Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112 – 116 have been reported but not fully authenticated						

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

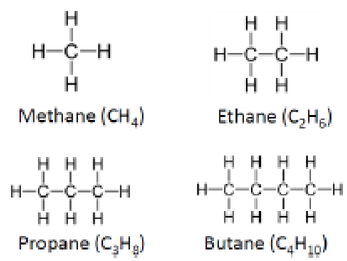
Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.

AQA C7a Crude Oil COMBINED FOUNDATION

Crude oil, hydrocarbons and alkanes

Crude oil	A finite resource	Consisting mainly of plankton that was buried in the mud, crude oil is the remains of ancient biomass.
Hydrocarbons	They are made of hydrogen and carbon only. These make up the majority of the compounds in crude oil	Most of these hydrocarbons are called alkanes.
General formula for alkanes	C_nH_{2n+2}	For example: C_2H_6 C_6H_{14}

Displayed formula for the first four alkanes



Cracking and Alkenes

Decane → pentane + propene + ethane

$$C_{10}H_{22} \rightarrow C_5H_{12} + C_3H_6 + C_2H_4$$

Alkanes to alkenes	Long chain alkanes are cracked into short chain alkenes.
Alkenes	Alkenes are hydrocarbons with a double bond (some are formed during the cracking process).
Properties of alkenes	Alkenes are more reactive that alkanes and react with bromine water. Bromine water changes from orange to colourless in the presence of alkenes.

Cracking	*The breaking down of long chain hydrocarbons into smaller chains*	The smaller chains are more useful and in demand. Cracking can be done by various methods including catalytic cracking and steam cracking.
Catalytic cracking	*The heavy fraction is heated until vaporised*	After vaporisation, the vapour is passed over a hot catalyst forming smaller, more useful hydrocarbons.
Steam cracking	*The heavy fraction is heated until vaporised*	After vaporisation, the vapour is mixed with steam and heated to a very high temperature forming smaller, more useful hydrocarbons.

Alkenes and uses as Polymers	Used to produce polymers. They are also used as the starting materials of many other chemicals, such as alcohol, plastics and detergents.
Why do we crack long chains?	Without cracking, many of the long hydrocarbons would be wasted as there is not much demand for these as for the shorter chains.

Properties of hydrocarbons

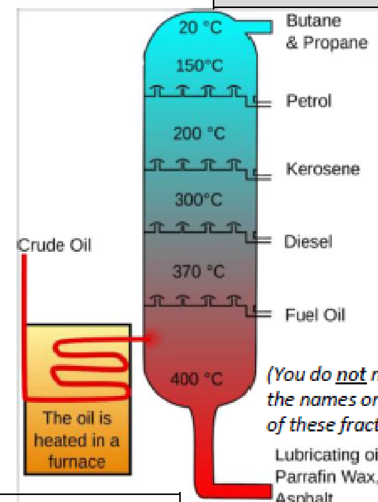
Combustion	During the complete combustion of hydrocarbons, the carbon and hydrogen in the fuels are oxidised, releasing carbon dioxide, water and energy.

Complete combustion of methane:

Methane + oxygen → carbon dioxide + water + energy

$$CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2\ H_2O\,(l)$$

Boiling point (temperature at which liquid boils)	As the hydrocarbon chain length increases, boiling point increases.
Viscosity (how easily it flows)	As the hydrocarbon chain length increases, viscosity increases.
Flammability (how easily it burns)	As the hydrocarbon chain length increases, flammability decreases.



(You do not need to remember the names or boiling points of any of these fractions)

Fractional distillation and petrochemicals

Hydrocarbon chains

Boiling points	*In oil*
The boiling point of the chain depends on its length. During fractional distillation, they boil and separate at different temperatures due to this.	Hydrocarbon chains in crude oil come in lots of different lengths.

Fractions	*The hydrocarbons in crude oil can be split into fractions*	Each fraction contains molecules with a similar number of carbon atoms in them. The process used to do this is called fractional distillation.
Using fractions	*Fractions can be processed to produce fuels and feedstock for petrochemical Industry*	We depend on many of these fuels; petrol, diesel and kerosene. Many useful materials are made by the petrochemical industry; solvents, lubricants and polymers.

