CE Physics – Top Exam Tips

Units

Make sure that you know and understand the following prefixes and units

Prefixes come before a unit and indicate what fraction or multiple of the unit is being discussed.

milli-	one thousandth	$\frac{1}{1{,}000}$	Centi-	One hundredth	$\frac{1}{100}$
	deci-	one tenth	$\frac{1}{10}$		
kilo-	one thousand	$1{,}000$	Mega-	one million	$1{,}000{,}000$

Length	millimetres	mm
	centimetres	cm
	metres	m
	kilometres	km
Area	millimetres squared	mm^2
	centimetres squared	cm^2
	metres squared	m^2
	kilometres squared	km^2
Volume	milimetres cubed	mm^3
	centimetres cubed	cm^3
	metres cubed	m^3
Energy	joules	J
	kilojoules	kJ
Temperature	degrees celsius	$°C$
Mass	grams	g
	kilograms	kg
Weight / Force	newtons	N
Density	grams per centimetre cubed	g/cm^3
	kilograms per metre cubed	kg/m^3
Pressure	newtons per centimetre squared	N/cm^2
	newtons per metre squared	N/m^2
Sound – amplitude (loudness)	decibels	dB
Sound – frequency (pitch)	hertz	Hz
Electricity – current	amps (amperes)	A
	milliamps (milliamperes)	mA
Time	seconds	s
	minutes	min
	Hour	hr
	hours	hrs
Speed	miles per hour	mph
	metres per second	m/s
	kilometres per hour	km/h

Equations

You need to learn the following equations.

The triangles help you to learn them but THEY ARE THERE ONLY AS A REMINDER. YOU WILL NOT GET ANY MARKS FOR THEM.

When answering questions that involve calculations they must ALWAYS include the following:-

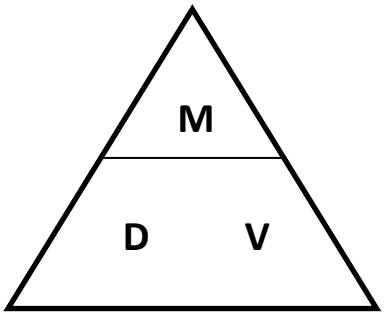
- ★ The equation written in words
- ★ The substitution line (With units)
- ★ The answer (with units)

If the equation involves division then it should be written as follows:

$$Density = \frac{mass}{volume} = \frac{55\ g}{20\ cm^3} = 2.75\ g/cm^3$$

If there is not enough space to work down the page the working across is acceptable as shown above.
It is advisable to draw the triangle in the margin and write down the 3 statements so that you know what you are looking for.

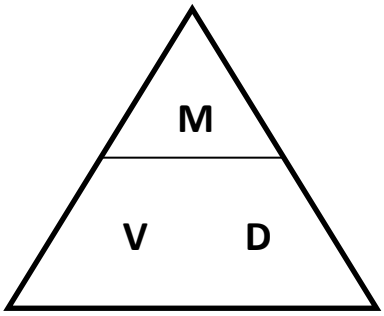
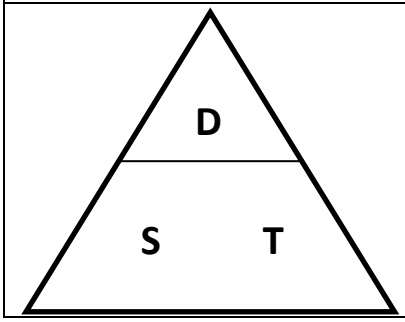
e.g.

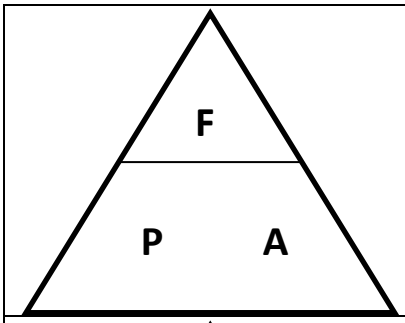
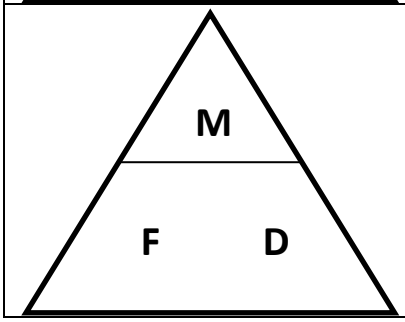


$mass = 55\ g$
$volume = 20\ cm^3$
$Density = ?$

We do not know what the density is so we put our finger over the D and are left with $\frac{M}{V} = \frac{mass}{volume}$ so we can use the equation above.

