2023. They will assist you in designing assessment tasks for use in 2024. The completed templates cover all of the four types of Assessment Tasks A to D. They also cover all Areas of Study. There are 47 in total. Your critique of these examples is welcome.

Assessment Task A: application of physics concepts to explain a model, theory, device, design or innovation

Unit: 3, Outcome: 2. Prepared for the Conference

Contexts	Assessment Criteria	Task components
Maglev train, Voltmeter, Ammeter, Motors (Series, Shunt and Compound), Loudspeaker, Mass spectrometer, Velocity selector, Dielectric elastomer (Electrical energy to mechanical work), Electric field sensor, Magnetometer, Pulsed electric field (food preservation)	i) What does it do? (Physics terms and their Accurate use) ii) How does it work? (Explanation, Coherence and Completeness) <u>High level of achievement</u> i) sound knowledge and precise description ii) shows deep understanding, successfully collates and analyses relevant information, constructs a logical, thorough of a device. <u>Minimum level of achievement</u> i) little knowledge and limited relevance ii) shows poor understanding, some sense of structure, but incomplete coverage of information and concepts.	Students select or are allocated a device. They use a log-book in class to research it, which can be retained in class. Then with their log-books under SAC conditions: • Describe the purpose of your chosen device, • Explain its operation using relevant physics concepts, units and typical values for quantities, • Hand-draw a labelled diagram to support the explanation, • Acknowledge references.

Generated as part of the Small Group Discussion

Unit 3, Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
Toys that use motion concepts. Circ: flutterbye fairy, fidget spinners, bey blades Projectiles (nerf gun) Hot Wheels tracks: collisions, GPE to KE, circ motion Springs: wind-up toys	• Sample calculations • Clearly link theory to device and use scientific language • Apply similar principles to similar toys or describe improvements to toy • Compare to other toys	• State observation of use of toy • State theory / energies used but not linked well to device usage	• Identify types of energy used / converted • Describing components of design of device • Documented in a log book

Unit: 3, Outcome: 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Orbit of James Webb Space Telescope (JWST)	• Explanations of orbits • Explaining impact of changes	• Calculations correct	• Either provide some stimulus material beforehand depending on complexity of text and probably simplify orbit to circular • Questions about orbit calculations • Energy conversions / graphs • *Other* calculations • Change conditions and what happens • Compare circular orbit with the real JWST orbit • Discuss why in particular orbit

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
Build a speaker; paper cone, ring magnet, coil, stick and sig gen	• Model works well (volume and freq) • Physics is clearly explained (Lorentz force: vary B, I and *l*) • RH Grip rule, Flemings/Slap rule • Lenz's law	• Not so well • Some physics • Increased current produces increased magnitude	• Research speakers • Dismantle speaker • Assemble a kit speaker, • Test. Evaluate • Explain

Unit 3 Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
Electricity generation and transmission system	• Sound knowledge and precise description • Correct transformer equations • Completeness (each part of the system explained) • Correct power loss equation	• Limited knowledge • No equations • Wrong power loss equation	• Describe the purpose of step and step don transformers. • Explain the operation of a transformer using Physics concepts: coil and core • Diagrams

Unit 3, Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
explain how a device that uses induction: metal detector, magnetic damping, dynamo, RFID chip, dog chip	• Draw EMF – time graph • Draw flux – time graph • Explain qualitatively Faraday's law	• Know of Faraday's law • Explain it qualitatively • Draw diagrams	Step 1 Research device Step 2 Answer a set of questions on how device works as an application of Faraday's law, Lenz's law.

Unit 3 Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
Transformers in different contexts • Power lines • Cable chargers • *Micro waves*	• Able to make links to more parts of the study design • Information is clearly and succinctly presented • Their *peers* can explain clearly describe another student's device	• May not be able to make links *behind hidden* physics • jumbled / unclear order / presentation of ??? • Their peers are unable to clearly describe another student's device	20 mark structured questions in one context. PPT delivered to Yr 7 class • What is your device? How does it work? • Explain the background theory of your device • Link this device to concepts taught in class Peer assessment??

