Name: _____ Class: _____

Additional Science Homework

P2 Physics for your future

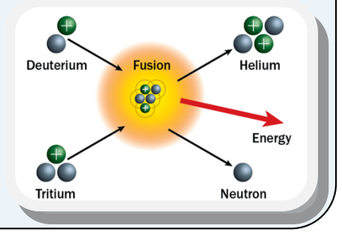
Topic 5: Nuclear fission and nuclear fusion

5.11 Recall that the products of nuclear fission are radioactive

The products of fission, whilst smaller in size than Uranium, are still large unstable nuclei. Unstable nuclei can emit _____,_____ and _____ radiation, which is harmful to human health as well as other organisms in the environment.

5.12 Describe nuclear fusion as the creation of larger nuclei from smaller nuclei, accompanied by a release of energy and recognise fusion as the energy source for stars

Deuterium and tritium are isotopes of _____. Deuterium has __ extra neutron, Tritium has __ extra neutrons. When they travel together at extremely high speed, the _____ together to form an unstable _____ isotope. To become stable, this isotope of _____ ejects a _____, which carries away most of the _____ released by this reaction. This leaves behind a _____ nucleus.



5.13 Explain the difference between nuclear fusion and nuclear fission

	Nuclear Fission	Nuclear Fusion
Similarities		
Differences		

5.14 Explain why nuclear fusion does not happen at low temperatures and pressures, due to electrostatic repulsion of protons

The Strong Nuclear Force (which holds the nucleus together) is attractive once particles are less than 3 fm apart (3×10^{-15}m). Explain, referring to the diagram in 5.12, how the following help Deuterium and Tritium come close enough to each other to be attracted by the Strong Nuclear Force and so fuse together:

Temperature: _____

_____

Pressure:_____

_____

5.15 Relate the conditions for fusion to the difficulty of making a practical and economic form of power station

Fusion reactions must be contained in order to maintain _____ and _____. No material can withstand these conditions, so the gases involved are _____ in order to respond to _____ fields. These _____ fields are used to contain the reaction, and must be extremely strong. More _____ is needed to create these _____ fields than can usefully be transferred out of the fusion reaction.

Explain what is needed in order to make a viable fusion power station:_____

_____

_____

5.16 Demonstrate an understanding that new scientific theories, such as 'cold fusion', are not accepted until they have been validated by the scientific community

In 1989 Martin Fleischmann and Stanley Pons claimed to have achieved 'cold fusion' (fusion without the need for a high temperature or pressure). Explain what other scientists would need to do before they accept 'cold fusion' as a scientifically correct theory._____

_____

_____

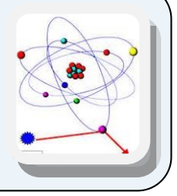
_____

5.1 Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass (nucleon) number and using symbols in the format $^{14}_{6}C$

Draw a diagram showing the arrangement and number of protons, neutrons and electrons in each of these isotopes:

$^{14}_{6}C$	$^{12}_{6}C$	$^{16}_{8}O$	$^{18}_{8}O$

5.2 Explain how atoms may gain or lose electrons to form ions



When _____, _____, or _____ radiation interact with an _____ in the shell of an atom, _____ is transferred from the radiation to the _____. If sufficient _____ is transferred, the _____ will leave the atom completely. This leaves the atom as a _____ ion, as there are now more _____ than _____ so the overall charge is _____. The _____ will join another atom, causing it to become a _____ ion.

5.3 Recall that alpha and beta particles and gamma rays are ionising radiations emitted from unstable nuclei in a random process

5.4 Recall that an alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation

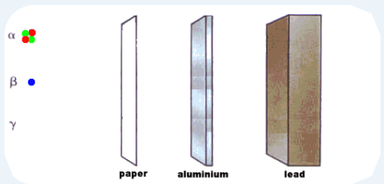
The emission of nuclear radiation occurs because the nucleus of a radioisotope is _____ and collapses into a more _____ state, emitting either a particle, energy or both. It is _____ to predict when an individual atom of a radioisotope will decay.

For each form of radiation, draw a diagram, state what it is made of and explain how it is emitted from the nucleus.

Alpha (α)	Beta (β)	Gamma (ɣ)

5.5 Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise

Draw arrows to demonstrate the penetrating power of each form of radiation.



Radia-tion	Penetrating power (High/Medium/Low)	Ionising power High/Medium/Low)	Use information in section 5.4 to explain the relative penetrating and ionising powers of these radiations.
α			
β			
ɣ			

If I were stood near a radiation source, I would rather it be an α/β/ɣ emitter because: _____

_____

_____

_____

_____

_____

5.6 Demonstrate an understanding that nuclear reactions can be a source of energy, including fission, fusion and radioactive decay

The energy from radioactive decay can be used to power _____

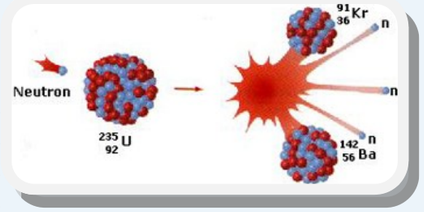
Nuclear fission is used to release energy in a controlled way in _____

Nuclear fission is used to release energy in an uncontrolled way in _____

Nuclear fusion occurs naturally in _____

5.7 Explain how the fission of U-235 produces two daughter nuclei and two or more neutrons, accompanied by a release of energy

Explain the process of nuclear fission, using the words “Neutron”, “Uranium nucleus”, “Release of energy” and “Daughter nuclei”.



_____

_____

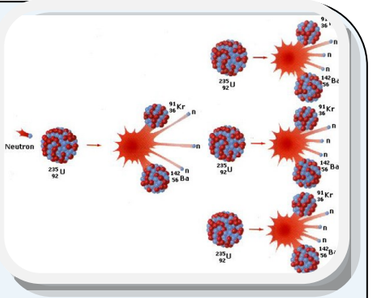
_____

_____

_____

5.8 Explain the principle of a controlled nuclear chain reaction

Explain, referring to the diagram, how a chain reaction occurs in uncontrolled nuclear fission.



_____

_____

_____

_____

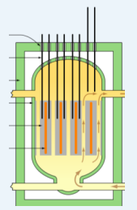
_____

A controlled chain reaction is achieved by _____

_____

5.9 Explain how the chain reaction is controlled in a nuclear reactor including the action of moderators and control rods

Label the control rods, uranium fuel rods and moderator on the diagram.



The role of the moderator: _____

_____

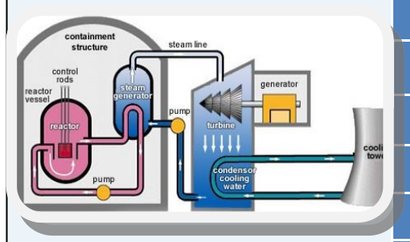
_____

The role of the control rods: _____

_____

_____

5.10 Describe how thermal (heat) energy from the chain reaction is converted into electrical energy in a nuclear power station



Component	Function
Reactor	
Steam generator	
Turbine	
Generator	
Condenser	
Cooling tower	