Here are the triangles that you need to learn and what the letters mean. Units can be found on page 1.

	**Density** $Rhyme = Ain't\ no\ \boldsymbol{M}ountain\ high\ enough, ain'no\ \boldsymbol{V}alley\ \boldsymbol{D}eep\ enough.$ $M = mass$ $V = volume$ $D = density$
	**Speed** $Rhyme = \boldsymbol{D}on't\ \boldsymbol{S}i\boldsymbol{T}\ \ or\ \ \boldsymbol{D}owning\ \boldsymbol{S}tree\boldsymbol{T}$ $D = distance$ $S = speed$ $T = time$

	**Pressure** $Rhyme = \boldsymbol{F}at\ \boldsymbol{PA}$ $F = force$ $P = pressure$ $A = area$
	**Moments** $Rhyme = \boldsymbol{M}a's\ \boldsymbol{F}oo\boldsymbol{D}$ $M = mass$ $F = force$ $D = distance$

Density

Calculations for density can be found in the example above but in general density is how much matter can be concentrated into a set volume.

In general

- ★ Gases have low densities
- ★ Liquids have medium densities
- ★ Solids have high densities

However there are exceptions to the rule, e.g.

- ★ wood (a solid floats on water)
- ★ A cannon ball which would sink in water will float in mercury which although it is a liquid has a very high density.

As a general rule when we pick up an object and say "it is heavy" we should say "it is heavy for its size" therefore it is dense. When we pick up an object and say "it is light" we should say "it is light for its size" therefore it is not very dense.

Wedding rings appear "heavy" as they are made of gold which is a dense metal. So it appears heavier than we are expecting.

Mass and weight

Mass and weight are commonly confused. This is because these words are used incorrectly in everyday language.

Mass is a measure of the amount of matter or particles of "stuff" within an object. This is measured in grams and kilograms.

Weight is a force. Weight is the special word that is given to the force which objects are pulled down to a star, planet or moon. The only unit for weight is the Newton.

Calculating weight given the mass and the force of gravity.

Examination questions will often be worded as follows:-

On planet X each kilogram will be pulled down with a force of 12 Newtons (or other figure.) What will the weight of an astronaut with a mass of 90kg?

From this we know that the gravitational field strength is $12\ N/kg$

The sum we must do is as follows:

$$weight = mass \times gravitational\ field\ strength$$

$$weight = 90\ kg \times 12\ N/kg$$

$$weight = 1080N$$

Energy

Types of Energy

Chemical energy	Energy stored in chemicals – this includes fuels.
Kinetic energy (K.E.)	Energy in moving objects.
Light energy	Energy in light rays.
Sound energy	Energy in the movement of particles associated with generating sounds.
Elastic potential energy (E.P.E.)	Energy stored in an elastic object. The energy has the POTENTIAL to do work if released.
Gravitational potential energy (G.P.E.)	The POTENTIAL for an object to do work if it is allowed to fall due to gravity.
Nuclear energy	Just mentioned to say that it CANNOT be converted to chemical energy or vice versa

If you only write potential energy without putting the gravitational or elastic in front of it you will get zero marks as the examiner will not know which you are referring to.

Energy transfers

When asked to describe an energy change in an exam even if it is for only one mark you will need to include the type of energy at the start of the change AND the type of energy at the end.
e.g. a microphone takes in sound energy and converts it to electrical energy AND THAT IS ALL IT DOES so the energy transfer would be

$$sound\ energy \rightarrow electrical\ energy$$

Please remember that the arrow →shows the direction in which the energy flows.
If the question asks how the energy in an electric cell goes to light up a torch bulb then the following diagram would be correct.

$$chemical\ energy \rightarrow electrical\ energy \rightarrow light\ energy + thermal\ energy$$

The chemical energy is how the energy is stored in a cell or battery.
The electricity is generated when it is needed.
This electricity is converted into light and thermal energy AT THE SAME TIME so a + sign is used to show this.

