Year 10 AQA GCSE Physics Revision Booklet

Particle model of matter	☺	😐	☹
Density of materials - know • the density of a material is defined by the equation: density = mass/volume - ρ = m/V • density, ρ, is measured in kilograms per metre cubed, kg/m^3 • mass, m, is measured in kilograms, kg • volume, V, is measured in metres cubed, m^3 • How to explain the differences in density between the different states of matter in terms of the arrangement of atoms or molecules. • How to explain differences in density between the different states • How to describe practical methods to measure the density of regular and irregular solids and a liquid.			
The three states of matter – know • The states of matter are solid, liquid and gas and how to recognise and draw simple diagrams to model the difference in arrangement of particles between solids, liquids and gases. • The names of the changes of state (Melting, freezing, boiling, evaporating, condensing, sublimation) • How to use melting and boiling point data to decide the state of a substance			
Changes of state • Students should be able to describe how and that when substances change state (melt, freeze, boil, evaporate, condense or sublimate) and that mass is conserved. • Changes of state are physical changes which differ from chemical changes			
Internal Energy • Internal energy is stored inside a system by the particles that make up the system. It is the total kinetic energy and potential energy of all the particles • Heating changes the energy stored within the system by increasing the energy of the particles that make up the system. This either raises the temperature of the system or produces a change of state.			
Temperature changes in a system and specific heat capacity • If the temperature of the system increases, the increase in temperature depends on the mass of the substance heated, the type of material and the energy input to the system. • The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius. • The following equation applies • change in thermal energy = mass× specific heat capacity x temp change. • change in thermal energy is measure in joules, J, mass, m, in kilograms, kg • specific heat capacity, c, is measured in joules per kilogram per degree Celsius, J/kg °C • temperature change, Δθ, is measured in degrees Celsius, °C.			

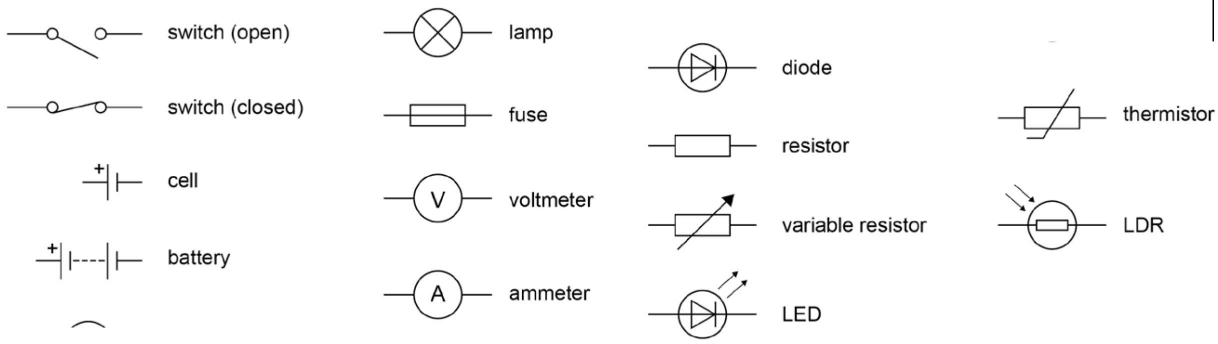
Particle model of matter continued	☺	😐	☹
Changes of heat and specific latent heat • Latent heat is the energy needed for a substance to change state. • When a change of state occurs, the energy supplied changes the energy stored (internal energy) but not the temperature. • The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature. • energy for a change of state = mass × specific heat capacity x latent heat • energy, E, is measured in joules, J; mass, m is measured in kilograms, kg • specific latent heat, L, is measured in joules per kilogram, J/kg • Specific latent heat of fusion is the change of state from solid to liquid • Specific latent heat of vaporisation is the change of state from liquid to vapour • Be able to interpret heating and cooling graphs that include changes of state. • Be able to distinguish between specific heat capacity (a change in temperature is involved) and specific latent heat (a change of state is involved at constant temperature).			
Particle motion in gases • The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules. • Changing the temperature of a gas, held at constant volume, changes the pressure exerted by the gas. • Be able to explain how the motion of the molecules in a gas is related to both its temperature and its pressure • Be able to explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.			
Pressure in gases • A gas can be compressed or expanded by pressure changes. The pressure produces a net force at right angles to the wall of the gas container • Be able to use the particle model to explain how increasing the volume in which a gas is contained, at constant temperature, can lead to a decrease in pressure. • For a fixed mass of gas held at a constant temperature: pressure × volume = constant • pV=constant ($p_1V_1 = p_2V_2$) • pressure, p, is measured in pascals, Pa; volume, V, is measured in metres cubed, m^3 • Be able to calculate the change in the pressure of a gas or the volume of a gas (a fixed mass held at constant temperature) when either the pressure or volume is changed.			
Increasing the pressure of a gas • Work is the transfer of energy by a force. • Doing work on a gas increases the internal energy of the gas and can cause an increase in the temperature of the gas. • Be able to explain how, in a given situation eg a bicycle pump, doing work on an enclosed gas leads to an increase in the temperature of the gas.			

