P5 Forces

Scalars and Vectors	Define the meaning of ***scalar*** and ***vector***. Differentiate between scalars and vectors. List vector and scalar quantities. How we represent vectors as arrows of different length.	Green	Amber	Red
Contact and Non-contact forces.	Identify examples of each. Explain that forces act in pairs when 2 bodies interact (force of A on B, force of B on A). These forces are equal in magnitude and opposite in direction (this is Newton's 3rd law). Representing forces as arrows.	Green	Amber	Red
Gravity	Gravity: attractive force between objects with mass. Force of gravity due to the earth is weight. **Weight = Mass x gravitational field strength (W = mg)** **SI units (N, N/kg, kg)** **Centre of mass** as place where the entire mass appears to be concentrated and the weight appears to act. How it is measured.	Green	Amber	Red
Resultant force	Definition of ***resultant force***. – single force that represents all others, or ***the sum of all the forces***. Calculating resultant forces in a straight line (same/opposite directions). Using labelled free body diagrams to show/calculate resultant forces (HT only). Forces represented as components at 90^{o} to each other (resolution). (HT only) Be able to use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and direction. (HT only) – scale diagrams.	Green Green	Amber Amber	Red Red
Work done and energy transfer	This links with P1: Define work done (= force x distance moved). 1 joule = 1 Newton metre This links with P1:	Green	Amber	Red
Forces and Elasticity	More than one force acting on an object can lead to bending (torsional forces), stretching (tensile forces) and compressing (compressive forces) of a material. Differentiate between: Elastic deformation (returns to original length when the force is withdrawn) Plastic deformation (permanent deformation after the force is withdrawn).	Green	Amber	Red

Hooke's law	Hooke's law - The proportionality relationship between the force applied to a spring and its extension (or compression) – double one, the other doubles etc.. **F = ke** k= spring constant e = extension/compression F = force applied Graphical representation (F against e demonstrating proportionality relationship – straight line through the origin). Calculating the spring constant from the graph (gradient). Linear graphs versus non-linear graphs (e.g. elastic bands).	Green	Amber	Red
Elastic potential energy	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 $E_e = ½ k e^2$ Also covered in P1.	Green	Amber	Red
Required practical activity 6:	Investigate the relationship between force and extension for a spring.	Green	Amber	Red
Forces and Motion	Distance and displacement Speed and velocity Typical speeds e.g. walking etc. **distance travelled = speed × time** s = v t distance, s, in metres, m speed, v, in metres per second, m/s time, t, in seconds, s Relate circular motion to a change in velocity but not speed. (HT only)	Green	Amber	Red
Measuring speed from a graph	Speed = gradient of distance-time graph. For curves, speed = gradient of a ***tangent*** to the curve. (HT only) Calculation of speed/velocity from graphs.	Green	Amber	Red
Acceleration	acceleration= change in velocity/time taken $a = \Delta v/t$ Estimate the magnitude of everyday accelerations. Calculate acceleration from velocity–time graph (gradient). (HT only) The distance travelled = the area under a velocity–time graph. Be able to: • draw velocity–time graphs from measurements and interpret lines • and gradients to determine acceleration • interpret enclosed areas in velocity–time graphs to determine distance travelled (or displacement) (HT only) • measure, the area under a velocity–time graph by method of counting squares (HT only)	Green	Amber	Red

Uniform and non-uniform acceleration	Use the equation Final velocity^2 − initial velocity^2 = 2 × acceleration × distance $v^2 - u^2 = 2 a s$ final velocity, *v*, in metres per second, m/s initial velocity, *u*, in metres per second, m/s acceleration, *a*, in metres per second squared, m/s2 distance, *s*, in metres, m Near the Earth's surface any object falling freely under gravity has an acceleration of about 9.8 m/s^2. Describe how an object falling through a fluid reaches terminal velocity in terms of the forces acting and the resultant force. (Physics only) Students should be able to: • draw and interpret velocity–time graphs for objects that reach terminal velocity • Interpret the changing motion in terms of the forces acting.	Green	Amber	Red
Newton's 3 laws of motion	Knowledge of Newton's 3 laws of motion. Application of Newton's 3 laws of motion in describing the motion of objects when there is a resultant force or when the resultant force = 0 Newton's 2nd law: F = ma Concept of mass as inertia as being resistance to acceleration/change in velocity (HT only).	Green	Amber	Red
Forces and Braking: Stopping distance	Definition of stopping distance in terms of braking distance and thinking distance. (Physics only) Be able to estimate how the distance for a vehicle to make an emergency stop varies over a range of speeds typical for that vehicle. (Physics only) Students will be required to interpret graphs relating speed to stopping distance for a range of vehicles.	Green	Amber	Red
Reaction time and thinking distance	Typical reaction times (around 0.7s) How to measure reaction time experimentally Evaluate factors affecting reaction time and hence thinking distance.	Green	Amber	Red
Braking distance	Evaluate factors affecting braking distance. Estimate braking distances in certain situations. Relate accelerations to braking. explain the dangers caused by large decelerations (HT only) estimate the forces involved in the deceleration of road-vehicles in typical situations on a public road.	Green	Amber	Red
Momentum (HT only)	Momentum is defined by the equation: Momentum = mass × velocity p = m v momentum, p, in kilograms metre per second, kg m/s mass, m, in kilograms, kg velocity, v, in metres per second, m/s	Green	Amber	Red
Conservation of momentum.	State what is meant by the conservation of momentum. You should be able to use the concept of momentum as a model to:	Green	Amber	Red

	• describe and explain examples of momentum in an event, such as a collision or an explosion. • (physics only) complete calculations involving an event, such as the collision or explosion involving two objects.			
Changes in momentum (Physics only)	Relating change in momentum to forces. That F= ma and the fact that a = v-u/t can lead to the equation in terms of momentum: Resultant force = Change in momentum/time $F = m\Delta v/\Delta t$ Relate safety features such as air bags, seat belts, crumple zones, gym mats etc. to the idea of increasing time for the same change in momentum. Carry out calculations using the above.	Green	Amber	Red
Moments, levers and gears. (Physics only)	Define moment of a force as the turning effect of the force. Moment = Force x perpendicular distance from the pivot to the line of action of the force. Use of the idea of directions (clockwise or anticlockwise) The condition for balanced moments (principle of moments). Calculations involving the principle of moments. Calculate the size of a force, or its distance from a pivot, acting on an object that is balanced. How a simple lever and a simple gear system can both be used to transmit the rotational effects of forces (ratio of distances form the load to the effort and number of teeth/radius). Students should be able to explain how levers and gears transmit the rotational effects of forces.	Green	Amber	Red
Pressure in fluids (Physics only)	pressure = force normal to a surface/area of that surface p = F/A pressure, p, in Pascals, Pa force, F, in Newtons, N area, A, in metres squared, m^2 The pressure due to a column of liquid = height of the column × density of the liquid × gravitational field strength ($p = h \rho g$) Calculate the pressure at a depth. Calculate different pressures at different depths. Calculate the upthrust on a partially-submerged object in a liquid.	Green	Amber	Red
Atmospheric Pressure (Physics only)	The atmosphere gets less dense with increasing altitude. Air molecules colliding with a surface create atmospheric pressure. The number of air molecules (and so the weight of air) above a surface decreases as the height of the surface above ground level increases. So as height increases there is always less air above a surface than there is at a lower height. Therefore, atmospheric pressure decreases with an increase in height.	Green	Amber	Red

	Students should be able to: • describe a simple model of the Earth's atmosphere and of atmospheric pressure • Explain why atmospheric pressure varies with height above a surface.			