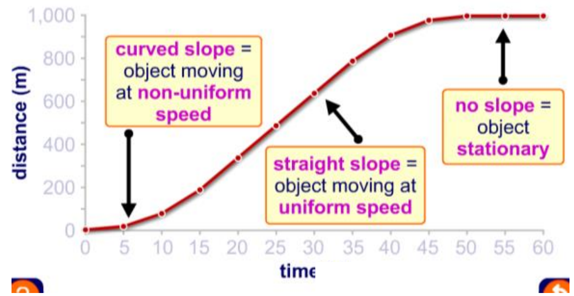
Physics: 4.5 Forces

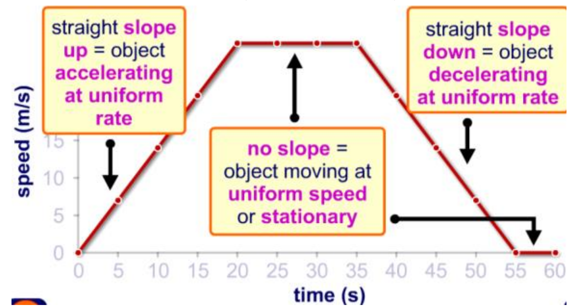
1. Key Terms-Motion		2. Key Term-Forces	
Vector	A vector quantity has both magnitude (size) and a direction	Weight	Weight is the force acting on an object due to gravity acting on its mass. Units Newtons (N)
Scalar	A scalar quantity has magnitude (size) only	Gravity	The force of gravity close to the Earth due to the gravitational field around Earth. $9.8m/s^2$
Speed	Walking- 1.5 m/s, running 3m/s	Mass	The amount of matter an object is made of
Distance	How much ground an object has covered during its motion. (Scalar)	Contact force	A force caused by object physically touching each other, e.g friction, tension and air resistance
Displacement	How far an object is from its starting point (Vector)	Non-contact force	A force caused by objects that do not physically touch each other, e.g. gravity, magnetism and electrostatic
Acceleration	The rate of change of velocity, affected by force and mass	Weight equation	Weight (N) =Mass (Kg) x gravitational field strength (N/Kg) W=m x g
Velocity	Speed in a given direction, unit m/s	Resultant force	This is where all of the individual forces acting on an object are replaced by a single force. This is because some forces cancel each other out.
Terminal Velocity	The point at which forces acting on an accelerating object become balanced so the object travels at constant speed.	Free body diagram	A diagram that shows the forces acting on an object. The arrows can be drawn to scale and represent the magnitude and direction of the force.
Thinking Distance	The distance travelled before the brake is pressed (whilst reacting), affected by tiredness, drugs and alcohol.	3. Newton's Laws	
Braking Distance	The distance travelled after the brake is pressed. Affected by road and weather conditions, mass, speed and maintenance of tyres and brakes.	First law	An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.
Stopping Distance	The overall distance travelled from noticing a hazard and stopping. The sum of thinking distance and braking distance	Second Law	The acceleration of an object is proportional to the resultant force acting on the object, and inversely proportional to the mass of the object.
Distance time-Graph	Gradient represents objects velocity. Increasing gradient= constant velocity. Steeper gradient=faster velocity. Flat gradient=stationary. Curved line= acceleration.	Third Law	Whenever two objects interact, the forces they exert on each other are equal and opposite.
Velocity-Time Graph	Gradient represents objects acceleration. Steadily increasing gradient= constant acceleration, constant decreasing gradient= constant deceleration. Flat gradient= constant velocity. Area under the graph= distance travelled	Acceleration equations	F=ma Force (N) = Mass (Kg) x Acceleration (m/s^2) a= $\Delta v/t$ acceleration(m/s^2) = final velocity- initial velocity/t (s)
		Inertial mass	A measure of how difficult it is to change the velocity of an object

Distance-Time Graph



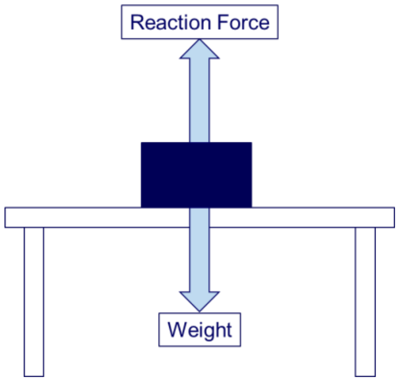
Gradient = speed

Velocity – Time Graph



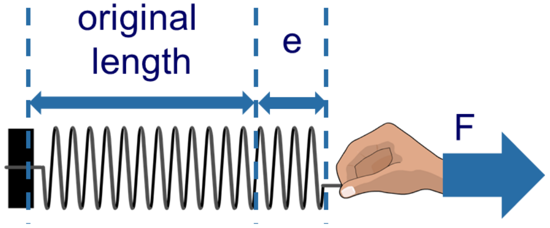
Gradient = acceleration
Area under graph = distance travelled

The **reaction force** is equal and opposite to the weight of an object when resting on a flat surface