Unit 3 Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Transmission of electricity	• Apply Lenz's law to explain why induced current will travel in a particular direction • Explain using Faraday's Law the impact changing each variable has • Identify and explain the positioning and function of step up and step down transformers	• Apply Lenz's law to predict direction of a current • Apply Faraday's law to calculate unknown quantities • Complete calculations regarding transformer output and input	• Explaining the effect of changing number of coils, magnetic field strength • Explain how a transformer works • Looking at the use of transformers in a power distribution grid • Calculations involving coils, voltage and current • Calculations involving power input and output using different transformers • Compare AC and DC transmission and different voltages and currents • Explain the need for the use of inverters

Unit 4, Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	Minimum level of achievement	
Application of relativity to GPS satellites	• Describe what physics aspects in calculating in time and position • Time dilation, laws of motion,Transforms, Twin paradox, Non-accelerating inertial references frames, • How signal is produced, How it is received, How it is calculated • Appropriate use of physics terms • Calculate orbital characteristics	• Some attempt to explain relativity • Changes measurements of time and space • Attempts to use relativity terms	• Heavens above website Heavens-Above • Research relevant data source

Unit 4 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	Minimum level of achievement	
Light: Provide 2 devices that demonstrate / apply wave model and particle model of light, e.g. solar panels, solar cooker, polaroid sunglasses	• Uses evidence to support model link to device • Thoroughly describes / explains models of light • Identify model of light with more devices • Expands explanation to include other behaviour of light, e.g. dispersion	• Link device with appropriate model of light • Identifies there are two models of light	• Students provided devices • Explain device using physics concepts

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Example of a Small Discussion Report

Assessment Task B: analysis and evaluation of primary and/or secondary data, including data plotting, identified assumptions or data limitations, and conclusions.

Unit: 3, Outcome: 3. Two versions: One with secondary data, another with primary data.

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
Induced emf in a coil. (Using secondary data)	• Able to explain the purpose of the investigation. • Able to interpret the data provided. • Able to do appropriate calculations. • systematically collated data, appropriate to the investigation. • organised and presented data in useful and meaningful ways, including tables and graphs. • Able to analyse the information from the graph. • Able to evaluate the data and draw relevant inferences. • Identifies data limitations. • used appropriate numbers of significant figures throughout.	• Can identify the purpose of the investigation. • Can identify the data that is relevant. • Able to do some of the calculation and manipulation of the data. • Limited attempt to collate data • Attempts to construct a graphical representation of the data. • Limited attempt to analyse the data. • Attempted to present data in a meaningful way. • Occasionally used appropriate numbers of significant figures	Investigate the magnitude of the emf produced in a solenoid when dropping a permanent magnet through it. Vary the initial height or strength of the falling magnet. • Identify the purpose of the task. • Explain the theory underpinning the investigation. • Select appropriate data and organise it in a meaningful way. • Interpret the data and relate this to the purpose of the task. • Comment on any limitations of the data.

<table>
<tr><th>Contexts</th><th colspan="2">Assessment Criteria</th><th>Task components</th></tr>
<tr><td rowspan="2">Induced emf in a coil. (Using primary data)</td><td>High Level of achievement</td><td>Minimum level of achievement</td><td rowspan="2">Investigate the magnitude of the emf produced in a solenoid when dropping a permanent magnet through it. Vary the initial height or strength of the falling magnet.
• Identify the purpose of the task.
• Explain the theory underpinning the investigation.
• Design an experiment in order to produce data to address the purpose of the task.
• Organise it in a meaningful way.
• Interpret the data and relate this to the purpose of the task.
• Comment on any limitations of the data.</td></tr>
<tr><td>• Able to explain the purpose of the investigation.
• Able to collect all appropriate data over a suitable range of values.
• Able to interpret the data collected.
• Able to do appropriate calculations.
• Organised and presented data in useful and meaningful ways, including tables and graphs.
• Able to analyse the information from the graph.
• Able to evaluate the data and draw relevant inferences.
• Identified data limitations.
• Used appropriate numbers of significant figures throughout.</td><td>• Can identify the purpose of the investigation.
• Able to collect some appropriate data.
• Can identify the data that is relevant.
• Able to do some of the calculation and manipulation of the data.
• Attempts to construct a graphical representation of the data.
• Limited attempt to analyse the data.
• Attempted to present data in a meaningful way.
• Occasionally used appropriate numbers of significant figures.</td></tr>
</table>

Generated as part of the Small Group Discussion
Unit 3 Outcome 1

<table>
<tr><th>Contexts</th><th colspan="2">Assessment Criteria</th><th>Task components</th></tr>
<tr><td rowspan="2">Evaluation of projectile motion
• Launch a projectile consistently
• Measure distance, time and ??? height</td><td>High Level of achievement</td><td>Min level of achievement</td><td rowspan="2">• Experiment with balls and projectiles
• Measure variety of balls mass/size
• 2 same mass, diff size
• 2 same size diff mass
• 3 balls in each</td></tr>
<tr><td>• Understanding measurement uncertainty
• Calculate uncertainty.
• Apply accurately Newton's laws
• ??? a qualitative calculation of air resistance
• Graphically represent Dist vs time with uncertainty bars</td><td>• Attempt to do the high level
• Results contain inaccuracies</td></tr>
</table>

