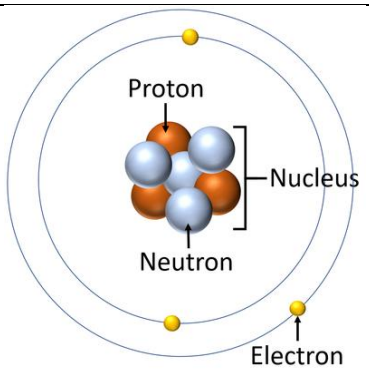
Pearson Edexcel

YEAR 10 GCSE Physics

Spring Term Knowledge Organiser

ALDER Community High School

	Nuclear Physics	
1	What is the size of the average atom?	1 x 10^{-10}m or 0.1nm
2	Draw a labelled diagram of an atom.	
3	Which two sub atomic particles are found in the nucleus?	Protons and neutrons
4	What properties does a nucleus have?	Very dense and positively charged
5	What charges do protons, neutrons and electrons have?	Protons = +1 (**P**rotons are **P**ositive) Neutrons = 0 (**Neutr**ons are **Neutr**al) Electrons = -1
6	What are the relative masses of protons, neutrons and electrons?	Protons = 1 Neutrons = 1 Electrons = 0 or 1/2000 or 0.0005
7	What is the radius of nucleus compared to radius of atom?	1/10000 of the size (one ten thousandth of the size)
8	Electrons go up an energy level when… (HT only)	They absorb electromagnetic radiation
9	Electrons move down an energy level when… (HT only)	They emit electromagnetic radiation
10	Are atoms positive, negative or neutral?	Neutral
	In nuclear physics, nuclei are represented with the following notation: $^{4}_{2}He$	
11	What does ‘He’ represent?	This is the chemical symbol that tells us it is a ‘Helium Nucleus’
12	What does the 4 represent?	The mass number of the nucleus.
13	What does the 2 represent?	The atomic number.
14	What is the atomic number?	Number of protons
15	What is the mass number?	Number of protons AND neutrons.
16	How many protons does Calcium (Ca) have?	Protons = 20

	How many neutrons does Calcium (Ca) have? What is the relative mass of Calcium(Ca)? $^{40}_{20}Ca$	Neutrons = 20 Relative mass = 40
17	What is an "ion"?	A charged atom (lost or gained electrons)
18	What are isotopes?	Atoms of the same element with the SAME number of protons but a DIFFERENT number of neutrons.
19	Describe the plum pudding model	The atom is a ball of positive charge with negative electrons embedded in it
20	What is the name of the current model of the atom?	Nuclear model
21	Describe the Gold foil experiment by Rutherford	Alpha particles directed towards a piece of gold foil. Most particles pass straight through foil, Some is deflected through small angles Very small number of alpha particles are deflected back at the alpha source
22	State two conclusions from the gold foil / alpha scattering experiment	1) mass of an atom is concentrated in a nucleus in the centre 2) nucleus is positive
23	State the conclusion provided by Niels Bohr	Electrons orbit the nucleus in shells
24	For an electron to be excited to a higher energy level, the energy of the incoming photon must be equal to…	The difference in energy between the two levels
	What type of ion does an atom become if it loses electrons?	A positive ion

	Radioactive decay and radiation	
1	What two words can we use to describe the process of radioactive decay?	Random and unpredictable
2	What is the word to describe the rate at which a source of unstable nuclei decays	Activity
3	What is the word to describe the number of decays recorded each second by a detector	Count rate
4	What is the equipment for measuring radiation?	Geiger-Muller tube
	What are the units of measurement for a activity of a radioactive sample?	Becquerels (Bq)
5	Name the four types of nuclear radiation	alpha particle, beta particle, gamma ray, neutron
6	Describe the structure of an alpha particle	2 neutrons & 2 protons (helium nucleus)
7	What is a beta particle?	A negative electron
8	What is a gamma ray?	A high energy electromagnetic wave from the nucleus
9	What is the nuclear symbol for alpha radiation?	'$^{4}_{2}\alpha$' (greek symbol for alpha)

		Or '$^{4}_{2}He$' the Symbol for Helium
10	What is the nuclear symbol for beta radiation?	'$^{0}_{-1}\beta$' (greek symbol for beta) Or '$^{0}_{-1}e$' (symbol for an electron)
11	What is the nuclear symbol for Gamma radiation?	'γ' (greek symbol for gamma)
12	Three main types of radiation in order of high to low ionising power.	alpha, beta, gamma
13	Three main types of radiation in order of high to low penetrating power.	gamma, beta, alpha
14	Which materials are able to stop each type of radiation?	Alpha = paper, beta = aluminium, gamma = thick lead or concrete
15	Distances alpha, beta and gamma can go in air.	Alpha: 3-5cm, Beta: around 1m, Gamma: over 1km.
16	Define "irradiation"	Exposing an object to nuclear radiation. The irradiated object does not become radioactive.
17	Define "half-life"	The time it takes for the number of unstable nuclei of the isotope in a sample to halve.
18	If there are 1000 nuclei in a radioactive sample, how many should be left after 2 half lives?	1000 → 500 → <u>250</u>
19	If a half-life is 200 years, how many half lives have there been in 600years?	600/200= 3 half lives
20	What proportion of radioactive nuclei will be left from a sample after 4 half lives?	$1 \rightarrow \frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8} \rightarrow \mathbf{\frac{1}{16}}$
21	Below is a decay equation – what does each symbol represent? $^{222}_{136}Rn \rightarrow {}^{218}_{134}Po + {}^{4}_{2}\alpha$	$^{222}_{136}Rn$ - Parent nucleus appears on the left of the arrow – in this case it is Radon -222 $^{218}_{134}Po$ Daughter Nucleus appears after the arrow to show the decay has taken place – in this case it is Polonium $^{4}_{2}\alpha$ The decay produces radiation – in this case it's alpha.
22	How is an alpha decay of Thorium-228 ($^{228}_{90}Th$) represented by an equation?	$^{228}_{90}Th \rightarrow {}^{224}_{88}Ra + {}^{4}_{2}\alpha$

