**Name of the Student**:_____
**Max. Marks : 19 Marks** **Time : 19 Minutes**

**Q1.**

Positron emission tomography (PET) is a nuclear medicine imaging technique. Pairs of gamma rays, produced when positrons from a radioisotope annihilate with electrons, are detected to form the image.

Radioisotopes used in PET scanning are typically isotopes with short half-lives such as carbon-11. Carbon-11 has a half-life of 1220 s and decays by positron emission to stable boron-11. Positrons are the antiparticles to electrons.

(a) Explain what is meant by a radioactive atom.

**(2)**

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(b) Complete the equation for the decay of carbon-11.

$$^{11}_{6}C \rightarrow \text{.....}B + \text{.....}e^{+} + {}^{0}_{0}\nu_{e}$$

**(2)**

(c) Calculate the energy in joules released in a positron decay of carbon-11.

| | Mass / MeV/$c^2$ |
|---|---|
| positron | 0.511 |
| carbon | 10 253.6 |
| boron | 10 252.2 |

**(3)**

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Energy = ..... J

(d) Explain why carbon-11 is a relatively safe radioisotope to use within the body.

**(2)**

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(e) A patient was injected intravenously with a radioactive compound containing carbon-11 with an activity of $1.58 \times 10^6$ Bq.

The sample was prepared 3600 s before it was administered to the patient.

Calculate the activity of the sample when it was prepared.

**(4)**

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Activity of the sample = .....

**(Total for Question = 13 marks)**

**Q2.**

* The energy radiated by stars is released by nuclear fusion.

Explain the conditions required to bring about and maintain nuclear fusion in stars.

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**(Total for question = 6 marks)**