AC1: Key Outcomes – Year 11

Curriculum: Science

Excellence. No Excuses.

Section	Knowledge Code:	Outcomes:	How students will demonstrate success:
1	S11.1.1 Forces and their interactions part 1	SWBAT • Explain the difference between scalars and vectors • Draw vector quantities with an arrow and recognise from diagrams that the length of the arrow represents the magnitude, and the direction of the arrow the direction of the vector quantity. • Use arrows to represent the directions of forces. • State the difference between a contact and a non-contact force • Give examples of contact and non-contact forces. • Compare the sizes of forces using the unit newton (N). • Describe the action of pairs of forces in a limited range of scenarios. • State that weight is the force acting on an abject due to gravity and that the weight depends on the gravitational field strength. • Calculate weight using the formula w= m x g (where weight, *W*, in newtons (N), mass, *m*, in kilograms, kg and gravitational field strength, *g*, in newtons per kilogram, N/kg • State that the weight of an object and the mass of an object are directly proportional. • Describe what is meant by 'centre of mass'.	• Draw force diagrams using labelled arrows to identify types, magnitude and direction of the forces • Draw vector diagrams • Carry out investigations using newton meters and use results to determine the weight of objects • Carry out calculations to convert between weight and mass on Earth and on the Moon
2	S11.1.2 Forces and their interactions part 2	SWBAT • Draw scaled diagrams of forces acting in a range of situations using arrows to represent the forces • Describe the change to motion depending on the direction of the force and the size of the force which is applied to the object • Predict the motion of objects when forces are unbalanced (causing them to start moving, change speed and/or direction of motion) and balanced (causing them to stop moving or remain stationary) • **(HT only) Describe examples of forces acting on an isolated object** • **(HT only) Use free body diagrams to describe qualitatively examples where several forces lead to a resultant force on an object, including balanced forces when the resultant force is zero**	• Investigate what will happen to a stationary object when the forces acting on it are unbalanced • Predict what is happening to the motion of an object based on information of the forces acting on it
3	S11.1.3 Work done and energy transfer	SWBAT • Define work done and state the units of work. • Calculate the work done by a force on an object when given the magnitude of the force and the displacement of the object. Rearrange this equation to find any unknown value. W = F x D • Define a joule. • Covert Joules to newton-metre and vice versa • Describe the energy transfer involved when work is done on an object • Describe how work done against frictional forces acting on an object results in a rise in temperature of the object	• Carry out a variety of calculations linking work done to the force applied and the displacement of the object • Carry out calculations to convert between joules and newton-meter
4	S11.1.4 Forces and elasticity	SWBAT • Give examples of the forces involved in stretching, bending or compressing an object • Explain why, to change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only • Describe the difference between elastic deformation and inelastic deformation caused by stretching forces. • State and rearrange Hooke's law equation and apply to a range of questions • Describe the difference between a linear and non-linear relationship between force and extension • Calculate a spring constant in linear cases • Interpret data from an investigation of the relationship between force and extension • Calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) using the equation: elastic potential energy = 0.5 × spring constant × extension^2 • Calculate the relevant values of stored energy and energy transfers	• Carry out the required practical (physics RP 6) Investigate the relationship between force and extension for a spring. • Investigate the effect of loading and unloading springs stretched to and beyond their limit of proportionality. • Investigate the loading curve of an elastic band/spring and identify the limit of proportionality. • Carry out calculations using Hooke's law.

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5	S11.1.5 Forces and Motion (Distance and displacement, speed, velocity,The distance-time relationship, acceleration)	SWBAT • Define distance and recognise that it is a scalar quantitiy • Define displacement and recognise that it is a vector quantity being able to give both magnitude and direction • Recall speed as a scalar quantity • Define speed and state typical walking, running and cycling speeds in m/s, recognising that speed depends on many factors • Take measurements to determine distance and time and then use these to calculate speed • Calculate the speed of an object moving at a constant speed when given the distance travelled and the time taken (speed = distance / time) • Rearrange the equation to find either unknown quantity and apply the correct units (distance, s, in metres, m, speed, v, in metres per second, m/s, time, t, in seconds, s) • Calculate the average speed for non-uniform motion • Define velocity and explain why velocity is a vector quantity rather than a scalar quantity • **Explain why an object travelling around a circular track may have a constant speed but a constantly varying velocity (HT only)** • **Plan an investigation to show that the average velocity of an object around a circular track is 0 m/s (HT only)** • Draw and interpret distance – time graphs. • Calculate the speed of an object from a distance – time graph. • Compare the speeds of two or more objects, or from one object at different points, on a distance – time graph from the gradients of the lines. • State that the steeper the line on a distance – time graph, the faster the object is travelling. • Draw and interpret distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs, translating information between graphical and numerical form • **Determine the speed at a given time for an accelerating objects by drawing a tangent and measuring the gradient (HT only)** • Calculate unknown values when given appropriate data using the following equation: *acceleration = change in velocity / time taken a = Δ v/ t acceleration, a, in metres per second squared, m/s2 change in velocity, Δv, in metres per second, m/s time, t, in seconds, s* • Be able to rearrange the equation stated above • State that an object which slows down is decelerating • Compare the accelerations of different vehicles. • Explain how the acceleration of a vehicle can be determined experimentally. • Draw and interpret velocity – time graphs. • Explain how the acceleration of an object can be found from a velocity – time graph. • Compare the acceleration of a vehicle at different points of a velocity – time graph from the gradients of the lines. • **Calculate the distance travelled using the area under the line on a velocity – time graph. (HT only)** • **For velocity-time graphs that show non-uniform acceleration, measure the area under the line by counting squares. (HT only)** • Use the equation $\boldsymbol{v^2 - u^2 = 2as}$ to calculate the final velocity of an object at constant acceleration. Rearrange the equation to find any unknown given the other values. • Interpret questions to find values not specifically stated, eg starts at rest means an initial velocity of 0 m/s. • Describe why objects near the Earth's surface fall	• Identify which are scalar quantities and which are vector quantities • Plan and carry out an investigation into speed. Use the data collected to calculate the average speed • Explain the difference between speed and velocity • Draw distance-time graphs when given information about a journey • Interpret distance-time graphs and use to calculate the speed of an object at various points on the journey • Solve a variety of different calculations to determine acceleration • Plan and carry out investigations to determine acceleration • Draw and interpret velocity-time graphs, to include calculating the acceleration at various points and determining the distance travelled. • Plan an investigation to show that the average velocity of an object around a circular track I 0 m/s (HT only)