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Analysing $F_g = GMm/r^2$ (secondary data) Plotting F_g vs $1/r^2$ and finding G, using gradient and comparing to G	• Able to interpret the data provided • Organised data in useful including tables / graphs • Identifies data limitations • Compare values to theoretical data	• Manipulate data • Complete a table in some meaningful way • Some use of significant figures	• Give them data (mass values and r values) • Use data to answer questions

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	

• Coulomb's Law
• 'Weight force' / Force between two charges
	• Linearise graph based on knowledge gained from centripetal acceleration prac
	• Recognise data limitations and assumptions, error bars
	• Sensible conclusion, link to theory
	• Suggestions for future improvement
		• Able to plot F vs r
		• Proper scale, SI units used
			• Analysing secondary data based on Coulomb's Law
			• Conduct in class either of the following experiments:
			  • Metal sphere connected to Van de Graaff Gen is placed above another charged metal sphere placed on a top loading balance, which is on an adjustable stand
			  • Charged rod (horiz) is placed above a top loading balance with a large metal sheet on top, The balance sits on an adjustable stand, the rod is held in a bosshead attached to a retort stand.
			• Student to record the following: i) reading on top loading balance, ii) charge separation
			• Using previous learned skill to analyse and linearise data, F vs r and F vs $1/r^2$

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
• Current balance • Circular Motion (link to grav fields)	• Identify, quantify and calculate any limitations • Using sig figs to the correct context • Includes error bars on graphs and appropriately fits a line of best fit within the range of uncertainty • Can explain and link limiting factors to relevant concepts	• Can plot given data points • Can identify how the data should be manipulated	• Graphing • Ability to manipulate data • Calculating uncertainties • Identifying limiting factors • Recognising outliers and anomalous data • Analyse data and link to mathematical concepts of physics

Unit 3 Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Analysing transmission losses in power lines: Data sets of power *lines*	• Plot data clearly with trend line, explain/justify the trend with theory • Presenting the estimated loss with discussion on the uncertainty • High level of discussion (reasons for losses, bias of data publishers) • Identify ways to reduce power loss • Practical implications, cost, etc	• Plot the data • Identify the correct data set • Estimate the loss • Respond to some of the discussion	• Estimate power losses at given locations and specific conditions • Analyse existing data to identify averages and trends, research and during class • Assessment: apply to given circumstances, use das sest to estimate • To develop graph / plot from ???? and compare • Discussion on sources and limits of data collection

Unit 4 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
PE Effect investigation at Synchrotron	• Proper calculation of Planck's Constant, threshold frequency and work function including uncertainties from measured data • comparison of two models for light and • limitations of wave model	• Do all calculations but not evaluating uncertainties and not explaining limitation of light model	• Excursion to Synchrotron • Analysing data

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Example of a Small Discussion Report

Assessment Task C: problem-solving, applying physics concepts and skills to real-world contexts

Unit: 3, Outcome: 1

Contexts	Assessment Criteria		Task components
	High level of achievement	**Minimum level of achievement**	
Luna Park rides	• Able to explain the sources of the forces on the passenger, their effect and why any may vary. • Able to draw a force diagram. • Able to calculate the value of the forces, given speed and radius. • Able to convert energy changes between GPE and KE at different parts of the rides. • Can identify the driving mechanism in a ride. • Successfully collates and analyses relevant information, concepts and data to analyse and evaluate this real-world context.	• Can describe the experience using physics terms. • Can identify the forces involved acting on the passenger. • Can describe the energy changes.	• Draw a properly labelled force diagram for the Twin Dragon, Enterprise and Scenic Railway. • Calculate the value of relevant quantities, making reasonable estimates of the values of various parameters and dimensions. • Explain the changes in GPE and KE of and the forces on a passenger during each ride. • Identify potential risks and suggest safety protocols.

