ATHERTON COMMUNITY SCHOOL

Science: GCSE Forces

1. Contact and Non-contact forces

Contact	Non-contact
Friction	Gravity
Air resistance	Magnetism
Upthrust	Electrostatic
Thrust	

2. Vector and Scalar quantities

Scalar quantity	Value that only has magnitude, but no direction
Vector quantity	Value that has both magnitude and direction

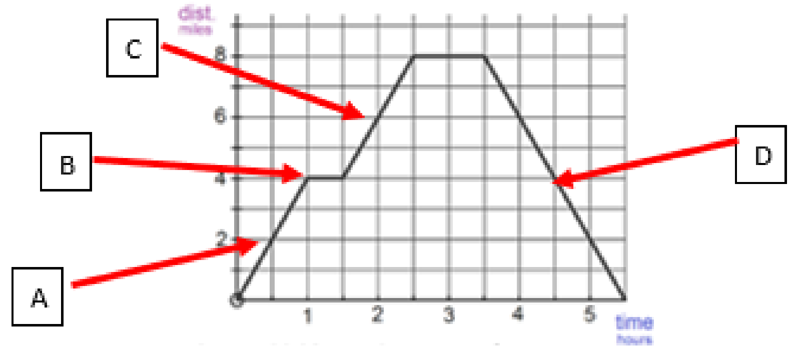
Scalar	Vector
Time	Force
Distance	Velocity
Speed	Displacement
Mass	Acceleration
Temperature	Momentum

3. Equations

Weight	Weight (N) = gravitational field strength (N/kg) x mass (kg)
Velocity	Velocity (m/s) = distance (m) ÷ time (s)
Acceleration	Acceleration (m/s^2) = change in velocity (m/s) ÷ time (s)
Resultant Force	Force (N) = mass (kg) x acceleration (m/s^2)
Stopping distance	Stopping distance = thinking distance + breaking distance
Momentum	Momentum (kg m/s) = mass (kg) x velocity (m/s)
Elastic potential energy	Elastic potential energy (j) = ½ x spring constant (N/m) x extension^2 (m)

4. Distance-time graphs

A	Travelling at a constant speed from the origin
B	Stationary as the line is flat
C	Traveling at the fastest speed as the line has a steeper gradient
D	Returning to the start



The velocity is calculated by calculating the gradient of the line

The total distance travelled is calculated by adding together the distances travelled in each component of the graph

5. Terminal Velocity

Maximum velocity reached when the weight and drag are balanced
Mass does not affect the terminal velocity of an object
Surface area affects the terminal velocity of an object. Increasing the surface area, decreases the terminal velocity of an object e.g. when a skydiver opens their parachute

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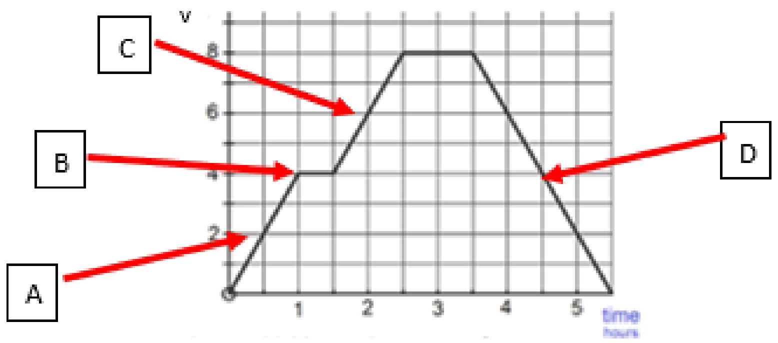
6. Velocity-time graphs

A	Accelerating
B	Travelling at a constant speed
C	Accelerating fastest
D	decelerating



The acceleration is calculated by calculating the gradient of the line
The total distance travelled is calculated by calculating the area under the graph

7. suvat Equations (HT ONLY)

s	Displacement
u	Initial velocity
v	Final velocity
a	Acceleration
t	Time

$v = u + at$	$s = ut + \frac{1}{2} at^2$	$v^2 = u^2 + 2as$	$s = \frac{1}{2} (v+u)t$

8. Newton's 3 Laws

1	If the resultant force on a stationary object is zero, the object will remain stationary or travel at a constant speed
2	The acceleration of an object is proportional to the resultant force exerted and inversely proportional to the mass of the object (F=ma)
3	For every action, there is an equal and opposite reaction

9. Stopping distances

Thinking distance	**Distance** travelled whilst thinking about pressing the brake pedal
Breaking distance	**Distance** travelled whilst the foot is on the brake pedal
Stopping distance	Total distance travelled whilst thinking about braking and physically braking

