Knowledge navigator: forces

Forces and their interactions	
1.Scalar quantities	A quantity that only has magnitude (size) *E.g.: mass, time, speed, temperature, energy, distance*
2.Vector quantities	A quantity that has magnitude and direction *E.g.: force, velocity, momentum, displacement*
3.Contact forces	Exerted between two objects when they touch *E.g.: Friction, air resistance, tension, normal contact force*
4.Non-contact forces	Exerted between two objects without touching *E.g.: Gravitational force, electrostatic force, magnetic force*
5.Resultant force	The overall effect of all of the forces acting upon an object - Two forces acting in the same direction are added. - Two forces acting in the opposite direction are taken away.
6.Free body diagram	Show magnitude and direction of all forces upon an object
7.Centre of mass	The weight of an object acts through a single point
8.Resolving forces	An object pulled with a force at an angle
9.Weight	Force acting on an object due to gravity
	Weight = mass X gravitational field strength (N) (kg) (N/Kg)
Work done and energy transfer	
10.Work done	Is the same as energy transferred
	Work done = force X distance (W = F s) (J) (N) (m)
Forces and elasticity	
11.One force is applied	The object changes speed or direction
12.To change shape	Apply two or more forces to object to change object's shape
13.Elastic deformation	Object has been stretched but returns to its original length
14.nelastic deformation	The object has been stretched but does not return to its original length; it is permanently deformed.
15.Extension (amount stretched)	The difference between stretched and unstretched lengths = current length – original length
16.Hooke's Law	The extension is directly proportional to the force applied, provided that the limit of proportionality is not exceeded
	Force = spring constant X extension (N) (N/m) (m)
17.Elastic Potential Energy	EPE = 0.5 X spring constant X (extension)² (J) (N/m) (m)
18.Limit of proportionality	Point at which the object becomes permanently deformed and stops behaving elastically.

Forces and motion		
19.Distance	How far an object moves	
20.Displacement	Distance an object has moved in a straight line and direction	
21.Speed	How fast an object moves	
	Speed = distance ÷ time (m/s) (m) (s)	
22.Typical speeds	Walking: 1.5 m/s	Running: 3 m/s
23.Velocity	The speed of an object with direction	
24.Acceleration	How fast an object is speeding up	
	Acceleration = change in velocity ÷ time taken (m/s^2) (m/s) (s)	
25.Deceleration	How fast an object slows down; Also negative acceleration	
25.Terminal velocity	The maximum constant speed that a free falling object eventually reaches.	
Newton's Law		
26.Newton's 1st Law (Balanced forces)	If the resultant force on an object is zero it will remain stationary or continue to move at the same speed	
27.Newton's 2nd Law (Unbalanced forces)	The acceleration of an object is proportional to the resultant force acting on the object.	
	Force = mass X acceleration	
28.Newton's 3rd Law (Equal and opposite forces)	When two objects interact, the forces exerted are equal and in an opposite direction.	
Forces and braking		
29.Stopping distance	Stopping distance = Thinking distance + braking distance	
30.Thinking distance	Distance travelled whilst the driver reacts and applies the brakes *Affected by: use of mobile, drugs, alcohol and tiredness*	
31.Braking distance	Distance the car travels once the brakes have been applied *Affected by speed and condition of road / tyres / brakes*	
32.Protective features	Seat belts, crumple zones and air bags	
Momentum		
33.Momentum	Momentum = mass X velocity (kg m/s) (kg) (m/s)	
34.Conservation of momentum	When two objects collide, the momentum they have before the collision = the momentum they have after the collision	

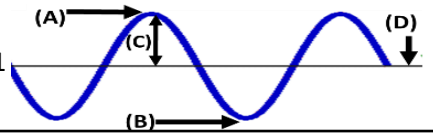
Knowledge organiser: Waves

Waves

1. Waves	**Carry energy** or information from one place to another. The are two types of waves; **transverse** and **longitudinal**.
2. Oscillation	Something that **repeats** in the **same pattern** or '**vibrates**'. They move back-and-forth (parallel= longitudinal) and up-and-down (perpendicular= transverse).
3. Transverse	**Oscillations** travelling **perpendicular** to the **direction** of **energy transfer**.
4. Longitudinal	**Oscillations** travelling **parallel** to the **direction** of **energy** transfer.
5. Light	The speed of light is **3 x 10^8 m/s** (300,000,000m/s).

Wave Properties

6. Amplitude	The **maximum displacement** of a point on a wave away from its **undisturbed position**.
7. Wavelength (λ)	The distance from a point on one wave to the same point on the next wave. It is usually measured in metres (m).
8. Frequency (*f*)	The **number of waves** passing a point **each second**. It is measured in Hertz (Hz). Frequency affects pitch.
9. Period (T)	The **time taken for one wave** to be produced.
10. Wavespeed (velocity)	Wavespeed is v, measured in metres per second (m/s). **Wavespeed** = **frequency** x **wavelength** or Speed = distance ÷ time

11 	(A) = Crest or Peak (B) = Trough (C) = Amplitude (D) = Rest position
13. Amplitude	The maximum disturbance from its rest position
14. Crest	The maximum value in an upward direction
15. Trough	The minimum value in a downward direction