Unit: 4, Outcome: 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Minimum level of achievement**	
Cosmic ray showers	• Able to explain the limitation of classical physics in explaining this phenomenon. • Able to explain that time dilation (or length contraction) occurs for the particles. • Able to correctly apply mathematical models for time dilation (or length contraction) to the particles. • Can justify why more particles are detected than predicted by classical physics. • Consistently used appropriate physics terminology, representations, and conventions • used clear, coherent and concise expression to communicate.	• Can identify the limitation of classical physics in explaining this phenomenon. • Can identify that time dilation (or length contraction) occurs. • Attempts to apply mathematical models for time dilation (or length contraction), but with limited success. • Attempts to compare classical prediction with experiment results. • Attempted to use appropriate physics terminology. • Occasionally used clear expression to communicate.	Investigate the observational evidence for the special theory of relativity. • Describe both the 'classical and relativistic' physics interpretations of this phenomena. • Identify key differences between the two. • Model the distance travelled by the particles in both a 'classical and relativistic' scenarios. • Explain the real world findings.

Generated as part of the Small Group Discussion
Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Bungee Jump Luna Park Design of a safe ride	• Safe ride with justifications, assumptions • Bring in 3 – 4 dot points in AOS1 U3 • Accurate calculations and analysis of F, a, or force and energy interactions, including error analysis on theme park rides • Relate findings to safety concerns	• Label the forces on different planes, motion • Linking 1 – 2 dot points • Simple / sample calculations with standard formulae of force / energy ineractions • Relate some findings to a real-world context	• Collect data / notes on your allocated ride • Teacher make a SAC with 4 – 5 general scaffolded questions on 'How the students can design a safe ride using the numbers /data collected in pairs or • Calculate forces on rides • Discuss the effect of changes in normal reaction force on the body • Apply findings from Luna Park visit to a series of questions with data from Luna Park and other theme parks

Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Circus Theme	• Calculate energy transformations, use to calculate spring constant, • Use suvat equations for multiple,scenarios, • Analyse force, • Describe and analyse effect of errors and uncertainties on the risks involved	• Describe where KE, GPE and SPE exist in problem • Understand range changes with angle • Describe forces in motion	• Human cannonball, projectile motion • Landing on a trampoline / net – Change in total mechanical energy • Calculate relevant quantities, • Explain the change in GPE, KE, SPE • Identify risks • Error analysis • How large does your net need to be to account for angle uncertainty?

Unit 3 Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Energy / power transmission over large distances Problem: • How can transformers be used to reduce power loss in long-distance energy transmission? • What would happen if you changed the conditions? Give examples, e.g. higher voltage	• Correctly calculate power loss with / without transformers using transformer equations • Correct explanation of purpose of transformers (ratio of turns) and their operations • Drawing waveforms • Understanding of voltage loss, power loss	• Identify the appropriate technique for transmission • Identify h owtransformers reduce power loss in transmission lines • Recognise that transformers can step or step down	• Potentially could do experimentally – try different configuations • Calculating power losses in DC transmission vs AC transmission with transformers • Operation of transformers • Explain how to reduce a power loss • Use of photovoltaic cells – limitation of positioning and DC • Analyse real world example, e.g. look at household power supply

Unit 3 Outcome 3

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Wind turbine	• Support conclusions with calculations • Determine power output • Describe any additional energy conversions • Limitations / errors in experimental set up • Energy efficiency calculations ??	• Able to set up wind turbine successfully • Able to measure current output • Describe KE of turbine to electrical energy conversion (each step of process)	• STELR Wind Turbine kit (or 3D printed blades) • DC Generator • Miltimeter • Links with Unit 2 How things fly • Fan to drive turbine

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Example of a Small Discussion Report

Assessment Task D: comparison and evaluation of two solutions to a problem, two explanations of a physics phenomenon or concept, or two methods and/or findings from practical activities.

Unit: 3, Outcome: 1

Contexts	Assessment Criteria		Task Components
	High Level of achievement	**Minimum level of achievement**	
Travelling by vehicle around a corner – banked versus non-banked solutions	• Correctly apply physics of circular motion to differentiate between the two cases • Able to quantitatively compare the two cases • Able to justify the use of banking and any relevant constraints • Consistently use appropriate terminology and effective representations of physical concepts. • Select key data and information to compare the two solutions. • Successfully apply evidence based argument to analyse and evaluate the two solutions.	• Identify appropriate formulae for modelling the two situations • Indicate the direction of overall force on a cornering vehicle • Identify that friction between the tyres and the road enables the car to turn • Identify that a banked road enables a car to turn with less reliance on friction than a non-banked road, for the same cornering speed. • Label basic elements of diagrams representing the two solutions • Identify relevant information needed to compare the two solutions. • Attempt to use the information to compare the two solutions	• Describe each method of cornering, including using labelled diagrams identifying forces involved and direction of motion • Compare relative sizes of relevant forces • Model effect of speed on the requirements of road surface and wheels • Evaluate benefits of each method • Comment on limitations of each solution • Identify key design parameters in the solution to this problem