Factors affecting thinking distance	**Factors affecting braking distance**
Tiredness	Speed
Visibility	Road surface conditions
Alcohol or drugs	Condition of the tyres
Distractions	Condition of the brakes
Speed	
Reaction times	

10. Momentum (HT ONLY)

Conservation of momentum	Momentum **before** = momentum **after**

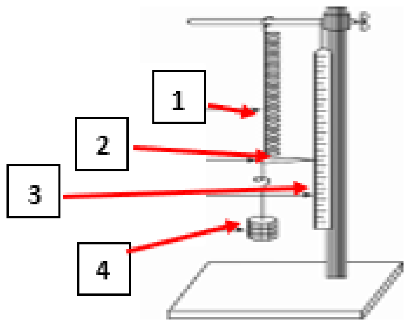
Momentum (kg m/s) = mass (kg) x velocity (m/s)

Science: GCSE Forces

11. Hooke's Law

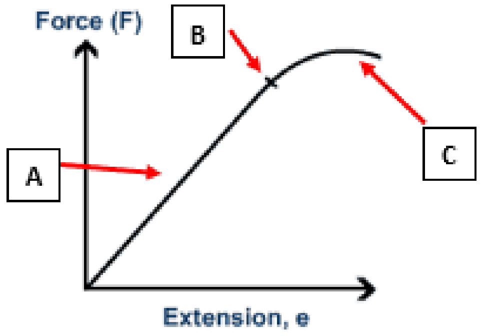
The extension of a stretched spring is directly proportional to the force applied

1	Spring
2	Pointer
3	Metre Ruler
4	Slotted masses



Force (N) = Spring constant (N/M) x extension (m)

A	Linear relation ship (obeys Hooke's Law)
B	Limit of proprtionalilty
C	Not a linear relationship (will no longer return to its original shape)

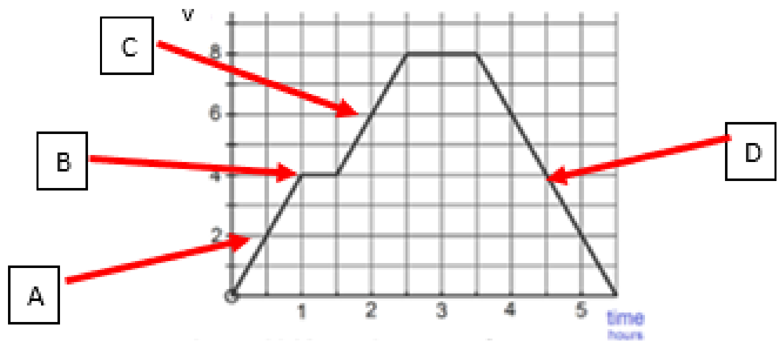


12. Key words

Centre of mass	Position in the centre of the object where the force of gravity acts on the mass
Resultant force	Residual force in a given direction
Balanced forces	Opposing forces that are equal in magnitude
Unbalanced forces	Opposing forces where one force has a greater magnitude
Pressure	Force applied over a given area

13. Pressure

Pressure (Pa) = height (m) x density (kg/m^3) x gravitational field strength (N/kg)
Pressure increases with depth in a liquid.
Pressure decreases with altitude in air



Challenge Questions	
1	Jenny says that the speed of her car is a vector quantity, explain why Jenny is incorrect.
2	Using the graph, how long was the car travelling at 8m/s?
3	Calculate the acceleration at points A and D.
4	Calculate the total displacement

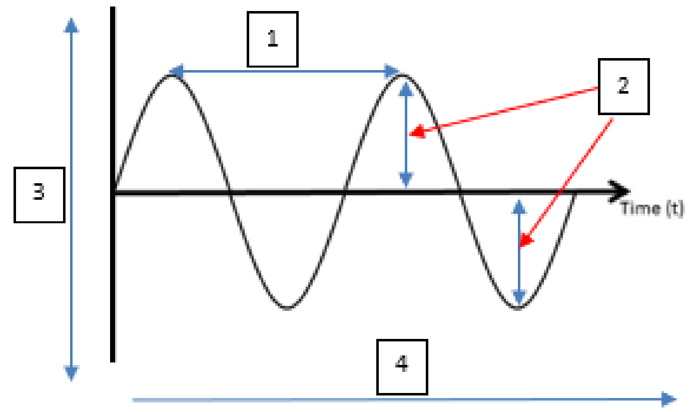
Science: GCSE Waves

1. Key Words

Transverse wave	A wave where the vibrations are perpendicular to the direction of travel
Longitudinal wave	A wave where the vibrations are parallel to the direction of travel
Frequency	Number of waves passing a point in 1 second (measured in hertz – HZ)
Period	Time for one complete wave
Reflection	When waves bounce off a surface
Refraction	When waves travel through materials of different densities and the frequency of the wave changes