Atomic Structure and Radioactivity			
Models of the atom – know: • Plum pudding model of the atom and Rutherford and Marsden's alpha experiments, being able to explain why the evidence from the scattering experiment led to a change in the atomic model. • Be able to explain the difference between the plum pudding and nuclear model of the atom. • Niels Bohr's adaptation of the Rutherford model • That Chadwick's experiments showed the existence of neutrons in the nucleus. • Atoms are very small, having a radius of about 1×10^{-10} metres with a positively charged nucleus surrounded by negatively charged electrons. • The radius of a nucleus is less than 1/10 000 (about $1x10^{-14}$ m).of the radius of an atom. • That most of the mass of an atom is concentrated in the nucleus. • The electrons are arranged at different distances from the nucleus (different energy levels). The electron arrangements may change with the absorption of electromagnetic radiation (move further from the nucleus; a higher energy level) or by the emission of electromagnetic radiation (move closer to the nucleus; a lower energy level). • The electrical charges and relative masses of protons, neutrons and electrons. • How to calculate the number of protons, electrons and neutrons in an atom or ion given the atomic number and mass number • What an isotope is – an atom with different numbers of neutrons but the same number of protons. • Atoms turn into positive ions if they lose one or more outer electron(s).			
Radioactive decay and nuclear radiation • Radioactive decay is a random process where an unstable nuclei becomes more stable. • Activity is the rate at which a source of unstable nuclei decays and is measured in becquerel (Bq) • Count-rate is the number of decays recorded per second by a detector/Geiger-Muller tube. • The nuclear radiation emitted may be a) an alpha particle (α) – this consists of two neutrons and two protons which is the same as a helium nucleus, b) a beta particle (β) – a high speed electron ejected from the nucleus as a neutron turns into a proton, c) a gamma ray (γ) – electromagnetic radiation from the nucleus or d) a neutron (n). • Know the penetration of alpha particles, beta particles and gamma rays through materials, their range in air and ionising power. • Be able to apply your knowledge to the uses of radiation and evaluate the best sources of radiation to use in a given situation			
Nuclear Equations • To be able to use the names and symbols of common nuclei and particles to write balanced nuclear equations that show single alpha (α) and beta (β) decay. This is limited to balancing the atomic numbers and mass numbers. Nuclear equations are used to represent radioactive decay. For example: $^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$ $^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}\text{e}$			