Unit: 3, Outcome: 2

Contexts	Assessment Criteria		Task Components
	High Level of achievement	**Minimum level of achievement**	
Some objects are attracted to each other: electrical versus gravitational explanations	• Correctly apply physics of electric and gravitational fields to differentiate between the two cases • Able to quantitatively compare the two cases • Able to give examples of where electrical and gravitational attractions are used to accelerate objects • Consistently use appropriate terminology and effective representations of physical concepts. • Select key data and information to compare the two solutions. • Successfully apply evidence based argument to analyse and evaluate the two solutions.	• Can draw the gravitational field around a point mass and the direction of force experienced by a mass placed in the field. • Can draw the electric field around a point charge and the direction of force experienced by a charge of opposite sign placed in the field • Can describe how the strength of the attraction depends on the amount of mass and charge. • Identify relevant information needed to compare the two solutions. • Attempt to use the information to compare the two solutions	• Describe the features of attraction between two masses • Describe the features of attraction between two charged particles • Compare form and relative sizes of relevant forces • Comment on the range of conditions when electrical attraction dominates gravitational attraction and vice versa • Identify key differences between electrical and gravitational interactions • Explore examples of the use of electrical and gravitational attraction to accelerate objects

Unit: 3, Outcome: 3

Contexts	Assessment Criteria		Task Components
	High Level of achievement	Minimum level of achievement	
Some appliances require DC power: compare production of DC using a generator versus PV cells	• Correctly apply physics of induction to quantitatively model the power produced by a DC generator • Able to quantitatively compare the DC generator with a PV array • Able to quantitatively and qualitatively justify use of a particular solution for a given scenario • Consistently use appropriate terminology and effective representations of physical concepts. • Select key data and information to compare the two solutions. • Successfully apply evidence based argument to analyse and evaluate the two solutions.	• Can relate power output to product of voltage and current output • Can describe how a generator produces a potential difference • Can relate the strength of the potential difference to properties of the generator such as rotational speed and magnetic field strength. • Label basic elements of a diagram representing the two solutions • Identify relevant information needed to compare the two solutions. • Attempt to use the information to compare the two solutions	• Describe the features of DC power produced by PV cells – current and voltage • Describe the features of DC power produced by DC generator – current and voltage • Compare form and relative sizes of typical currents and voltages • Investigate examples of application of each solution • Justify use of particular type of DC power supply for a given scenario eg measurement of the magnetic field around a current carrying wire

Generated as part of the Small Group Discussion
Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Travelling horizontal circles compared to vertical circles	• Identify and quantify forces in the Luna Park ride ‘Enterprise’ • Calculate the normal force at top and bottom of vertical circle	• Identify forces in the Luna Park ride ‘Enterprise’ • Identify the effect of gravity on the ‘apparent weight’ (rider experience) (normal force)	• Describe / explain forces in a horizontal circle / vertical circle • Label diagrams • Compare speed / change in speed of the two aspects • Apply physics of the two scenarios to them park rides (Enterprise at Luna Park) • Link to the ride experience

Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Enterprise Ride https://youtu.be/WcJ7FF-b06g (Phenomenon of being inside the track. Theoretical question - what would happen if the passenger was attached to the wheel of the ride, rather than where they are.	• Calculate radius of vertical circle, • Why someone may feel heavier (Normal Force no reference to apparent weight, though) • Comparison (lift example), someone's acceleration of their F_g 'weight' compared to a lift. • How fast would the ride to be travelling to not experience the harness holding them in place. • Link to pharaoh's curse? https://youtu.be/34gaOvTLZiI • Dropping a phone from the top • projectile motion based on the velocity of the ride at the top or bottom while travelling in a vertical circular path o Students could be expected to compare a kinematics approach with an energy approach. • Student A Says horizontal motion is faster, Student B says vertical path is faster. Explain which student is correct and why.	• Ability to identify the forces acting on someone on the ride, and the sources of those forces. • Understanding/explaining that as speed increases, radius increases	

Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Motion on a spring from force and energy points of view	• Interpretation and setting up of different spring systems to be compared. • Compare the shape of the energy transformations based on the equations (can depend on mathematical abilities of students). • Determining what variables need to be measured for the investigation, i.e. h is height from the bottom of spring oscillation, not to the ground (high or middle level). • Explaining what features of the graph can be used to derive the equations	• Create a graph of the three different energy transformations during the oscillation of a spring from their data. Understanding when to use Hooke's Law vs. spring potential energy. • Identify features of the graph that can be used for calculations, i.e. gradient of SPE for spring constant. • Identify features such as height, etc. from their graph and data • What have I found?	• Solve a set of problems using equations of motion and then solve the same problems using energy concepts. • Keep language to physics-appropriate language. "Squared relationship" as opposed to quadratic for kinetic/spring potential energy.

Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Two methods of determining spring constant	Differences between methods • Precision of instruments • Number of trials • Number of data points	No entries	• Student are given data from F = kΔx and T = 2π√m/k • Provide method, data and equipment, • Students will need to determine k for both, • Compare and evaluate the different methods.

Unit 3 Outcome 1 A few tables chose this context, various comments are included here

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Determining the value of g using two different methods - Pendulum - Bouncing balls - Inclined plane - Horizontal circular motion of hanging mass	• Able to quantitively compare results • Quantify error in method and analysis • Appropriate terminology • Suggested improvement to one / both methods • Identify two suitable pracs • Structured comparison (One point from prac 1, one point from prac 2, linking statement) • Keeping responses relevant to aim of finding g • Explicit about how limitations affect value of g • Explain the pracs	• Identify appropriate formula for modelling each scenario • Labelling both diagrams correctly / appropriately • Basic comparison of two methods used • Identify two suitable pracs • Surface level justifications, using evidence? • May not be explicit about how limitations affect the value of g • Describe the pracs	• Two pracs • Explain gravity, pracs • Ask students to select 2 pracs that involve measurement of g • Evaluate both methods as way of measuring g • Identify limitation of each method • List of strengths with each method • Final opinion, if you could only do one parc, justify which one you would … Ed note: May be more appropriate as a Unit 2 Assessment Task

Unit 3 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Circular Motion situations: - End of string, - Satellite motion - Wall of death - Spinning chairs - Turning a corner	• No entries	• No entries	• Two data sources for measurements of the same event • Two instances of circular motion that have different restrictions; constant v or constant r • Use multiple sensors or one device to create a comparison

Unit 3 Outcome 2 Several tables chose this context, various comments are included here

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Motors Compare the design of two simple DC motors (e.g. Beakman motor)	• Expand to multiple coils • Describe and explain the components of a DC motor • Analyse uncertainties and error • Systematic comparison • Quantatitive comparison of motor speed / strength / power • Demonstration of useful application of motors • Linking physics concepts e.g. polarity and direction of movement • Uses correct terminology consistently	• Identify components of a motor • Draw diagram of fields and forces acting on a motor • Able to explain basic design (label and identify input / output) • Draw field lines • Describe forces	• Investigate the effect of number of loops (or 2 sets of loops) • Collect data / findings • Analyse data • Compare and evaluate designs / impact of number of loops (high / low) • Students construct DC motor in groups – present it to others (Not assessed) • Task written (Q’ns) • Provide photos of two different motors and ask high and low level questions

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	Min level of achievement	
Orbits of satellites • Compare real orbits to movies • Analyse movie physics of fields (Spiderman 2)	• Correctly apply physics of fields to differentiate between two cases, • Able to quantitatively compare the two cases	• Identify correct formulae, • Identify mass makes no difference, • Field diagram, • Identify relevant info, • Attempt to compare	• Students given two articles. • They must read and understand the physics in the articles, • They must compare the physics in both articles and real life to evaluate which is more correct.

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Fields can originate from a point source or from a uniform plate	• Can draw fields for multiple point charges, the resultant field • Correctly calculates field strength and force • Difference between force and field with correct terminology • Is able to establish a mathematical relationship for a point charge i.e. inverse square law and compare it to a uniform field	• Can draw arrows in the correct direction of a point charge and uniform field • Choosing correct formula for point charge vs uniform • Difference between force and field • Identifies that field strength changes for point charge vs it doesn't for uniform	• Describe features of a point charge and uniform field • Compares the electric field for a point charge and a uniform field • Compares the relationship between the formula for the inverse square law and uniform field

