Year 11 Physics Assignment NAME_____

Nuclear Physics

1. Use an analogy to explain what an isotope is. "An isotope is like..." /2

2. For each of the following types of radiactive decay:
   (i) alpha
   (ii) beta minus
   (iii) beta plus
   (iv) gamma
   (a) State the nature of the radiation emitted. /4
   (b) State what would cause a nucleus to undergo it (e.g. too many protons compared to neutrons). /4

3. Complete the following nuclear reaction equations:
   (a) ${}^{4}_{2}\mathrm{He} + {}^{9}_{4}\mathrm{Be} \longrightarrow {}^{12}_{6}\mathrm{C} + ?$
   (b) ${}^{27}_{13}\mathrm{Al} + {}^{1}_{0}\mathrm{n} \longrightarrow {}^{1}_{1}\mathrm{H} + ?$
   (c) ${}^{241}_{94}\mathrm{Pu} + ? \longrightarrow {}^{242}_{94}\mathrm{Pu}$
   (d) ${}^{226}_{88}\mathrm{Ra} \longrightarrow {}^{222}_{86}\mathrm{Rn} + ?$

   /4

4. The radioisotope Curium-242 has a half-life of 163 days.
   (a) Sketch a graph showing how the number of nuclei of Curium-242 changes over a period of 652 days. /3
   (b) If a sample initially contains 4.2×10^{24} nuclei, calculate the number of nuclei remaining after 500 days. /2

5.
   (a) State the difference between nuclear fission and nuclear fusion. /1
   (b) Explain why fusion is much harder with two helium nuclei than two hydrogen nuclei. /2

6.
   (a) Describe how a uranium fission chain reaction takes place. /2
   (b) State why a moderator is needed. /1
   (c) State how the reaction can be controlled. /1

7. When Hydrogen-1 and Hydrogen-2 nuclei combine, they form a Helium-3 nucleus.
   ${}^{1}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \longrightarrow {}^{3}_{2}\mathrm{He}$
   The masses of the nuclei are listed below:
   ${}^{1}_{1}\mathrm{H}$ 1.6726218×10^{-27} kg
   ${}^{2}_{1}\mathrm{H}$ 3.3435831×10^{-27} kg
   ${}^{3}_{2}\mathrm{He}$ 5.0082352×10^{-27} kg
   (a) Calculate the change in mass during this reaction. /3
   (b) Hence calculate the energy released by this fusion. /2

TOTAL /26