# Mark scheme – Uses and Hazards (F)

| Question | | | Answer/Indicative content | Marks | Guidance |
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| 1 | | | **B** ✓ | 1 (AO1.1) | |
| | | | **Total** | **1** | |
| 2 | | | **Any one from:**<br><br>supplies of uranium are large enough / will not run out to consider it renewable / AW ✓<br><br>Uranium is not being replaced / used quicker than it is being replaced to consider it non-renewable | 1 (AO 2.1) | **Examiner's Comments**<br><br>Many candidates incorrectly referred to fusion rather than fission. Candidates are advised to underline key phrases in the question paper before answering the question. Many candidates answered the question in terms of the dangerous waste products or that the waste products could be re-used.<br><br>Candidates had the opportunity to explain why either of the scientists could be correct in terms of the supplies of uranium being large enough so will not run out and therefore renewable or that the uranium is not being replaced so non-renewable. |
| | | | **Total** | **1** | |
| 3 | | | **Any two from:**<br><br>Keeping a safe distance (from source) ✓<br><br>Use tongs ✓<br><br>Point sources away from people ✓<br><br>Keep sources in sealed containers ✓<br><br>Keep exposure time as short as possible ✓ | **2 (AO 2 x 1.2)** | **ALLOW** behind (lead) screen<br><br>**IGNORE** gloves/goggles<br><br>**ALLOW** lead box<br><br>**Examiner's Comments**<br>Many candidates answered this question in general terms suggesting general laboratory rules rather than specific safety precautions relevant to the experiment. A large number of candidates suggested keeping a safe distance from the source. Some candidates were confused about whether the barrier was part of the experiment or a safety device.<br><br>Higher ability candidates gave relevant precautions including the use of tongs to hold the source (in effect adding some distance), using the sources for a short |

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| | | | | | period of time (to minimise exposure) and storing the sources in lead lined boxes. |
| | | | **Total** | **2** | |
| 4 | | i | Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓<br><br>**Named** damage to environment:<br>Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓ | **2 (AO 3.1b)**<br><br>**(AO 3.1b)** | **ALLOW** being used faster than being produced / finite resource<br><br>**ALLOW** ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. $SO_2$ / carbon emissions<br>**IGNORE** just pollution or bad for the environment / more CFCs<br><br>**Examiner's Comments**<br>Most candidates recognised that fossil fuels may run out or be in short supply or stating that they are non-renewable. However, fewer candidates went on to give specific scientific reasons for scientists concerns that were creditable. Most candidates gave generalised responses about fossil fuels damaging the environment or causing 'pollution'. |
| | | ii | To meet demand for electricity / not enough energy from renewable resources ✓<br><br>Less **named** damage to environment:<br>(decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓ | **2 (AO 1.2)**<br><br>**(AO 1.2)** | **ALLOW** will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal)<br><br>**ALLOW** less polluting gases / carbon emissions / ice caps melting / droughts and storms<br>**IGNORE** just less pollution or just better for the environment / less CFCs<br><br>**Examiner's Comments**<br>Higher ability candidates said that there were not enough renewable energy resources and nuclear power stations would assist in meeting the demand for electricity, or help in preserving fossil fuels. Answers which gave detail about less damage to the environment were also credited, although a number of candidates thought that nuclear power stations would not cause any potential damage to the environment. |
| | | | **Total** | **4** | |
| 5 | a | i | Nuclei join (in fusion) ✓ | 1 (AO 1.1) | **ALLOW** fuse / combine<br><br>**Examiner's Comments**<br><br>There were many vague answers in terms of hydrogen reacting to produce large amounts of energy. Ideally candidates |

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| | | | | | should understand that fusion is where nuclei join together. |
| | | ii | **Any two from:**<br>High temperature ✓<br><br>High pressure ✓<br><br>Large gravitational forces (due to large mass) ✓ | 2 (AO 2×2.1) | **IGNORE** heat<br><br>**Examiner's Comments**<br><br>Examiners were keen that correct physics terms were used. Answers such as a lot of heat were not credited. Some candidates did mention very high temperatures. Other acceptable answers included high pressure and large gravitational forces. There needed to be some idea of size, e.g. high, large<br><br>Often only one comment was made when the mark bracket was [2] which indicates two points need to be made. |
| | | iii | The sun will expand / become a red giant / (ultimately) become a white dwarf ✓ | 1 (AO 1.1) | **ALLOW** fusion of helium / heavier elements<br><br>**Examiner's Comments**<br><br>The question required candidates to state what would happen when the sun ran out of hydrogen. Many candidates state what would happen to the sun eventually. |
| | b | i | C ✓ | 1 (AO 2.2) | **ALLOW** answer from diagram if clear<br><br>**Examiner's Comments**<br><br>A large majority of the candidates correctly identified C as taking the longest time to decay. The common error was A. |
| | | ii | **Any four from:**<br>A is more hazardous / B is safer (for most of the time on the graph) ✓<br><br>A has a higher activity (for most of the time) ✓<br><br>B is more hazardous at the beginning ORA ✓<br><br>B has a higher activity at the beginning ORA ✓<br><br>A has a longer half-life / B has a shorter half-life ✓ | 4 (AO 4×3.1b) | **Examiner's Comments**<br><br>This type of question gives candidates opportunities to demonstrate their knowledge of radioactivity as well as their skills in interpreting graphical information.<br><br>In answering this type of question, candidates should look at the information from the graph and discuss what happens initially while B had the higher activity and then discuss what happened after the two graphs crossed. There should also be a link between activity and hazardousness. For the highest marks, there needed to be a comparison between the relative activity / hazardousness of the isotopes initially during the first day compared to activity / hazardousness of the isotopes after two days.<br><br>Candidates could not gain the same mark |