Unit 3 Outcome 2

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Properties of electric, magnetic and gravitational fields	• Evaluate the effect of electric and gravitational fields interacting within Millikan's oil drop experiment. • How the change in one field can impact the change in another. • Tying the different fields into a potential future environmental technology. • Evaluating the potential uses for each field	• Being able to draw field diagrams on charged particles with mass (gravitational and electric). • Shape and direction of field diagrams. • Compare monopoles and dipoles. • Real world applications – where you can find them. • Identifying the effects of the field on the object's properties. • How forces from fields are dependent on an object's properties	• Outline the similarities and differences between the effects of electric fields, magnetic fields and gravitational fields on matter. • In your answer, refer to the definitions of these fields, the shapes of the fields etc. • or two methods and/or findings from practical activities" • Complete some practical activities on fields and have students compare the results from both. • Observe the electric field when holding a voltmeter and touching an electric cable

Unit 3 Outcome 3 A few tables chose this context, various comments are included here

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Comparison of HVDC and AC current for electricity transmission	• Describing advantages and disadvantages for each case with mathematical evidence • Describing possible conversion between AC and DC	• Describing advantages of only one way of transmitting electricity	• Do some measurement modelling transmission line, • Do calculation of power losses and efficiency of power transmission

Use proposed HVDC to Singapore/Indonesia as real-world application	• Complete all calculations correctly
	• Explain clearly the differences between the two systems
	• Evaluate the two systems to show how the choice would be made for a given situation
		• Differentiate between the two models, but with limited depth of explanation
		• Show limited understanding of the concept of efficiency
		• Show limited capacity to decide which to use ina given situation
			• Given two transmission models"
			  ◦ AC with transformers
			  ◦ DC without transformers
			• e.g. compare NSW to VIC(AC) against TAS to VIC across strait with DC.
			• Supply details with real life values and ask them to compare efficiency.

	• Justifying a conclusion with reference to their analysis / evaluation • Linking the theory to the real-life application	• Perform relevant calculations • Simple explanation / statement of issues involved	• Guided investigation into factors affecting power loss • Pracs involving calculating power loss • Under test conditions, students analyse 2 solutions (transformers and HVDC) and evaluate the pros and cons and justify a conclusion

Unit 3 Outcome 3: Two findings from practical activities

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	

• Current carrying conductors
• Current balance
• Lenz's law, solenoid
	• What does it do? Sound knowledge and precise description
	• How does it work? Shows deep understanding, collates and analyses relevant information
		• What does it do? Little knowledge and limited relevance
		• How does it work? Poor understanding, some sense of structure
			• Explain how the E / B field works in these contexts
			  ◦ Field of a current carrying conductor
			  ◦ Current balance of E and B fields
			  ◦ Magnetic induction: Lenz's Law of solenoid

Unit 4 Outcome 1 Several tables chose this context, Various comments are included here

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	

Particle model of light and Wave model of light	• Cohesive description of how data supports each model and depth of explanation
	• Can relate changes in graph / experiment conditions to the wave / particle model
	• Synthesising the two experiments (talking about wave particle duality)
	• Not introducing irrelevant info (e.g. talking about matter when focus is on light)
		• Identify what the graphs are and what they show and which model they support
		• Interpret and calculate from graph
			• Possible stimulus material
			  • 2 graphs (E_k vs f and Int vs dist graph or plot graph)
			  • Explain the phenomena in each graph (scaffolded)
			  • Possible calculations
			  • Interpret graphs
			  • Present changes in each graph (change freq or intensity)
			• Questions related to what these changes suggest about wave model or particle model
			• Discuss whether competing models ever agree
			• Maybe link to maths and similarities in behaviour?

Complete Young's DS expt, Simulation or expt of PE effect. Use results to explain both models	• Correctly explains how expt leads to diffraction and interference • Can use equations to justify bright and dark lines hence interference • Describe limitation of models • Interpreting q PE graph • What would the experiment look like if the other model was used	• Correctly explain WM wave • Wave diffraction: light is wave • Can explain constructive / destructive interference • Calculate energy of photon • Graph of PE, analysis	• Explain diffraction and wave interference • Explain experimental set up • Evidence of wave nature of light • PE expt, setup, results • Implications of results • Limitation of wave model for PE Effect • Results for opposing models

Unit 4 Outcome 1:

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Objects exhibit both wave and particle properties	• Detailed explanation of electron clouds • superposition • Orbitals/ sub-orbitals • Understanding that this is not a concrete explanation • Used standing waves to explain with mathematical approaches • Physics terminology is used appropriately and accurately	• It is a model, nor reality • Attempt to model • Attempt to use mathematical approach • Attempt to describe a wave	• Research • Schematic • Simulations • Identify historical sequence • Veratasium oil droplets 'walking' (19) Watch | Facebook The Quantum Experiment that Broke Reality | Space Time | PBS Digital Studios - YouTube Interpretations of quantum mechanics - Wikipedia

