Topic C.7A Mass Defect

Past Exam Questions (Paper 3)

1. *[2 marks]*

In the 20th Century, both fission and fusion were considered as sources of energy but fusion was economically and technically unattainable.

Calculate the loss in mass, in kg, and the energy released, in J, when 0.00100 mol of ^{228}Ac decays, each atom losing an electron. Use section 2 of the data booklet and $E = mc^2$.

$^{228}\text{Ac} \rightarrow {}^{0}_{-1}e + {}^{228}\text{Th}$

Particle	^{228}Ac	$^{0}_{-1}$e	^{228}Th
Mass / kg	3.78532×10^{-25}	9.109383×10^{-31}	3.78528×10^{-25}

Loss in mass:

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Energy released:

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2. *[3 marks]*

Carbon is produced by fusion reactions in stars.

The main fusion reaction responsible for the production of carbon is:

X + $^{4}_{2}He \rightarrow ^{12}_{6}C$

The mass of **X** is 8.005305 amu and that of $^{4}_{2}He$ is 4.002603 amu. Determine the energy produced, in J, when one atom of $^{12}_{6}C$ is formed in this reaction. Use section 2 of the data booklet.

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3. *[2 marks]*

The sun is the main source of energy used on earth.

Calculate the energy released, in MeV, in this reaction, using section 36 of the data booklet.

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4. *[3 marks]*

Red supergiant stars contain carbon-12 formed by the fusion of helium-4 nuclei with beryllium-8 nuclei.

Mass of a helium-4 nucleus = 4.002602 amu
Mass of a beryllium-8 nucleus = 8.005305 amu
Mass of a carbon-12 nucleus = 12.000000 amu

Calculate the heat energy released, in J, by the fusion reaction producing one atom of carbon-12. Use section 2 of the data booklet and $E = mc^2$.

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5. *[3 marks]*

Uranium-235, ^{235}U, is bombarded with a neutron causing a fission reaction.

Two products of the fission of ^{235}U are ^{144}Ba and ^{89}Kr.

The masses of the particles involved in this fission reaction are shown below.

Mass of neutron = 1.00867 amu
Mass of U-235 nucleus = 234.99346 amu
Mass of Ba-144 nucleus = 143.89223 amu
Mass of Kr-89 nucleus = 88.89788 amu

Determine the energy released, in J, when one uranium-235 nucleus undergoes fission. Use this data and information from sections 1 and 2 of the data booklet.

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6. *[1 mark]*

This question is about nuclear reactions.

Outline how the energy of a fission reaction can be calculated.

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