Atomic Structure and Radioactivity continued	🙂	😐	🙁
Radioactive Decay – know: • That Radioactive decay is random and that the half-life of a radioactive isotope is the time it takes for the number of nuclei of the isotope in a sample to halve, or the time it takes for the count rate to fall to half its initial level. • How to determine the half-life of a radioactive isotope from given information. • How to calculate the net decline, expressed as a ratio, in a radioactive emission after a given number of half-lives. • That radioactive isotopes have a very wide range of half-life values. • The hazards associated with a radioactive material depends on the half-life.			
Radioactive Contamination - know • That radioactive contamination is the unwanted presence of radioactive atoms with the hazard being the due to the decay of the contaminating atoms. • The type of radiation emitted affects the level of hazard. • Irradiation is when an object is exposed to radiation, but does not become radioactive. • How to compare the hazards associated with contamination and irradiation. • The precautions to protect against hazards from radioactive sources. • Recognise the importance for the findings of studies into the effects of radiation on humans to be published and shared so that the findings can be checked by peer review.			
Background radiation - know • Background radiation is around us all of the time. It comes from natural sources such as rocks and cosmic rays from space, man-made sources such as the fallout from nuclear weapons testing and nuclear accidents. • The level of background radiation and radiation dose may be affected by occupation and/or location. • Radiation dose is measured in sieverts (Sv) - 1000 millisieverts (mSv) = 1 sievert (Sv)			
Uses of radiation • Know that nuclear radiations are used in medicine for the exploration of internal organs and control or destruction of unwanted tissue. • Be able to describe and evaluate the uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue • Be able to evaluate the perceived risks of using nuclear radiations when given data and consequences			
Nuclear Fission –know that: • Nuclear fission is the splitting of a large unstable nucleus (eg uranium or plutonium). • Spontaneous fission is rare, for it to occur the unstable nucleus a neutron is absorbed. • The nucleus undergoing fission splits into two smaller nuclei, roughly equal in size, and emits two or three neutrons plus gamma rays. Energy is released by the fission reaction. • All of the fission products have kinetic energy and the neutrons may go on to start a chain reaction where the reaction is controlled in a reactor with controlled energy release. The explosion of a nuclear weapon is caused by an uncontrolled chain reaction. • How to draw/interpret diagrams representing nuclear fission/ chain reaction.			
Nuclear Fusion – know that: • Nuclear fusion is the joining of two light nuclei to form a heavier nucleus. • In this process some of the mass may be converted into the energy of radiation.			

Electricity

Circuit Symbols - You should know the circuit symbols below:



Electrical charge and current

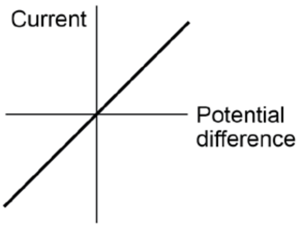
- For electrical charge to flow through a closed circuit the circuit must include a source of potential difference.
- Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation:
- Charge flow = current x time
- $Q = It$
- Charge flow Q, in coulombs, C, current I, in amperes, A (Amps is ok), time, t in seconds s.
- A current has the same value at any point in a single closed loop.

Current, Resistance and Potential Difference

- The current (I) through a component depends on both the resistance (R) of the component and the potential difference (V) across the component.
- The greater the resistance of the component the smaller the current for a given potential difference (pd) across the component.
- Current, potential difference or resistance can be calculated using the equation:
- Potential difference = current x resistance
- $V = I R$
- Potential difference (V) in volts V, current (I) in Amps A and resistance (R) in ohms Ω.
- Be able to draw a suitable circuit diagram and explain how to complete a practical to investigate the factors affecting the resistance of an electrical circuit. Including the effect of the length of wire at constant temperature and combinations of resistors in series and parallel.

Resistors

- be able to explain that, for some resistors, the value of R remains constant but that in others it can change as the current changes.
- The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes.

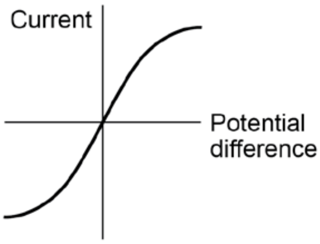


- The resistance of components such as lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component.

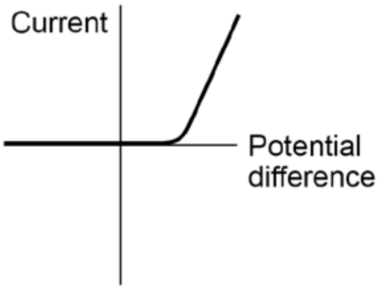
Electricity - continued ☺ 😐 ☹

Resistance

- The resistance of a filament lamp increases as the temperature of the filament increases.



- The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.



- Know the resistance of a thermistor decreases as the temperature increases.
- Know some applications of thermistors in circuits eg a thermostat
- Know the resistance of an LDR decreases as light intensity increases.
- Know the application of LDRs eg switching lights on when it gets dark.
- Be able to explain the design and use of a circuit to measure the resistance of a component (e.g. filament lamp, diode, resistor at constant temperature) by measuring the current through, and potential difference across the component including the graphs that should be drawn and information that can be obtained from the graph.
- Draw appropriate circuit diagrams using correct circuit symbols.
- Be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties.
- Explain an experiment to investigate the relationship between the resistance of a thermistor and temperature and the resistance of an LDR and light intensity.