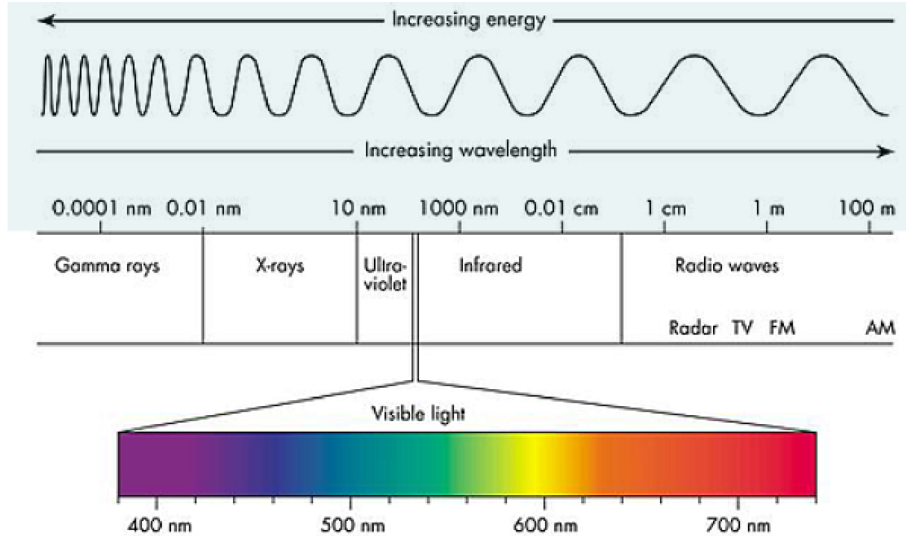
AQA - P6 Waves
Combined Foundation

Required practical's for this topic:
1. Ripple tank
2. Waves on a string
3. Infrared

Properties of Waves

Key word	Definition/description
oscillation	Vibrating back and forth about a fixed position.
wave	The transfer of energy from one place to another without the transfer of matter.
rest position	The undisturbed position of particles when they are not vibrating.
crest (peak)	The highest point above the rest position.
trough	The lowest point below the rest position.
amplitude	The distance from the rest position to the crest or trough.
wavelength	The distance from one point of one wave to the same point on the next wave. Usually measured from crest to crest or trough to trough. Wavelength is measured in metres (m)
frequency	The number of waves passing a point each second. Frequency is measured in hertz (Hz)
perpendicular	Lines that form an angle of 90° when they meet.
parallel	Lines that do not meet.
transverse waves	Where the direction of vibration is perpendicular to the direction of the energy transfer.
longitudinal waves	Where the direction of vibration is parallel to the direction of the energy transfer.

The Electromagnetic spectrum – Transverse Waves

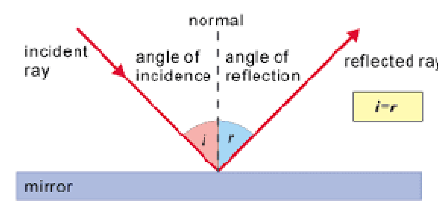


- Shiny surface → smooth → specular reflection
- Matte surface → rough → diffuse reflection
- White and shiny surfaces reflect infrared radiation
- Black and matte surfaces absorb infrared radiation

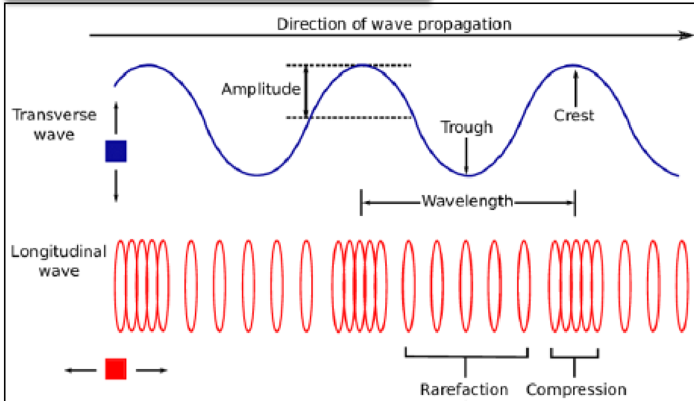
Reflection

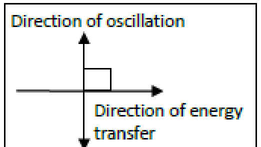
When light collides with a surface some of the light may be transmitted through, some may be absorbed but some may be reflected back.