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6	S11.1.6 Forces, accelerations and Newton's laws of motion	SWBAT • State Newton's first law of motion (recap from year 8 AC1) • Describe the effect of having a zero resultant force on: *a stationary object *an object moving at a constant velocity. • Explain that for an object travelling at terminal velocity the driving force(s) must equal the resistive force(s) acting on the object. • Define Newton's Second Law. • Calculate the resultant force acting on an object using the equation F = m a. • Rearrange the equation to find any other unknown quantity. • **Define and explain inertial mass (HT only)** • Define Newton's Third Law. • Draw force diagrams to show Newton's third law, eg a falling object being pulled down by gravity and the Earth being pulled by the falling object. • Define: *thinking distance, *braking distance, *stopping distance. • State that the overall stopping distance of a vehicle is made up of the thinking distance plus the braking distance. • Describe and explain how the speed of a vehicle affects the stopping distance, for a given braking force • Estimate the typical reaction time of a person. • Describe and explain how using a mobile phone when driving will affect a driver's reaction time and therefore their thinking distance. • Describe and explain how drugs will affect a driver's reaction time and thinking distance. • Evaluate and explain factors which could affect braking distance • Explain the dangers caused by large decelerations • **Estimate the forces involved in the deceleration of road vehicles in typical situation on a public road (HT Only)**	• Carry out the required practical (Physics RP 7) Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force • State Newton's three laws of motion • Describe the two possible conditions of an object with a resultant force of zero • Use force diagrams to help explain Newton's three laws of motion • Carry out calculations using the question F = ma • Define breaking distance, stopping distance and thinking distance and discuss the factors that affect a persons reaction time and the stopping distance for a vehicle
7	**S11.1.7** **Momentum (HT only** **(*PHYSICS ONLY)***	SWBAT • Define momentum and recall it is a vector quantity. • State the equation that links momentum, mass and velocity. • Calculate the momentum of an object. Rearrange the equation to find any unknown quantity. • State the units of momentum. • Calculate the momentum of an object given its mass, speed and direction of movement. • Explain the importance of the minus sign for a numerical velocity in the calculation of momentum. • Explain what is meant by a closed system. • Explain what is meant by conservation of momentum. • *Carry out conservation of momentum calculations for systems involving two objects, including collisions and explosions.* • *State that the force acting on an object is equal to the rate of change of momentum.* • *Use the equation $F = (m \Delta v)/\Delta t$ to calculate the force that acts on an object when the momentum of that object changes, eg calculate the braking force when a car of mass 800 kg slows from 30 m/s to 10 m/s in 2 s.* • *Apply knowledge of force equals the rate of change of momentum to vehicle safety features.* • *Name common safety features found on road transport and around the home/school.* • *Describe and explain how safety features such as air bags and crumple zones reduce injuries in a collision, with reference to the rate of change of momentum.* • *Describe and explain why motorcyclists are at greater risk in collisions than car drivers.*	• Give the definition and units for momentum be able to identify it as a vector quantity. • Use the equation linking momentum, mass and velocity to carry out a variety of calculations. • Carry out a variety of calculation on momentum • Identify a range of safety features found on road transport and around the home/school and with reference to changes in momentum explain how these work