Thermal energy

Heat and temperature are TWO different things.

Heat is another name for thermal energy and is measured in Joules.
Temperature is how hot or cold something is and is measured in °C.

There are four types of energy

- ★ Conduction – mostly occurs in solids
- ★ Convection – occurs in fluids (liquids and gases)
- ★ Radiation – thermal energy in part of the electro magnetic spectrum. This is the ONLY type of thermal energy transfer that can travel through a vacuum or space.
- ★ Evaporation

When a substance is heated it gains more thermal energy so the particles vibrate (move backwards and forwards) more as a result they jostle each other more, giving each other more space to move around in.

IT IS THE SPACE BETWEEN THE PARTICLES THAT GETS BIGGER NOT THE PARTICLES THEMSELVES.

This is why solids expand if they get hot. It is also why convection currents occur.

Specific Heat Capacity

Specific heat capacity is a way of comparing how much thermal energy is required to raise the temperature of a particular substance to that of another.
Substances with a low specific heat capacity need very little thermal energy to get them hot. e.g. copper
If an item was made of a substance with a high specific heat capacity it would take a lot of thermal energy to heat it up. e.g. iron.

Energy resources

Energy resources can be split into two categories

- ★ Renewable – The energy source is being replaced continuously within a human lifetime
  - WILL NOT ACCEPT can be used again and will never run out.
- ★ Non renewable – there is a limited quantity of it and it will run out eventually.

Coal, oil and gas are fossil fuels as they come from the fossilised remains of organisms that were once alive MILLIONS of years ago.
One question which often trips candidates up is the question that is worded
Where did this energy come from?
If talking about fossil fuels the correct answer would be either fossilised trees in the case of coal or fossilised sea creatures in the case of oil or gas.
If the words ORIGINALLY or ORIGINATE or IN THE FIRSTPLACE or similar phrase is used then the answer the examiners are looking for is the SUN.

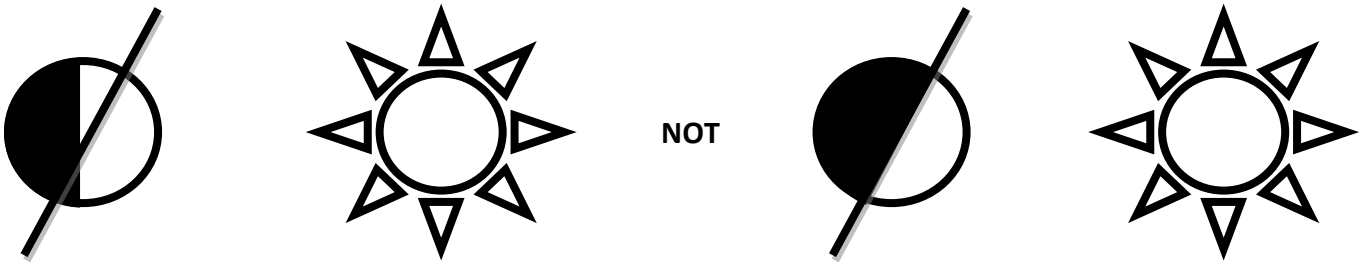
Space

The definition of a day is the time taken for a planet to spin once on its axis.
The definition of a year is the time taken for a planet to orbit its star once.

For EARTH

- ★ A day is 24 hours
- ★ A year is 365 ¼ days
- ★ The moon takes 28 days to spin on its own axis
- ★ The moon takes 28 days to orbit the earth.

This means that we ALWAYS see the same side of the moon.
We do not always see the LIT side of the moon e.g. in a new moon
When asked to shade the dark side of the earth be careful.



The difference between a star and a planet is that a star gives out light and a planet orbits the star.
Some stars do spin on their own axis so this cannot be used to distinguish the difference between the two.
The earth is tilted slightly sometimes the northern part is tilted towards the sun (summer in the northern hemisphere) sometimes it is tilted away from the sun. (Winter in the northern hemisphere)
The temperature differences experienced on earth either due to being o n the equator or Polar Regions or the seasons are to do with the angle at which the sunlight strikes the earth not the distance from the sun changing.