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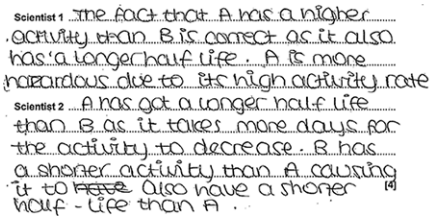
| | | | | | twice, i.e. A had a longer half-life and B had a shorter half-life would only gain one mark. Again, the physics term "half-life" was expected to be seen.<br><br>**Exemplar 4**<br><br>  <br>Scientist 1 The fact that A has a higher activity than B is correct as it also has a longer half life. A is more hazardous due to the high activity rate<br>Scientist 2 A has got a longer half life than B as it takes more days for the activity to decrease. B has a shorter activity than A causing it to ~~here~~ also have a shorter half-life than A. [4]<br><br>This candidate makes the link clearly between hazardous and activity and also clearly states on two occasions that A has the longer half-life. The candidate says that A has a higher activity which is assumed as overall. The writing at the end has been ignored and it would seem that the candidate did not fully understand the term half-life. To improve on this answer, some comment should have been made with regard to the graph initially during the first day. This answer was given 3 marks. |
| | | iii | **Maximum two from:**<br><br>One absorber placed between detector and isotope A ✓<br><br>(Idea of) change absorber and repeat experiment ✓<br><br>Measures (background) count with no source✓<br><br>**Maximum two from:**<br><br>Drop in count rate with cardboard indicates alpha ✓<br><br>Drop in count rate with aluminium indicates beta ✓<br><br>Drop in count rate with lead OR cardboard and aluminium / all materials are penetrated indicates gamma ✓ | 4 (AO 2×2.2) (AO 2×1.2) | May be described or drawn in a diagram<br><br>**ALLOW** stopped / absorbed for drop in count rate<br><br>**Examiner's Comments**<br><br>Good candidates drew a diagram to indicate the experimental set-up. Many candidates were able to describe how they would place the absorbers in front of the detector. It would be better if they had stated in turn. A few candidates under the procedure section stated that they would take a reading with no absorber present. A few candidates also stated that would take a reading without a source, i.e. taking a background count.<br><br>Several candidates were confused as to which absorber would stop which type of |

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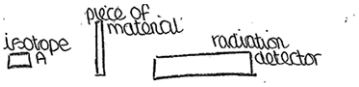
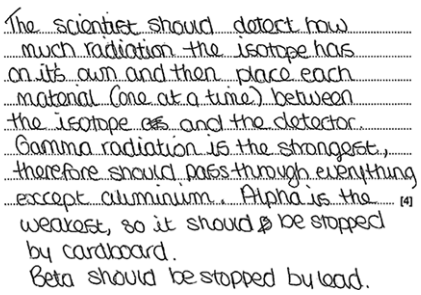
| | | | | | radiation.<br><br>**Exemplar 5**<br><br>  <br><br>  <br>The scientist should detect how much radiation the isotope has on its own and then place each material (one at a time) between the isotope as and the detector. Gamma radiation is the strongest, therefore should pass through everything except aluminium. Alpha is the [4] weakest, so it should be be stopped by cardboard. Beta should be stopped by lead.<br><br>This candidate has a clear diagram, indicating the piece of material placed between the isotope and the detector. In the text, the candidate clearly states that each of the materials should be placed between the detector and isotope in turn ("one at a time").<br><br>The candidate's understanding of the likely results is muddled and not always correct (gamma radiation stopped by thin aluminium), but the candidate does correctly state that alpha should be stopped by cardboard. This answer was given 3 marks.<br><br>  **AfL**<br><br>Candidates should be able to explain experimental procedures using a labelled diagram. |
| | | | **Total** | **13** | |
| 6 | | i | So (most of) the radioactivity / gamma rays are absorbed by the lead/do not get to the doctor. ✓<br><br>So the doctor is not irradiated/to prevent the doctor's cells being damaged. ✓ | 2 (AO2 × 1.1) | **ALLOW** will absorb alpha and beta radiation<br><br>**ALLOW** to stop the doctor getting cancer |
| | | ii | Iodine-131 ✓<br><br>Gamma can pass through the body to the detector / alpha cannot pass through the body. ✓ | 3 (AO3.2)<br><br>(AO2.2) | **ALLOW** this mark if Cobalt-60 or Iodine-131 is chosen |

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| | | | Use a short half-life so patient's cells are less damaged. ✓ | (AO2.2) | **ALLOW** this mark if Radon-222 or Iodine-131 is chosen.<br>1 |
| | | | **Total** | **5** | |