Question 4

This question relates to Block 2, Chapter 8, and carries 26% of the marks for this assignment.

(a) (*11 marks*) Consider a carbonaceous chondrite of C2 composition.

(i) If you were presented with a complete, unbroken specimen of such a sample, how would you decide whether it was a meteorite just from its outer appearance? (*1 sentence*)

(ii) How could you confirm that it was a meteorite by making geochemical measurements? (*2 or 3 sentences*)

(iii) List the different constituents of a C2 meteorite.

(iv) Why are carbonaceous chondrites in general considered to be 'primitive'? (*1 or 2 sentences*)

(b) (*6 marks*) Some carbonaceous chondrites are more primitive than C2 meteorites.

(i) What are they? (*1 sentence*)

(ii) Explain how these more primitive samples document hydrothermal activity on primitive asteroidal bodies. (*2 or 3 sentences*)

(iii) What feature of the alteration process has enabled the preservation of the primitive chemical composition? (*1 sentence*)

(c) (*4 marks*) Carbonaceous chondrites are so-called because, compared to other meteorites, they contain relatively high proportions of carbon.

(i) What extraterrestrial material, available for study on Earth, is even more carbon-rich than this? (*1 sentence*)

(ii) What is the likely origin of this carbon-rich material? (*1 sentence*)

(d) (*5 marks*) Diamond of interstellar origin is found in C2 meteorites at a concentration of about 0.05% by mass with, on average, only one crystal in 10^{-20} kg of material. Assuming that a C2 meteoroid became fragmented into its constituent grains, say by a collisional event in the asteroid belt, determine whether the diamond grains could eventually spiral in towards the Sun and thus possibly enter the Earth's atmosphere?

(*Note*: In order to answer this question properly it will be necessary to calculate the size of the diamond grains – use the average size. For this you will need to know the density of diamond, which is 3.5×10^3 kg m^{-3}. Show your working.)