16. Reflection	Waves bounce off the surface
17. Refraction	Waves change direction at a boundary
18. Transmitted	Passes though an object
19. Absorbed	Passes into but not out of an object. Energy is transferred and heats up the object
20. Medium	The substance a wave travels through

21. Angle of refraction	Angle between the refracted ray and the normal
22. Transmitted	Passes through the object.
23. Absorbed	Passes into but not out of, transfers energy and heats up the object.
24. Optical density	Is a measure of how quickly light can travel through a material
25. Wave front	A line showing all the points on a wave that are in the same position as each other

Electromagnetic waves

26. Electromagnetic waves	**Transverse waves** that are caused by **oscillations** in an **electromagnetic field**.
27. Electromagnetic spectrum	Electromagnetic waves are grouped according to their **frequency**. Waves with **high frequencies** have **short wavelengths**. Waves with **low frequencies** have **long wavelengths**.
28. Wavelength	**Wavelength range** is **$10^4$to 10^{-15}** (radio waves to gamma rays).

Electromagnetic Waves Uses		Risks
29- Radio Wave	Television and Radio	
30. Microwaves	Satellite communications, cooking food	Heats up water
31. Infrared	Electrical hearts, cooking food, infrared cameras	Can burn skin
32. Visible Light	Fibre optic Communications	cataracts
33. Ultraviolet	Energy efficient lamps, sun tanning	Causes skin to age and skin cancer
34. X-rays and Gamma Rays	Medical Imaging and treatments	Ionising Radiation that can cause mutation in genes and cancer.

35. Order of colours	Red, orange, yellow, green, blue, indigo, and violet
36. Order of EM Spectrum	Radio waves, microwaves, infrared, visible light, ultra-violet, x-ray, gamma rays.
37. Rough, black surfaces	are the best emitters and absorbers of IR radiation
38. Shiny, silver surfaces	Are the worst emitters and absorbers of IR radiation
39. Radiation dose	Measure of risk of harm to the body from exposure to radiation and is measured in Sieverts (Sv)

Section 1: Magnetism Key Terms

1. Pole	The **places** on a magnet where the **magnetic forces** are **strongest**.
2. Magnetic Field	The **area** around a magnet where a **force acts** on another magnet or magneticmaterial.
2. Repel	Occurs when two **like poles** are brought close together. The magnets **pushapart**.
3. Attract	Occurs when two **opposite poles** are brought close together. The magnets **movetogether**.
4. Permanent magnet	A magnet that produces its **own magnetic field**.
5. Induced magnet	A magnetic material that **becomes a magnet** when it is placed in a **magneticfield**. When **removed** from the **field** it **quickly loses its magnetism**.
6. Magnetic material	There are four magnetic materials: **iron**, **steel**, **cobalt** and **nickel**.
7. Compass	Compasses contain small bar magnets which **points** to the **north pole** of the **Earth's magnetic field**.
8. Field lines	The magnetic field around a bar magnet. The **field lines** always go **from North to South**

Magnetic fields

9. Magnetic field	Region around a magnet where a force acts on another magnet
	Strength depends on distance (weaker away from the magnet) and strongest at the poles
	Direction is from north to south
10. Earth's magnetic field	Can be shown with a compass (small floating bar magnet)
	Compass needle points to the north pols because of the Earth's magnetic field

Section 2: Electromagnetism Key Terms

11. Solenoid	A **coil of wire** that will create a **magnetic field** when **current** is passed through it. The magnetic field **inside** the solenoid is **strong** and **uniform**. It acts in thesame way as a bar magnet.
12. Electromagnet	A **solenoid containing an iron core** which increases its strength.
13. Motor effect	When a **conductor carrying a current is placed in a magnetic field**, **the magnet producing the field and the conductor exert a force on each othe**r.This can be used to create a motor.
14. Fleming's Left Hand Rule)	A rule that shows the **relative direction** of the **current**, **force** and **magneticfield** in the motor effect.
15. A motor	. In this case the redpart of the wire would experience a force upwards.
16. Commutator	stops motor wires twisting and reverses polarity of motor so spins in a continuos direction

Section 3: Increasing the force of...

17 A Solenoid	18 A Motor (HT)
Add an **iron core**	Increase the **number of coils** of wire
Increase the **number of coils** of wire	Increase the **strength of the magnetic field**
Increase the **current**	Increase the **current**
Move the magnetic material/ magnet **closer** to thesolenoid	

19. Generators	Coil of wire rotating inside a magnetic field. The end of the coil is connected to slip rings.
	Produces alternating current.
20. Loudspeakers	Converts variations in electrical current into sound waves.
	Varying current flows through a coil that is in a magnetic field. A force on the wire moves backwards and forwards as current varies. Coil connected to a diaphragm. Diaphragm movements produce sound waves.

Fleming's right-hand rule

21. Thumb	Direction of current.
22. Fingers	Direction of magnetic field

Fleming's left-hand rule

23. To predict the direction a straight conductor moves in a magnetic field.

24. Thumb	Direction of movement
25. First (index) finger	Direction of magnetic field.
26. Second (middle) finger	Direction of current
27. Force on a wire	Force = Magnetic flux density x current x length (N) (T) (A) (m)
28. Magnetic flux density	Measures the strength of the magnetic force