Series and parallel circuits – know:

- That there are two ways of joining electrical components, in series and in parallel and that some circuits include both series and parallel parts.
- That for components connected in series there is the same current through each component, the total potential difference of the power supply is shared between the components, the total resistance of two components is the sum of the resistance of each component.
- $R_{total} = R_1 + R_2$ - resistance, R, is measured in ohms, Ω
- For components connected in parallel: the potential difference across each component is the same, the total current through the whole circuit is the sum of the currents through the separate components (branches), the total resistance of two resistors in parallel is less than the resistance of the smallest individual resistor.
- How to use circuit diagrams to construct and check series and parallel circuits that include a variety of common circuit components, describe the difference between series and parallel circuits, explain qualitatively why adding resistors in series increases the total resistance whilst adding resistors in parallel decreases the total resistance

Electricity - continued ☺ 😐 ☹

Series and parallel circuits - continued

- How to explain the design and use of dc series circuits for measurement and testing purposes
- How to calculate the currents, potential differences and resistances in dc series circuits
- How to solve problems for circuits which include resistors in series using the concept of equivalent resistance.

Static Electricity – know

- That when certain insulating materials are rubbed against each other they become electrically charged. Know how this happens in relation to the movement of negatively charged electrons and be able to describe the production of static electricity and sparking.
- What happens when electrically charged objects are brought close together and that this depends on their charge
- That attraction and repulsion between two charged objects are examples of a non-contact force and describe evidence (examples) of this.

Electric Fields – know that

- A charged object creates an electric field around itself. The electric field is strongest close to the charged object and diminishes with distance from the charged object.
- A second charged object placed in the field experiences a force. The force gets stronger as the distance between the objects decreases.
- How to draw the electric field pattern for an isolated charged sphere, explain the concept of an electric field, explain how the concept of an electric field helps to explain the noncontact force between charged objects as well as other electrostatic phenomena such as sparking.

Domestic uses and safety

Direct and alternating potential difference – know

- Mains electricity is an ac supply In the UK the supply has a frequency of 50Hz and is about 230V
- Explain the difference between a direct (one direction only) and alternating (constantly changing direction) potential difference.

Mains electricity – know

- Most electrical appliances are connected to the mains using three-core cable
- The insulation covering each wire is colour coded for easy identification. (live wire – brown, neutral wire – blue, earth wire – green and yellow stripes)
- The live wire carries the alternating p.d. from the supply so can be dangerous even when a switch in the mains circuit is open.
- The neutral wire completes the circuit.
- The earth wire is a safety wire to stop the appliance becoming live
- To explain the dangers of providing any connection between the live and earth.
- The p.d. between the live wire and earth is about 230V. The neutral wire is at, or close to, earth potential (0V). The earth wire is at 0V and only carries a current if there is a fault.

Energy Transfers, Power – know

- Explain how the power transfer in any circuit device is related to the potential difference across it and the current through it, and to the energy changes over time:
- Power = potential difference x current

$P = IV$

Electricity - continued	🙂	😐	🙁
Power – continued. • Power = (current)^2 x Resistance $P = I^2R$ Power P in Watts, W p.d. V in volts, V Current I, in amps, A Resistance R, in ohms Ω			
Energy transfers in everyday appliances • Everyday electrical appliances are designed to bring about energy transfers. • The amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance. • Describe how different domestic appliances transfer energy from batteries or ac mains to the kinetic energy of electric motors or the energy of heating devices. • Work is done when charge flows in a circuit. • The amount of energy transferred by electrical work can be calculated using the equation: • Energy transferred = power x time $E = Pt$ • Energy transferred = charge flow x potential difference $E = QV$			
Energy transfers in everyday appliances • Energy transferred = current x p.d. x time $E = VIt$ Energy transferred E in joules J Power P in watts W Time t, in seconds, s Charge flow Q in coulombs Potential difference V in volts V Current I in amps A • Explain how the power of a circuit device is related to the p.d across it and the current through it • Explain how the power of a circuit device is related to the energy transferred over a given time. Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use.			
The National Grid • The National grid is a system of cables and transformers linking power stations to consumers. • Electrical power is transferred from power stations to consumers using the National grid. • Step up transformers are used to increase the potential difference from the power station to the transmission cables then step-down transformers are used to decrease, to a much lower value, the potential difference for domestic use. • Explain why the National Grid system is an efficient way to transfer energy.			
Static Electricity – know • That when certain insulating materials are rubbed against each other they become electrically charged. Know how this happens in relation to the movement of negatively charged electrons and be able to describe the production of static electricity and sparking.			