- The law of reflection states that the angle of incidence is equal to the angle of reflection
- The normal line is an imaginary line drawn perpendicular to the surface at the point where the ray of light collides with the surface
- Angles of incidence and reflection are measure from the normal line to the ray, not from the mirror to the ray

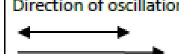


Transverse and Longitudinal waves





e.g. water, light and secondary S waves of earthquakes



e.g. sound waves and primary P waves of earthquakes

For a transverse wave the direction of oscillation is perpendicular to the direction of energy transfer, whereas for a longitudinal wave the direction of oscillation is parallel to the direction of energy transfer

Wave Properties - Equations

Property	Word Equation	Symbol Equation
Wave speed	Wave speed (m/s) = frequency (Hz) x wavelength (m)	$V = f \times \lambda$
Wave period	Wave period (s) = 1 / frequency (Hz)	$T = 1 / f$
Speed	Speed (m/s) = distance (m) / time (s)	$v = d \times t$

Sound – Longitudinal Waves

- Sound waves transfer energy through vibrating particles and therefore require a medium to travel through – sound waves cannot be transmitted through space as there are no particles.
- The speed of sound can be calculated using the equation speed = distance / time

AQA P5a Forces - the basics Combined Foundation	Required Practical for this topic: Hooke's Law

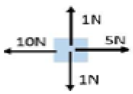
Gravity, mass and weight	Mass	How much matter something is made of	Measured in kilograms (kg)
	Weight	The force acting on an object due to gravity	Measured in newtons (N)
	Gravitational field strength	How much weight is experienced per kilogram of mass	On Earth, this is 9.8 N/kg
	Weight = mass x gravitational field strength (W = m x g)		

Units and definitions	Unit	For example: newton (N), kilogram (kg), metre (m)	
	kilo	For example: kilonewton (kN), kilogram (kg)	1000 or $1x10^3$
	Mega	For example: meganewton (MN)	1,000,000 or $1x10^6$
	Velocity	Speed in a given direction	m/s
	Distance	How far	m
	Displacement	Distance in a given direction	e.g. 5 metres east
	Centre of mass = the single point through which the weight of an object acts		

Scalars and vectors	Scalar	A quantity that only has magnitude (size), e.g. mass, time, temperature, energy, speed	Arrows can be used to show vectors: Length of the arrow = size of the vector Direction of the arrow = direction of the vector
	Vector	A quantity that has magnitude and direction, e.g. force, velocity, momentum	

Work done and energy transfer	Work done	When work is done, energy is transferred. Work done = force x distance (W = Fs)
	1 joule of work is done when 1 newton of force moves an object 1 metre in the direction of the force	
	If the force is at right angles to the direction of movement then no work is done	
	If work is done against friction then the thermal energy store of the object will increase	

Forces	A force can be a push or a pull	Examples are stretch, squash and turn
	Contact forces are exerted between two objects when they touch	E.g. friction, air resistance and tension
	Non-contact forces are exerted between two objects without touching	E.g. gravity, magnetism, electrostatic forces
	Resultant force = the single force which has the same effect as all the forces on an object	
	Two forces acting in the same direction...	...are added together
	Two forces acting in opposite directions...	...are taken away

A free body diagram shows the magnitude and direction of all the forces on an object	
The object in the diagram would experience a force of 5N to the left.	

Forces and elasticity	Forces can...	...accelerate or deform an object
	Elastic deformation	An object has been stretched but can return to its original length
	Inelastic deformation	An object is stretched and can't return to its original length
	Extension =	Current length – original length
	Hooke's law	The extension is directly proportional to the force stretching an object
	Limit of proportionality	The point at which a force-extension graph stops being a straight line and Hooke's law stops being true
	Elastic potential energy	Energy stored in a stretched spring
	Work done on a spring	Increases the elastic potential energy store and thermal energy store of the spring
Hooke's law: force = spring constant x extension (F = k x e)		
elastic potential energy = ½ x spring constant x $extension^2$ ($E = ½ ke^2$)		

AQA P5b Forces and motion **Combined Foundation**	**Required Practical for this topic:** **None**

Speed and acceleration	Speed unit	Metres per second (m/s)
	Velocity	The vector form of speed. Speed in a given direction
	Acceleration	The rate of change of velocity
	Deceleration	A negative acceleration. Slowing down.
	Acceleration unit	Metres per second per second or metres per second squared (m/s/s or m/s^2)
	For questions with two speeds	Use *u* for initial speed and *v* for final speed
Distance = speed × time $(s = v \times t)$		
Acceleration = change in velocity ÷ time $(a = \Delta v \div t$ or $a = (v - u) \div t)$		

Motion graphs	Distance time graph for a stationary object	Horizontal line
	Distance-time graph for an object at a steady speed	Straight line sloping upwards
	Distance-time graph gradient	Equals the speed
	Velocity-time graph for an object at a steady speed	Horizontal line
	Velocity-time graph for an accelerating object	Straight line sloping upwards
	Velocity-time graph for a decelerating object	Straight line sloping downwards
	Velocity-time graph gradient	Equals the acceleration

Terminal velocity	Terminal velocity	The maximum speed of a falling object
	When an object accelerates	The force of air resistance increases
	Terminal velocity is achieved when	The forces of weight and air resistance balance