UNIT 6 – RADIOACTIVITY AND NUCLEAR CHEMISTRY

When is it happening?	Wednesday May 20th
How long will it take?	30 minutes
What is the format?	multiple choice questions (5 points) short answer questions (20 points)
What is it worth?	15% of your Q4 grade
What will it cover?	See below
What resources will be useful?	Unit 6 Lesson Helpsheets, Research Task 6.1 Class Worksheets 6.1 – 6.4

UNIT 6 HONORS CHECKLIST

No.	Concept	😊 ☹
1	Be able to define the terms atomic number (Z), mass number (A) and isotopes; be able to deduce the symbol of an isotope (eg $^{235}_{92}\mathrm{U}$) and/or the name of an isotope (eg uranium-235) if the number of protons and the mass number or number of neutrons is given, and vice versa	
2	Know that all atoms with $Z > 82$ and many isotopes with $Z \leq 82$ are unstable and will stabilize themselves by emitting alpha particles or beta particles from their nucleus, and that atoms which do this are said to be radioactive; know that the reduced potential energy resulting from these emissions may result in a gamma ray being emitted at the same time	
3	Know that an alpha particle ($^{4}_{2}\mathrm{He}$ or $^{4}_{2}\alpha$) contains two protons and two neutrons; that they are emitted when the original nucleus has too many protons and the new atom has two protons and two neutrons fewer than the original atom; that alpha particles are very ionizing but have very low penetrating power due to their large charge and size; know how alpha particles can be stopped; appreciate the circumstances under which alpha radiation could be dangerous; be able to write nuclear equations for alpha-decay reactions	
4	Know that a beta particle ($^{0}_{-1}\mathrm{e}$ or $^{0}_{-1}\beta$) is a fast moving electron emitted from the nucleus as a result of the conversion of a neutron into a proton; that they are emitted when the neutron/proton ratio in the original nucleus is too high and the new atom has one proton more and one neutron fewer than the original atom; that beta particles are less ionizing but have more penetrating power than alpha particles due to their smaller charge and size; know how beta particles can be stopped; appreciate the circumstances under which beta radiation could be dangerous; be able to write nuclear equations for beta-decay reactions	
5	Know that gamma rays have a very high penetrating power (they are almost unstoppable) but very low ionizing power as they have neither a mass nor a charge; know how gamma rays can be reduced in intensity; appreciate the circumstances under which gamma radiation could be dangerous	
6	Know that the rate of emission of alpha and beta particles does not depend on environmental factors and is proportional to the amount of the isotope present; as a result all isotopes have a fixed half-life; be able to define half-life; be able to use the equations $t = n \times t_{1/2}$ and $N = N_i(0.5)^n$ (if n is an integer) or $\log(\frac{N_i}{N}) = \frac{t\log 2}{t_{1/2}}$ (if n is not an integer) to calculate t, $t_{1/2}$ or N/N_i, given the other two	

7	Know that radioactive isotopes and the radiation they emit are very useful for a range of purposes, including radiotherapy and tracing in medicine, industry and agriculture; be able to link the use of the radioisotope to the type of radiation emitted (ie penetrating power vs ionizing power) and the half-life (short half-life for internal medical use and most tracers, long half-life for external medical use and most other industrial applications)	
8	Know that the atom with the most stable nucleus is $^{56}_{26}\mathrm{Fe}$, that the nuclei of atoms smaller than $^{56}_{26}\mathrm{Fe}$ can in theory become more stable by joining together to form larger atoms and that this is called nuclear fusion, and that the nuclei of atoms much larger than $^{56}_{26}\mathrm{Fe}$ can become more stable by splitting up into smaller atoms and that this is called **nuclear fission**; know that both types of reaction can release a very large amount of energy; be able to write equations for nuclear fission and fusion reactions given sufficient information; know that the sum of the mass numbers and the sum of the atomic numbers must be the same on both sides of a nuclear equation	
9	Know that nuclear fusion reactions require extreme temperatures and pressures (due to the repulsion between the nuclei), that they are the source of the sun's energy and can only happen under the conditions present in stars, and that once they start they release so much energy that they are impossible to control; know that humans have yet to develop a technique for generating energy by controlled nuclear fusion; know that the hydrogen bomb is based on a fusion reaction initiated by a fission reaction	
10	Know that nuclear fission reactions are usually initiated by firing a neutron at a large nucleus and that this is relatively easy to do; know that the products of nuclear fission usually include several neutrons which can result in a chain reaction and that the reaction can be controlled by using boron to absorb excess neutrons; know that the atom bomb is based on an uncontrolled fission reaction	
11	know that fusion uses widely available raw materials (hydrogen) and does not generally produce radioactive products; know that the products of nuclear fission (the daughter nuclei) are almost always radioactive and that there is no easy way to dispose of them or recycle them safely; know that the raw materials for nuclear fission (uranium and plutonium) are expensive and need to be mined; appreciate that generating energy through nuclear fission generates a large amount of energy whilst producing almost no CO_2; understand both sides of the debate (including safety and cost) on whether nuclear energy is an appropriate way to meet our energy needs in the 21st century	