2. Transverse waves

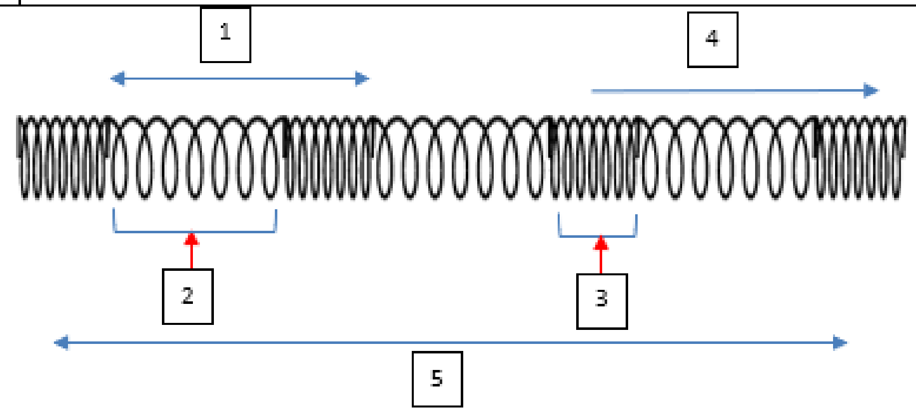
1	Wavelength
2	Amplitude
3	Direction of vibration
4	Direction of travel



Examples	Light, water waves, electromagnetic waves, s-waves

3. Longitudinal waves

1	Wavelength
2	Rarefaction
3	Compression
4	Direction of vibration
5	Direction of travel



Examples	Sound, p waves, water waves

4. Wave Equations

Wave speed (m/s) = frequency (Hz) x wavelength (m)

$$v = f\lambda$$

$$\text{Period (s)} = \frac{1}{\text{frequency (Hz)}}$$

Science: GCSE Waves

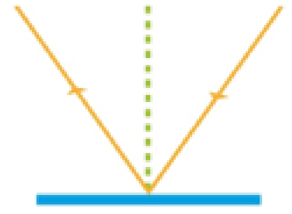
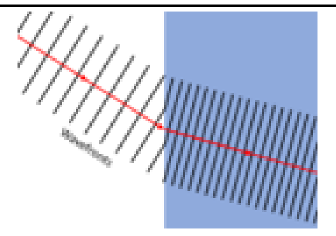
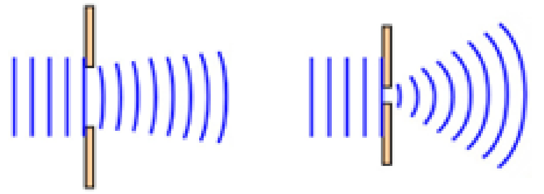
5. Electromagnetic waves

Name	Wavelength	Uses	Dangers
Radio wave	$1\ m - 10^4\ m$	Communication e.g Bluetooth, TV and FM radio	Low risk as the waves pass easily through soft tissue
Microwave	$10^{-2}\ m$	Communications e.g mobile phones and satellite TV Heating objects	Increased risk of tissue damage in localised areas
Infra-red	$10^{-5}\ m$	Infra-red cameras and electric heaters	Burns
Visible	$10^{-7}\ m$	Fibre optic cables	Damage to the retina
Ultra-violet	$10^{-8}\ m$	Fluorescent lights, security pens and sunbeds	Sunburns, premature aging of the skin, blindness and cancer
X-ray	$10^{-10}\ m$	Radiography (CT scans and x-rays) and treating cancer	Cancer
Gamma	$10^{-15}\ m$	Treating cancer and sterilising medical equipment	Cancer and radiation poisoning

6. Infra-red radiation

All objects emit and absorb infra-red radiation
Objects **HOTTER** than their surroundings emit more IR radiation than they absorb
Objects **COOLER** than their surroundings emit less IR radiation than they absorb
Dark colours absorb and emit more IR radiation than white
Matt surfaces absorb and emit more IR radiation than shiny ones

7. Wave behaviour in materials

Reflection	
Refraction	
Diffraction	

Challenge Questions

1	Calculate the wave speed of a wave with a wavelength of 0.125m and a frequency of 50Hz.
2	Compare the properties of longitudinal and transverse waves
3	Explain why microwaves are used to transmit communications across the world rather than radio waves.
4	Describe an experiment that could be used to determine the speed of water waves using a ripple tank.