Eclipses

Although the moon is much smaller than the sun, it is much nearer so they appear to be about the same size in the sky.
A SOLAR eclipse is when the moon gets directly in between the earth and the sun and blocks it out completely so the shadow of the moon falls on the earth.
A LUNAR eclipse is when the earth gets directly in between the sun and the moon so the shadow of the earth falls over the moon.

Light

Light travels in straight lines.
Light waves are transverse i.e. the deflection of the wave is at right angles to the direction of travel.
When drawing light ray diagrams a PENCIL and RULER must be used and a small arrow is drawn on the line to show the direction that the light is travelling.

Reflection

The definitions must be known:-

- ★ Normal – the imaginary line at right angles to the surface
- ★ Incident ray – the incoming ray of light
- ★ Angle of incidence – the angle between the normal and the incident ray
- ★ Reflected ray – the ray of light moving away from the surface
- ★ Angle of reflection – the angle between the normal and the reflected ray

$$angle\ of\ incidence = angle\ of\ reflection$$

Although you may not use a protractor it MUST LOOK to be about the same or mare the two angles on your diagram like you mark angles in maths then write the above phrase.
You must understand that smooth surfaces produce REGULAR reflections e.g. a mirror and that rough surfaces produce a diffuse reflection such as this page.

Refraction

When light goes from one substance to another it will either slow down or speed up. The denser the substance the slower light will travel.
e.g. if light travels from air to glass it will slow down. If it goes from glass to air it will speed up again.
The boundary between the two substances is often called the interface.
If the light strikes the interface at an angle the light will bend.

If it is going into a denser material e.g. air → glass it will bend TOWARDS the normal.
If it is going into a less dense material e.g. glass → air it will bend AWAY FROM the normal.
If the light strikes the interface at right angles NO REFRACTION WILL OCCUR. The light will go straight through the interface WITHOUT bending.

Prisms

White light can be split up into the spectrum using a spectrum.
Red light travels fastest so is refracted the least
Blue light is slower so it is refracted more.
The light begins to split up after it has gone through the first air → glass interface. The beams are then refracted a second time as they go from glass → air.

REMEMBER THAT THE RULES OF REFRACTION STILL APPLY TO EACH LIGHT RAY.

Total internal reflection

As the angle of incidence of a light ray entering a glass block increases, the refracted ray will get closer and closer to running parallel to the edge of the glass block. At a specific angle known as the CRITICAL ANGLE, the refracted ray is TOTALLY INTERNALLY REFLECTED. This is how cat eyes in the road work or why the red diffusers in the rear lights of a car can reflect the headlights of a car behind it.

Colour

If we are using a white light, it contains all colours of the rainbow. We see a red object as the object absorbs all colours except red which is reflected.
If a red light is shone on this object then the object will still appear red but if a blue light is used, it will appear black as there is no red component in blue light.

Sound

Sound waves are longitudinal i.e. the deflection is in the same direction as the wave is travelling.
Sound waves cannot travel through a vacuum as they need particles to move.
There are a limited number of questions that can be asked about sound.

Scientific term	**Musical term**
Amplitude	Loudness / volume
Frequency	pitch

The unit of frequency is the Hertz (Hz)
The unit of amplitude is the decibel (dB)

There is often a question linking sound and speed. Remember that if the question talks about echoes the sound has to travel from the source of the sound to whatever the sound bounces off and back again.

i.e. if the sound bounces off a wall 50m away the sound has travelled 100m. 50m there and 50m back.

If the question asks about how we hear a sound you have to mention that the sound "enters the ear "

Speed and motion

- ★ Note that time is not decimal
- ★ 60 seconds in one minute
- ★ 60 minutes in one hour

Calculations may well be simple so remember to show full workings with units.

- ★ Acceleration is when speed is increasing
- ★ Deceleration is when speed is decreasing.

Forces

Forces can be measured using a Newton meter and the ONLY unit of force is the Newton.
Weight is a force and as such is measured in Newtons.
Friction is a force. It cannot start any movement but can only oppose movement.

Air resistance

Air is a fluid and as such flows. If you try to move quickly through it air resistance will try to slow you down. This is why your hand is pushed backwards if it is put out of the window of a moving car.

Balanced and unbalanced forces.

When forces on an object are balanced that object is either stationary or moving at a steady speed the forward thrust is equal and opposite to the drag or air resistance. If the forces are unbalanced then the object is either speeding up or slowing down.

