

**GCSE Additional Science**



**Module P4 – Explaining Motion:**

**What you should know**

|  |
| --- |
|  **Name:** **Science Group:** **Teacher:** |

|  |  |
| --- | --- |
| **P4.1 How can we describe motion?** | **R.A.G.** |
| I can apply the following equation to situations where an average speed is involved:  speed = distance travelled (m) (m/s) time taken (s) |  |
| I can distinguish between average speed and instantaneous speed (in effect, an average over a short time interval) for examples of motion where speed is changing |  |
| **I understand that the displacement of an object at a given moment is its net distance from its starting point together with an indication of direction** |  |
| I can draw and interpret a distance-time **(or displacement-time)** graph for an object that is:a. stationaryb. moving at constant speed**c. moving with increasing or decreasing speed** |  |
| I can interpret a steeper gradient of a distance-time graph as a higher speed |  |
| **I can calculate a speed from the gradient of a straight section of a distance-time graph** |  |
| I can draw and interpret a speed-time graph for an object that is:a. stationaryb. moving in a straight line with constant speedc. moving in a straight line with steadily increasing or decreasing speed (but no change of direction) |  |
| I understand that in many everyday situations, acceleration is used to mean the change in speed of an object in a given time interval |  |
| I can recall that the instantaneous velocity of an object is its instantaneous speed together with an indication of the direction |  |
| **I understand that the velocity of an object moving in a straight line is positive if it is moving in one direction and negative if it is moving in the opposite direction** |  |
| **I can draw and interpret a velocity-time graph for an object that is:****a. stationary****b. moving in a straight line with constant speed****c. moving in a straight line with steadily increasing or decreasing speed****(including situations involving a change of direction)** |  |
| I can calculate acceleration using the equation: acceleration = change in velocity (m/s) (m/s2) time taken (s) |  |

|  |  |
| --- | --- |
| **P4.2 What are forces?** | **R.A.G.** |
| I can recall that a force arises from an interaction between two objects |  |
| I understand that when two objects interact, both always experience a force and that these two forces form an interaction pair |  |
| in simple everyday situations, I can:a. identify forces arising from an interaction between two objectsb. identify the ‘partner’ of a given force (i.e. the other force of the interaction pair)c. specify, for each force, the object which exerts it, and the object on which it actsd. use arrows to show the sizes and directions of forces acting |  |
| I understand that the two forces in an interaction pair are equal in size and opposite in direction; and that they act on different objects |  |
| I can describe the interaction between two surfaces which slide (or tend to slide) relative to each other: each surface experiences a force in the direction that prevents (or tends to prevent) relative movement; this interaction is called friction |  |
| I can describe the interaction between an object and a horizontal surface it is resting on: the object pushes down on the surface, the surface pushes up on the object with an equal force, and this is called the reaction of the surface |  |
| I crecall that friction and the reaction of a surface arise in response to the action of an applied force, and their size matches the applied force up to a limit |  |
| I can use the ideas of friction and reaction to explain situations such as the driving force on vehicles **and walking** |  |
| I can use the idea of a pair of equal and opposite forces to explain in outline how rockets and jet engines produce a driving force. |  |

**R.A.G. each of the statements to help focus your revision:**

*R = Red: I don’t know this*

*A = Amber: I partly know this*

*G = Green: I know this*

|  |  |
| --- | --- |
| **P4.3 What is the connection between forces and motion?** | **R.A.G.** |
| I can interpret situations in which several forces act on an object |  |
| I understand that the resultant force on an object is the sum of all the individual forces acting on it, taking their directions into account |  |
| I understand that if a resultant force acts on an object, it causes a change of momentum in the direction of the force |  |
| I can use the definition:  momentum = mass × velocity  (kg m/s) (kg) (m/s) |  |
| I understand that the size of the change of momentum of an object is proportional to the size of the resultant force acting on the object and to the time for which it acts:change of momentum = resultant force x time for which it acts  (kg m/s) (N) (s) |  |
| I understand how the horizontal motion of objects (like cars and bicycles) can be analysed in terms of a driving force (produced by the engine or the cyclist), and a counter force (due to friction and air resistance) |  |
| I understand that for an object moving in a straight line, if the driving force is:a. greater than the counter force, the vehicle will speed upb. equal to the counter force, the vehicle will move at constant speed in a straight linec. smaller than the counter force, the vehicle will slow down |  |
| I understand that, in situations involving a change in momentum (such as a collision), the longer the duration of the impact, the smaller the average force for a given change in momentum |  |
| I can use ideas about force and momentum to explain road safety measures, such as car seatbelts, crumple zones, air bags, and cycle and motorcycle helmets |  |
| I understand how the vertical motion of objects (falling, or initially thrown upwards) can be analysed in terms of the forces acting (gravity, air resistance) |  |
| I understand that, if the resultant force on an object is zero, its momentum does not change (if it is stationary, it stays at rest; if it is already moving, it continues at a constant velocity [a steady speed in a straight line]). |  |

|  |  |
| --- | --- |
| **P4.4 How can we describe motion in terms of energy changes?** | **R.A.G.** |
| I can recall that the energy of a moving object is called kinetic energy |  |
| I can recall that as an object is raised, its gravitational potential energy (G.P.E.) increases, and as it falls, its gravitational potential energy decreases |  |
| I can recall that when a force causes movement of an object, work is done |  |
| I can use the equation: work done by a force = force × distance moved by the force (joule, J) (newton, N) (metre, m) |  |
| I understand that when work is done on an object, energy is transferred to the object and when work is done by an object, energy is transferred from the object to something else, according to the relationship: amount of energy transferred = work done (joules, J) (joules, J) |  |
| I understand that when an object is lifted to a higher position above the ground, work is done by the lifting force; this increases the gravitational potential energy |  |
| I can use the equation: change in GPE = weight × vertical height difference (joule, J) (newton, N) (metre, m) |  |
| I understand that when a force acting on an object makes its velocity increase, the force does work on the object and this results in an increase in its kinetic energy |  |
| I understand that the greater the mass of an object and the faster it is moving, the greater its kinetic energy |  |
| I can use the equation: kinetic energy = ½ × mass × [velocity]2 (joule, J) (kilogram, kg) (metre per second, m/s)2 |  |
| I understand that if friction and air resistance can be ignored, an object’s kinetic energy increases by an amount equal to the work done on it by an applied force |  |
| I understand that air resistance or friction will cause the gain in an object’s kinetic energy to be less than the work done on it by an applied force in the direction of motion, because some energy is dissipated through heating |  |
| I can recall that energy is always conserved in any event or process |  |
| I can calculate the gain in kinetic energy, and the speed, of an object that has fallen through a given height |  |

|  |  |
| --- | --- |
| **Grades A\* - C (Higher)** | All statements shown in **bold** as well as all statements shown in normal type. |
| **Grades C – G (Foundation)** | All statements shown in normal type. |