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8	S11.1.8 Carbon compounds as fuels and feedstock	SWBAT • State that crude oil is a finite resource that is a mixture of hydrocarbons and understand how it was formed • State what a hydrocarbon is • Recognise substances as alkanes given their formulae and be able to draw the structural formula for the first 4 alkanes • Distinguish between alkanes and alkenes • Apply a general formula to generate a molecular formula and a displayed formula for a straight-chain alkane • Classify and justify the classification of a chemical as an alkane • List some of the uses of petrochemicals • Explain why and in detail how fractional distillation is used to separate crude oil into fractions • Give the names and uses of the different fractions • Explain how chain length affects the properties of crude oil fractions • Make predictions about the properties of crude oil fractions based on the hydrocarbon chain length • Describe how the combustion of hydrocarbon fuels releases energy. • Write balanced equations for the combustion of hydrocarbons and be able to identify it as an oxidation reaction • State the conditions needed for catalytic and steam cracking • Explain why cracking is required in terms of the demand for fuels with small molecules • Describe the test for alkenes • Balance chemical equations as examples of cracking given the formulae of the reactants • Explain how modern life depends on the uses of hydrocarbons	• Explain how crude oil is formed resulting in a mixture of hydrocarbons which need separating • Be able to define hydrocarbons • Explain how fractional distillation works and be able to give the names of the fractions in the correct order along with their uses. • Be able to draw the structure for the first four alkanes and alkenes • Give the general formulas for alkanes and alkenes • Recognise that the physical properties of alkanes alkenes are influenced by their chain length and use this information to help predict properties (eg boiling points) • Write balanced equations for the combustion of hydrocarbons • Explain why cracking in necessary and be able to give balanced equations for examples of cracking along with giving conditions required • Give the test for alkenes
9	S11.1.9 Reactions of alkenes and alcohol (CHEMISTRY ONLY)	SWBAT • Describe alkenes as saturated hydrocarbons and be able to give their general formula • Give the structural formula for the first 4 alkenes • To be able to identify the functional group in an alkene and recognise that this determines its reactions • Be able to write balanced symbol equations and full structural formulae equations for the reactions of alkene with hydrogen, water, chlorine, bromine and iodine and recognise that these are addition reactions. • Describe the combustion of alkenes • Give the full structural formula for the first 4 alcohols and be able to identify the functional group • Describe the fermentation of sugar to produce ethanol • Describe the reactions of the first four alcohols with sodium, with water, burn in air and with an oxidising agent. • Give the full structural formula for the first 4 carboxylic acids and be able to identify the functional group • Describe the reactions of the first four carboxylic acids with carbonates and with alcohols and describe what happens when they dissolve in water • **Explain why carboxylic acids are weak acids in terms of ionisation and pH (HT Only)**	• Give the definitions for saturated and unsaturated and apply these terms to alkanes and alkenes • Identify the functional group in alkenes, alcohols and carboxylic acids • Give the balanced symbol equations and full structural formulae equations for the reactions of alkene with hydrogen, water, chlorine, bromine and iodine and recognise that these are addition reactions. • Draw the structural formulas for the first four alcohols and carboxylic acids • Describe how ethanol can be formed from the fermentation of sugar • Give equations for the reactions of the first four alcohols with sodium, with water, burn in air and with an oxidising agent. • Give equations for the reactions of the first four carboxylic acids with carbonates and with alcohols and describe what happens when they dissolve in water • **Explain why carboxylic acids are weak acids in terms of ionisation and pH (HT Only)**

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10	S11.1.10 Synthetic and naturally occurring polymers (CHEMISTRY ONLY)	SWBAT • Explain the process of addition polymerisation • Predict the products of condensation polymerisation • Explain the process of condensation polymerisation, including using equations • Compare and contrast in detail, giving appropriate examples, the two methods of polymerisation • Explain how amino acids react together in an acid-base reaction	• Compare and contrast in detail, giving appropriate examples, the two methods of polymerisation
11	S11.1.11 PHYSICS ONLY Moments, levers and gears,	SWBAT • Use examples to be able to describe how forces cause rotation • Define moment and use the equation moment of a force (Nm) = force (N) x distance (m) **(M = F d)** where d is the perpendicular distance from the pivot to the line of action of the force. • Describe how the total clockwise moment about a pivot equals the total anticlockwise moment about the pivot • Explain how levers and gears transmit the rotational effects of forces	• Investigate how increasing the length of a lever makes moving objects easier and use the equation M=Fd to analyse their results and draw a conclusion • Explain how levers and gear work
	Pressure and pressure differences in fluids	• Know that a fluid can be a liquid or a gas • Know that the pressure in fluids causes a force normal to any surface • Us the equation p = F/A to calculate the pressure at the surface of a fluid where p = pressure in pascals Pa, F = force in newtons, N and A = area in metres squared, m2 • **Calculate the pressure due to a column of liquid using pressure = height of the column x density of the liquid x gravitational field strength (HT only)** • **Explain why in a liquid pressure at a point increases with the height of the column of liquid above that point and with the density of the liquid (HT only)** • **Calculate the differences in pressure at different depths in a liquid (HT only)** • **Define upthrust (HT only)** • **Describe the factors which influence floating and sinking (HT only)**	• Carry out a variety of calculations using p =F/A • Investigate how the liquid pressure at a point is affected by the height of the columnof liquid above it. Analyse their results and draw a conclusion explaining their findings.
	Atmospheric pressure	• Describe a simple model of the Earth's atmosphere and of atmospheric pressure • Explain why atmospheric pressure varies with height above a surface	• Use a simple model of the Earth's atmosphere to explain why atmospheric pressure varies with height above the surface.