Turning forces

The turning force or moment is the force multiplied by the distance.
The pivot or fulcrum can be anything that is the turning point of the force
These can be anything from:-

- ★ The base of a see saw.
- ★ The axle of a wheelbarrow.
- ★ A hinge of some description.
- ★ The edge or lip of a hole.

When balanced …

$$the\ anticlockwise\ moment = the\ clockwise\ moment$$

You may not be able to calculate the moment directly but you will be given enough information to calculate it by doing an interim sum.

Do not get units mixed up. If you are given the distance in cm it is ok to give the moment of a force as Ncm. UNLESS ASKED TO, DO NOT WORRY ABOUT CONVERTING IT TO Nm.

Pressure

Pressure is a measure of how concentrated a force is.
Remember that questions may not ask you a direct question on pressure.

If the area is in cm^2 then the pressure is quoted in N/cm^2
If the area is in m^2 then the pressure is quoted in N/m^2

$1\ N/m^2$ is 1 Pascal but DO NOT worry about this definition. If you are to use pascals the question will specifically ask you to do this. Use the other definitions above for all other questions.

Electricity

Symbols

Make sure that you know how to draw all the symbols correctly and what each is.
Making a game of "snap" with the names and symbols does help some pupils
Make sure that you know which are the positive and negative terminals for the following symbols

- ★ Cell
- ★ Battery
- ★ Diode
- ★ Light Emitting Diode

Key questions on symbols

- ★ Buzzer – often drawn incorrectly. Make sure that you can do this
- ★ Light DEPENDENT resistor (LDR) – is a resistor that has low resistance in light so current flows and high resistance in the dark so current does not flow.
- ★ LED's and diodes – these are SEMI CONDUCTORS. This means that they only conduct electricity if they are put into a circuit the correct way around i.e. positive side of diode to positive side of terminal etc.

The most common question is to give you a circuit with a led in it and a lamp or other device and ask if the lamp lights up. You need to check if the LED IS THE RIGHT WAY AROUND.

Circuits.

In a series circuit the components are linked together daisy chain style
The current is the same all the way around
The more lamps you put into a series circuit the dimmer they get but the cell or battery life is not affected.
Parallel circuits are like the rungs on a ladder.
The number of lamps in a parallel circuit does not affect the brightness however the more lamps there are the shorter the cell life.
Lamps work because there is a piece of wire that is a resistor. When current is passed through it, it gets very hot and glows. If another wire is connected from one side of the lamp to the other bypassing the lamp the electricity will flow through this as the resistance of the wire is far lower. The diameter of the wire is much bigger than the diameter of the wire within the bulb.
"It is like bank holiday traffic going down a small country road then given the option to use the 12 lane motorway."

Magnetism

Magnets have two poles north and south.
Metals that can be magnetised are iron cobalt and nickel.
If a compass is placed near a bar magnet the needle will point in the direction of the magnetic field around the bar magnet as this is far stronger than the earth's magnetic field.
Wires moving through a magnetic field generate electricity
Currents flowing through a wire generate a magnetic field.

Electromagnets

Three ways to increase the power of an electromagnet

- ★ Increase the number of turns on the electromagnet
- ★ Use an iron core

- ★ Increase the current flowing through the wires.

Springs

The length of the spring and its extension are two different things.
To find the extension of a spring, take the total length of the spring then subtract the length of the unstretched spring.
A spring will stretch in a uniform manner until it reaches its elastic limit another name for this is limit of proportionality.
If a graph of extension against force or load will be a straight line through the origin (0,0) of the graph
If a graph of length against force is drawn, then the point at which the straight line cuts the y axis is the unstretched length of the spring.
A graph may start out as a straight line but then begin to curve upward.
The point at which the graph begins to curve is the elastic limit.

Springs in series

2 springs in series will stretch twice as far as the individual springs alone. This is because all the force is acting on each spring in turn.

Springs in parallel

2 springs in parallel will stretch half as far as the individual springs as each spring is taking half the load.

Exam questions will often combine groups of springs sometimes in series or parallel or give you data on two springs in series and ask what the extension or length would be if they were in parallel.

They will try to confuse you by asking one set of questions about the length then the next set about the extension.
Read the questions very carefully as they will all be possible to do.