| Question number | Answer | Notes | Marks |
|---|---|---|---|
| 12 (a) (i) | neutron numbers correct;<br>particle X numbers correct;<br>  <br> | | 2 |
| (ii) | proton / p; | allow hydrogen, H, $H^+$ (ion) | 1 |
| (iii) | any two from:<br>MP1. both have same number of protons (and electrons);<br>MP2. C-12 has **fewer** {neutrons / nucleons} than C-14;<br>MP3. C-12 is lighter than C-14; | both C atoms have 6 protons<br>allow RA<br>C-14 has 8 neutrons, C-12 has 6 neutrons<br>allow RA | 2 |
| (iv) | mass number is constant;<br>atomic number increases by one; | however expressed, including numerically | 2 |
| (b) | working seen / appropriate line(s) on graph seen;<br>5 500 (years) | e.g. line drawn across from 125 Bq<br>allow 5000-6000 (years) | 2 |
| (c) (i) | (due to) background radiation; | | 1 |
| (ii) | idea that activity depends on the mass; | allow 'fair test' idea<br>ignore 'to have the same activity' | 1 |

| Question number | Answer | Notes | Marks |
|---|---|---|---|
| (d) | {activity / amount of C-14} too low (to measure);<br><br>quantitative supporting statement;<br>e.g.<br>• age of bone is much greater than one half-life<br>• activity becomes zero after 35 000 years<br>• C-14 decays fully after 35 000 years | allow activity is zero<br>allow no longer emits radiation<br>allow 'all C-14 has gone'<br><br><br><br><br>allow any value given greater than 35 000 years<br>allow any value given greater than 35 000 years | 2 |

**Total for question 12 = 13 marks**