Unit 4 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Compare single and double slit behaviour of water and light	• Evaluate the two and find commonalities and differences, • Advantages / disadvantages • How can experiment be improved	• Record data • Interpretation (basic) • Some link to theory • Some calculations • Basic comparison	• Experiments with single and double slits to find λ /w relationship, • Do standing waves in both light and water

Unit 4 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Newtonian vs relativistic physics in explain measurement made of high-speed muons	• Able to correctly identify which FoR measures dilated time, contracted length etc. • Able to do above in context of high-speed muons and scientist observing. • Able to compare the calculations made with relativistic physics to Newtonian physics and identify issues with Newtonian.	• Calculations of Lorentz factor, time dilation and length contraction with a given frame of reference. • Newtonian calculations of speed, distance and time • Identifying an inertial frame.	• Completing calculations of proper length, contracted length, dilated time, proper time and Lorentz factor. • Identifying postulates • Identifying an Inertial frames of reference • Comparison of Newtonian vs relativistic calculations of time and distance (and perhaps kinetic energy or momentum •

Unit 4 Outcome 1

<table>
<tr><th>Contexts</th><th colspan="2">Assessment Criteria</th><th>Task components</th></tr>
<tr><td></td><td>High Level of achievement</td><td>Min level of achievement</td><td></td></tr>
<tr><td>The nature of light - wave-particle duality</td><td>Explain three aspects of an experiment that supports light as a wave.
Explain three aspects of an experiment that supports light as a particle.
Complete calculations to give quantified comparisons between light as waves and matter.</td><td>Explain one aspect of an experiment that supports light as a wave.
Explain one aspect of an experiment that supports light as a particle.</td><td>Describe the features of the photoelectric effect.
Explain and analyse the results of Young’s double slit experiment.
Calculate respective wavelengths.
Populate energy of light from emission spectra.</td></tr>
<tr><td>Comparing the properties of light and matter</td><td>Provide evidence of how both light and matter exhibit wave like behaviour and apply this understanding to compare and contrast two sets of data.
Interpret problems to complete multi step calculations.</td><td>Provide evidence of how both light and matter exhibit wave like behaviour.
Complete simple calculations when formulas are provided</td><td>Compare and anlyse diffraction images for photons and electrons.
Explain and analyse standing waves.
Calculate wavelengths and momentum.</td></tr>
</table>

Unit 4 Outcome 1

<table>
<tr><th>Contexts</th><th colspan="2">Assessment Criteria</th><th>Task components</th></tr>
<tr><td>The Wave-particle model

The dual nature of light and waves</td><td>High Level of achievement
Able to use the evidence of the practicals to draw conclusions
Articulating the limitations of these experiments
Using appropriate Physics vocab and sentence structure</td><td>Min level of achievement
Explains one prac of wave model
Explains one prac of particle model</td><td>SAC - Compare and contrast the wave model and particle model.
Pracs
Young’s double slit
Phet Simulation - photoelectirc effect
Tracker: standing waves in strings
Mickelson - Morley experiment. Watch video. Students write a conclusion
Interference using sound. Students walk in straight line and find nodes and antinodes. Using phone and speakers.
Emission spectrum using vapor lamps possible using spectroscopes.
Diffraction - single slit. Piece of hair and a laser. Also Toothbrush.
Visit to the synchrotron. Lab sessions</td></tr>
</table>

Unit 4 Outcome 1

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Light- particle vs wave Expt: Photoelectric effect; emission and absorption spectra; Double slit experiment	• In depth comparison of the two models of the data with calculations to support • Appropriate diagram – eg demonstrating path difference or electron jumps in emission spectra • Perhaps - issues presented	• definition of concepts • simple calculations • wave-particle duality explanation • Which model does each set of data support	• Practical to generate data or use second hand data • Analyse and compare data from two experiments • Explanation of how data supports each model

Unit Outcome Generic:

Contexts	Assessment Criteria		Task components
	High Level of achievement	**Min level of achievement**	
Practical Activity • Investigate the same thing (something fairly simple) • Two different methods • Everyone gets all of the data from both experiments • Each group could give a short presentation on their method	• Include uncertainty in graph and discussion • Collect sufficient data to establish meaningful relationship between the variables • Justify the quantity of data collected • Assess risk • Compare and evaluate the two methods with reference to scientific theory	• Graph of results • Collect some data • Analyse their own data and method	• Carry out experiment using one of two methods (teacher to assign evenly) • All students to all of the data • Students individually analyse the data and compare the two methods