Hooke's Law

The extension of an elastic object is directly proportional to the force applied, provided its limit of proportionality is not exceeded. ($F=ke$)



4. Work Done

Work Done	When a force causes an object to move through a distance work is done. Unit is Joule (J). One Joule of work is done when a force of 1 Newton causes a displacement of 1m
Equation	Work done (J) = Force (N) x Distance (m)
Friction	Work done against friction causes a rise in temperature of the object

5. Forces and Elasticity

Effects	Forces can stretch, bend and compress an object. In order to do this more than one force must be applied
F=Ke	Force (N)= Spring Constant (N/m) x extension(m)
Inelastic deformation	If an object has its shape changed but doesn't go back to its original shape it has been inelastically deformed. E.g. squashing a can of coke
Limit of proportionality	The extension of a spring is directly proportional to the force applied, providing the limit of proportionality is not exceeded
Elastic Deformation	If an object has its shape changed, because of forces applied to it, but it then goes back to its original shape, it has been elastically deformed. E.g stretching an elastic band and it returns to its original shape
Elastic potential energy	A force that stretches or compresses a spring does work and elastic potential energy is stored in the spring.
E_p=0.5Ke^2	Elastic potential energy (J) = 0.5 x spring constant (N/m) x extension^2 (m)

6. Momentum

Momentum	Any moving object has momentum, it is affected by mass and velocity
p=mv	Momentum(Kgms)= mass (Kg) x velocity (m/s)
Conservation of momentum	In a closed system the total momentum before an event is equal to the total momentum after the event. The total momentum remains equal in a collision or explosion.
Changes in momentum	When a force acts on an object that is moving, or able to move, a change in momentum occurs.
Change in momentum	F=mΔV/Δt where mΔV is the change in momentum

7. Safety Features

Air bag,	Air bags increase the time taken for the head's momentum to reach zero, and so reduce the forces on it. They also act a soft cushion and prevent cuts.
Crumple zone	Crumple zones are areas of a vehicle that are designed to crush in a controlled way in a collision. They increase the time taken to change the momentum of the driver and passengers in a crash, which reduces the force involved.
Seatbelt	Seat belts stop you tumbling around inside the car if there is a collision. However, they are designed to stretch a bit in a collision. This increases the time taken for the body's momentum to reach zero, and so reduces the forces on it.

8. Moments

Moment	The turning effect of a force
M=fxd	Moment (Nm) = Force (N) x Distance (m)
Principle of moments	Anticlockwise moment= clockwise moment
Levers	Reduces the amount of force needed to move a load
Gear	Used to increase the size of the turning force. Small gears turn quickly with less force, Large gears turn slowly with more force.

9. Pressure	
Pressure	The force acting on a certain area (usually $1m^2$)
Calculation	Pressure(p) = Force (F) ÷ Area (A)
Unit	Pascal's (Pa) also the same as $1N/m^2$
Fluid	Gas or liquid
Fluid	The particles are constantly moving and therefore colliding with objects, this causes pressure
Force	The force of a particle colliding with a surface acts at right angles to the surface
Height in a fluid	The deeper you go in a fluid, the greater the pressure because of the weight of the fluid above, the particles collide with greater force
Floating	A floating object has more pressure under it than above it, creating a resultant upward force, this force is called upthrust
Floating vs Sinking	Objects will float or sink depending on their density compared with the density of water • If it has the same density it does not move • If it is more dense it will sink • If it is less dense it will float
Atmospheric pressure	Air pressure is caused by air particles colliding with objects in air. The number of air molecules (and so the weight) above a surface decreases as the height of the surface above ground level increases. Atmospheric pressure decreases with an increase in height
Atmosphere	Thin layer of air round the Earth. The atmosphere gets less dense with increasing altitude
Pressure in a column	Pressure= height x density x gravitational field strength $P=h\rho g$ Pressure- Pa Height- m Density- Kg/m^3

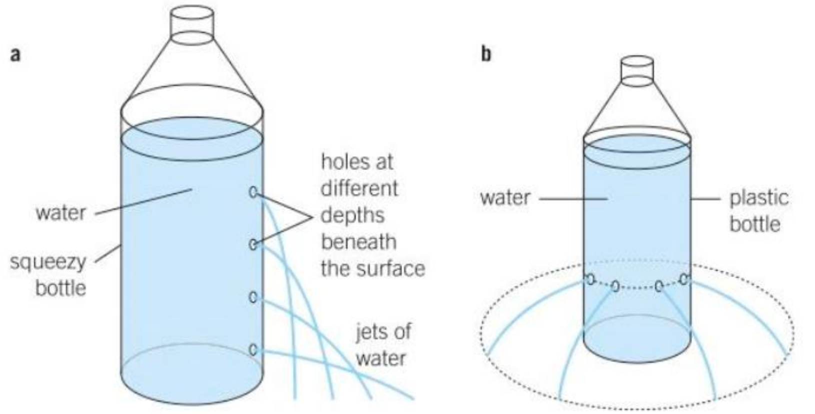


Figure 2 *Pressure in a liquid at rest*
a *Pressure increases with depth* **b** *Same pressure at the same depth*