		Note the mass and atomic numbers. Thorium loses 2 protons and 2 neutrons in alpha decay and so decays into Radium. In alpha decay – 4 is taken from the mass number and 2 is taken from the atomic number. Total mass numbers and total atomic numbers must be balanced on both sides.
23	How is a beta (-) minus decay of Carbon -14 ($^{14}_{6}C$) represented by an equation? Describe the process of β– decay (a neutron becomes a proton plus an electron)	$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta$ In beta - decay – the mass number stays the same and Carbon 14 loses a neutron and gains a proton in beta decay. Therefore the mass of the nucleus does not change but the atomic number goes up by 1.
24	How is a beta plus (+) decay of Carbon -14 ($^{14}_{6}C$) represented by an equation? Describe the process of β+ decay (a proton becomes a neutron plus a positron)	$^{14}_{6}C \rightarrow {}^{14}_{5}B + {}^{0}_{1}\beta$ In beta + decay – the mass number stays the same and Carbon 14 loses a proton and gains a neutron in beta decay. Therefore the mass of the nucleus does not change but the atomic number goes up by 1.

	Background decay and radiation	
1	State two natural sources of background radiation	Rocks, soil and cosmic rays
2	State two man made sources of background radiation	Fallout from nuclear weapons testing, nuclear accidents
3	Define 'background radiation'	Radiation around us all the time.
4	Define 'radiation dose'	The amount of radiation that is absorbed by a person (Measured in Sieverts - Sv)
5	Define Contamination.	Contact of radioactive atoms on an object, a person's skin or in their body. Danger arises from those radioactive atoms decaying and giving out radiation.
6	Define Irradiation	Process of an object being exposed to nuclear radiation. The 'irradiated' object does not become radioactive.
7	Would a long or short half-life radioactive material be more dangerous in the long term?	Long half-life material.
8	State 2 medical uses of nuclear radiation	Exploring internal organs, control/destruction of unwanted tissue.
9	How do we account for background radiation when determining a source's count rate?	Subtract the background radiation
10	Give an example of an internal organ that would be explored with radiation	Intestines - to look for blockages.

11	Would you use a short or long half-life material for using a tracer in the intestine?	Short - an hour or so - you don't want to leave the hospital if you are still giving out high levels of radiation.
12	What kind of radiation is used to look at internal organs?	Beta
13	Why can't alpha be used to look at internal organs?	Stopped by skin
14	What kind of radiation is used to destroy tumours?	Gamma rays (sometimes beta)
15	Why is gamma used to destroy tumours?	Most ionising & can penetrate the skin and bones.
16	Why is a long half-life material high risk?	It will still be giving out radiation in years to come.
17	State 2 factors that affect the amount of background radiation people are exposed to	Occupation (job) & location

	Nuclear fission and fusion	
1	Define 'Nuclear fission'	Splitting a large & unstable nucleus.
2	State 2 examples of elements that undergo fission.	Uranium & plutonium
3	Spontaneous fission is rare. What usually causes fission?	An unstable nucleus absorbs a neutron
4	State the 3 products of nuclear fission	2 smaller nuclei, 2 or 3 neutrons, gamma rays
5	In what form is energy released in a fission reaction?	Gamma rays
6	How do the sizes of the two nuclei produced in a fission reaction compare?	Roughly the same size.
7	The nuclei and neutrons produced have after a fission reaction have energy in which store?	Kinetic store
8	What is a chain reaction?	Neutrons from a fission reaction are absorbed by another nucleus & start another fission reaction
9	How is a fission reaction in a nuclear power station controlled?	Control rods absorb neutrons (slow down the chain reaction)
10	In a nuclear weapon, is the chain reaction controlled or uncontrolled?	Uncontrolled.
11	Define 'nuclear fusion'	The joining of two light nuclei to form a heavier nucleus
12	Where does nuclear fusion happen in nature?	In stars e.g. the sun.
13	Why does nuclear fusion happen in the sun?	High temperature & pressure
14	Why does fusion need a high temperature and pressure?	To overcome the repulsion force between the 2 positive nuclei
15	State two elements that undergo nuclear fusion	Hydrogen and helium