P6.1 Summary questions

1  a protons, electrons, neutrons  
   b proton, neutron, electron  
   c charge, protons, electrons  
   d isotopes

2  a i D  
    ii B  
    iii A  
    iv C

<table>
<thead>
<tr>
<th>Type of decay</th>
<th>Change of mass of nucleus?</th>
<th>Change of charge on nucleus?</th>
<th>Different element produced?</th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>beta</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>gamma</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>neutron</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

3  a least  
   b most  
   c ionising  
   d ionising  
   e aluminium

4  a Random means that an event is equally likely in any time interval.  
   b \[^{219}_{86}\text{Rn} \rightarrow ^4_2\text{He} + ^{215}_{86}\text{Po}\]  
   c \[^{131}_{53}\text{Rn} \rightarrow ^0_0\text{e} + ^{131}_{54}\text{Xe}\]

5  a Electrons from higher levels fall down to lower energy levels and emit a photon of light. Different transitions produce photons of different energy, and so of a different frequency.  
   b An electron moves up from one energy level to another.

6  The frequency/energy of the electromagnetic radiation emitted by nuclei is higher than that of the frequency/energy of the electromagnetic radiation emitted by atoms because the energy of levels in nuclei are higher.

7  a alpha decay  
   The atomic mass decreases by 4.  
   b Half-life is the time it takes half the atoms to decay, or the time for the activity to halve.

8  a Half-life = 1.5 hours (reading 80 Bq – 40 Bq)  
   ii After 7 half-lives you have \[\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{128}\] of the original, so the net decline is \[\frac{1}{128}\]  
   iii After 7 half-lives you have \[\frac{1}{128}\] of the original  
   \[\frac{1}{128} \times 24.00 \text{ g} = 0.19 \text{ g (2 sig fig)}\]  
   So you have 24.00 g – 0.19 g = 23.81 g  
   iv The element that the material decays into is not itself radioactive.