P10: Forces and Motion Knowledge Organiser (Physics) PT65.3

Newton's Second Law	•The resultant force acting on an object is equal to its mass times its acceleration (F = ma) •Bigger resultant force gives a bigger acceleration •Bigger masses need bigger forces to get the same acceleration
Inertia	• The tendency of an object to stay at rest or continue to travel in uniform motion (i.e. not accelerate)
Mass, m	•The amount of matter in an object. •Measured in kilograms, kg.
Weight, W	•The force acting on an object due to gravity. •Measured in Newtons, N.
Gravitational Field Strength, g	•The force acting on an object per kilogram due to gravity. •Measured in N/kg •On Earth's surface, g is 9.8 N/kg
Acceleration Due to Gravity, g	•The acceleration experienced by an object caused by the gravitational field. •On Earth, this is 9.8 m/s^2
Terminal Velocity	•When the frictional force (drag) acting on an object falling through a fluid is equal to its weight, it has reached terminal velocity •The resultant force = 0 •Acceleration = 0
Stopping Distance	•Stopping distance = thinking distance + braking distance •Thinking distance is the distance travelled during the driver's reaction time. Affected by drugs, alcohol, tiredness, using a mobile phone (i.e. distraction) •Braking distance is the distance travelled during the time the braking force acts. Affected by road conditions and poor vehicle maintenance. •The faster a vehicle is travelling, the bigger the stopping distance because it travels further in the time taken to stop •The braking force can be calculated using F = ma

Momentum, p	•Depends on the mass and velocity of an object. •Measured in kg m/s •It's a vector as it has size and direction
Law of Conservation of Momentum	•In a closed system, the total momentum before an event (like a collision or explosion) is equal to the momentum after. •$(m_A \times v_A) = -(m_B \times v_B)$ •When two objects push apart from each other (i.e. In an explosion), momentum is conserved. •This means that if the objects have different masses they move apart at different speeds and with equal and opposite momentum, meaning the total momentum is conserved. •When two objects recoil, $m_A v_A + m_B v_B = 0$
Impact force	•Impact force = change in momentum ÷ impact time •This means that the longer the impact time, the more the impact force is reduced. •Cars have crumple zones to increase the impact time and reduce the impact force •In a collision, the impact force depends on the mass, change in velocity and the length of impact time.
Car safety	•Safety helmets increase impact time, so reduce the impact force acting on someone's head, which helps to reduce injury. Crash mats and other cushioned surfaces do a similar job. •Seatbelts increase impact time and therefore reduce the decelerating force. They also spread the force out over the chest. •Airbags, side impact bars and collapsible steering wheels reduce the impact force acting on a person by increasing the impact time.

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Elastic Object	•An object that returns to its original shape when the forces deforming it (changing its shape) are removed
Extension, e	•The increase in length from the original length •Measured in cm or m •Extension = new length – original length •Directly proportional to the force applied to the object
Limit of Proportionality	•Beyond the limit of proportionality, the extension stops being directly proportional to the force applied to the object. •A graph of F against x stops being a straight line
Hooke's Law	•The extension of a spring is directly proportional to the force applied as long as the limit of proportionality is not exceeded •F = k x e
Spring Constant, k	•How 'stretchy' a spring is •The bigger the spring constant, the less stretchy it is

Key Equations To Learn	
Force, F	Force = spring constant x extension F = k x e
Momentum, p	Momentum = mass x velocity p = m x v