Electricity - continued

Static Electrcitiy continued.

- What happens when electrically charged objects are brought close together and that this depends on their charge
- That attraction and repulsion between two charged objects are examples of a non-contact force and describe evidence (examples) of this.

Electric Fields – know that

- A charged object creates an electric field around itself. The electric field is strongest close to the charged object and diminishes with distance from the charged object.
- A second charged object placed in the field experiences a force. The force gets stronger as the distance between the objects decreases.
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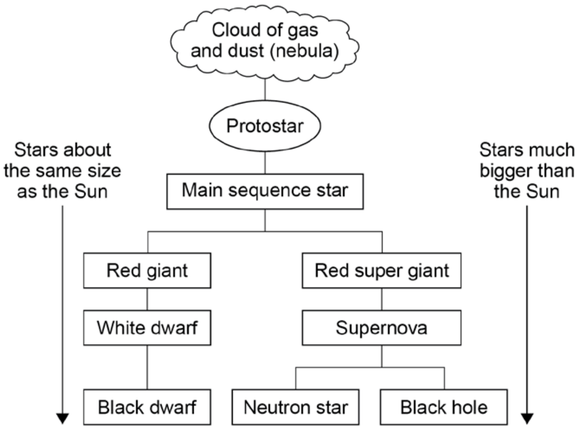
Space Physics

Our solar system – know

- The planets and the dwarf planets that orbit around the Sun including the order.
- That natural satellites, the moons that orbit planets, are also part of the solar system.
- That our solar system is a small part of the Milky Way galaxy.
- That the Sun was formed from a cloud of dust and gas (nebula) pulled together by gravitational attraction.
- How to explain the start of a star's life cycle, the dust and gas were drawn together by gravity causing fusion reactions, that fusion reactions led to an equilibrium between the gravitational collapse of a star and the expansion of a star due to fusion energy.

Life cycle of a star – know that

- A star goes through a life cycle. The life cycle is determined by the size of the star.
- How to describe the life cycle of a star, the size of the Sun and the life cycle of a star much more massive than the Sun.
- That fusion processes in stars produce all of the naturally occurring elements. Elements heavier than iron are produced in a supernova.
- The explosion of a massive star (supernova) distributes the elements throughout the universe.
- How to explain how fusion processes lead to the formation of new elements.



Equations:
These are the equations that you need to be able to recall and apply for your year 10 exam:

Word equation	Symbol equation
Weight = mass x gravitational field strength (g)	W = mg
Work done = force x distance (along the line of action of the force)	W = F d
Pressure = force normal to a surface / area of that surface	$p = \frac{F}{A}$
Distance travelled = speed x time	s = v t
Acceleration = change in velocity / time taken	$a = \frac{\Delta v}{t}$
Power = energy transferred / time	$P = \frac{E}{t}$
Power = work done / time	$P = \frac{W}{t}$
Efficiency = useful power output/total power input	
Charge flow = current x time	Q = I t
Potential difference = current x resistance	V = I R
Power = potential difference x current	P = V I
Power = $(\text{current})^2$ x Resistance	$P = I^2R$
Energy transferred = power x time	E = P t
Energy transferred = charge flow x potential difference	E = Q V
Density = mass / volume	$\rho = \frac{m}{V}$

These are the equations that you will be given and will need to select from.

Equation number	Word equation	Symbol equation
5	Change in thermal energy = mass x specific heat capacity x temperature change	$\Delta E = mc\Delta\theta$
9	Thermal energy for a change of state = mass x specific latent heat	E = m L
12	For gases: pressure x volume = constant	p V = constant

Good Luck ☺