Assess Quizzes from the o-book – Explanations for the answers.

Chapter 12 Review – Support

Q	Reason
1	That's how Rutherford described it. The other option about neutrons is wrong as neutrons weren't discovered until 30 years after Rutherford's experiment. See description NCPQ page 330. You should be able to recall this experiment in detail.
2	Electrons reside in the orbital rings such as positions A, C and D. But not B (in between orbits).
3	This was de Broglie's conjecture. It is mostly about electrons being wave-like and confined to the space around the nucleus.
4	It is continuous as it is not just a collection of separate lines like the hydrogen spectrum (which is an emission spectrum (see NCPQ page 331). Hydrogen can also give an absorption spectrum depending on how it is analysed (see Figure 4 page 332).
5	As stated above, hydrogen is a collection of separate lines, so is a line spectrum. It can also be an emission or absorption spectrum to demonstrate these lines.
6	The word *quantum* or *quanta* (plural) was proposed by Planck and refers to the bundle of energy we now call a *photon*.
7	By definition, we say the energy at infinity is zero.
8	$E(eV) = \frac{E(J)}{J/eV} = \frac{4.0\times10^{-18}J}{1.6\times10^{-19}J/eV}$ $= \frac{4.0\times10^{-18}}{1.6\times10^{-19}}eV$
9	Bohr never said anything about the hydrogen spectrum in his model. His model can be learnt by the letters STA: Stationary states; Transitions emit or absorb electromagnetic energy; Angular momentum is quantised.
10	The line spectrum is not a limitation. Although Bohr didn't describe his model in terms of the hydrogen spectrum, his model does support it (well, at least it doesn't refute it).

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Chapter 12 Review – Consolidate

Q	Reason
1	$E = hf = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E(J)} = \frac{6.626\times10^{-34}\times3\times10^{8}}{3.5eV\times1.6\times10^{-19}J/eV}$ $= 3.5\times10^{-7}m$
2	$E_n = \frac{E_1}{n^2} = \frac{-13.6eV}{3^2} = -1.51eV$ Note: this formula can be found on page 336 of the NCPQ text but is not in the syllabus or the QCAA formula book – so won't be on the EA. It just helps you understand how the energy levels work.
3	$\Delta E = E_f - E_i = -13.6-(-1.51) = -12.09$ $E = hf = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E(J)} = \frac{6.626\times10^{-34}\times3\times10^{8}}{12.09eV\times1.6\times10^{-19}J/eV}$ $=1.02\times10^{-7}m$ $=102\times10^{-9}m$ $=102\,nm$ To convert from *m* to *nm* just divide the *m* by 10^{-9} (nano).
4	Must be equal to the energy difference, not greater and certainly not smaller – but just right. Think of the *Goldilocks and the Three Little Bears* (not too hot, not too cold, but just right).
5	$\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{6.626\times10^{-34}}{9.109\times10^{-31}\times2.0\times10^{8}} = 3.6\times10^{-12}m$ In actual fact, this speed is relativistic (>0.1c) so the relativistic formula for momentum should really be used (but you haven't, so don't). If you did:

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	$v = 2.0\times10^{8}\,m\,s^{-1} = \frac{2.0\times10^{8}}{3.0\times10^{8}} = 0.667\,c$ $p_v = \frac{m_0 v}{\sqrt{1-v^2/c^2}}$ $= \frac{9.109\times10^{-31}\times0.985\times3\times10^{8}}{\sqrt{1-(0.667)^2)}} = \frac{2.691\times10^{-22}}{0.745}$ $= 3.61\times10^{-22}\,kg\,m\,s^{-1}$ $\lambda = \frac{h}{p_v} = \frac{6.626\times10^{-34}}{3.61\times10^{-22}} = 1.8\times10^{-12}\,m$ This is about half the wavelength using the non-relativistic formula for momentum. However, you haven't been told to use relativistic momentum and as that belongs to the topic of special relativity, you would need to be told if you had to use it. The top answer is okay.

Chapter 12 Review – Extend

Q	Reason
1	$\lambda = \frac{h}{p} = \frac{h}{mv}$ As the voltage increases the energy of the electron increases ($W=V/q_e$). As energy increases the velocity increases ($E_K = ½\,mv^2$). As the velocity increases there will be a decrease in wavelength and hence better resolution. See NCPQ page 344 for a description of how an electron microscope works. It is highly unlikely that it would be in the EA as it is not specifically in the syllabus.
2	Highest f means biggest energy difference E as we know that $E = hf$. The biggest energy difference is from the lowest to highest level (1st to 5th).
3	The photon has an energy of 1.9 eV so you need to look for two energy levels that are 1.9 eV apart. $\Delta E = E_f - E_i = -1.5-(-3.4) = 1.9\,eV$
4	$\lambda = \frac{h}{p} = \frac{h}{mv}$ $\lambda \propto \frac{1}{v}$ $\lambda \propto \frac{1}{\sqrt{v^2}}$ $\lambda \propto \frac{1}{\sqrt{E_K}}\ (as\ E_K = \tfrac{1}{2}mv^2)$

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5	$\lambda = \frac{h}{p}$ $\lambda \propto \frac{1}{p}$ $y \propto \frac{1}{x}$ $(= inverse\ relationship)$