The Atom and Quantum

Year 11 Physics Worksheet ***SOLUTIONS***

1. Under low intensity light, an image will build up in dots. These dots are each produced by a single 'packet' of light, a photon.

2. $E = hf = 6.63\times10^{-34} \times 6.00\times10^{14} = 3.978\times10^{-19}$ J (3 s.f.)

3. The light must have enough energy (E = hf) to overcome the work function. The low frequency light in this case must have less energy than the work function, while the high frequency has more energy than the work function.

4. Intensity is number of photons. Since the frequency is high enough, each photon ejects one electron, so increasing the number of photons increases the number of electrons (current).

5. Its wavelength will decrease, since wavelength is inversely proportional to speed according to the equation $\lambda = \frac{h}{p} = \frac{h}{mv}$

6. $\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{6.63\times10^{-34}}{9.11\times10^{-31}\times2.65\times10^{7}} = 2.75\times10^{-11}$ m (3 s.f.)

7. The detail that can be achieved depends on the wavelength of whatever is being used to view the object. Electrons have much smaller wavelengths than visible light, so they can achieve much greater detail.

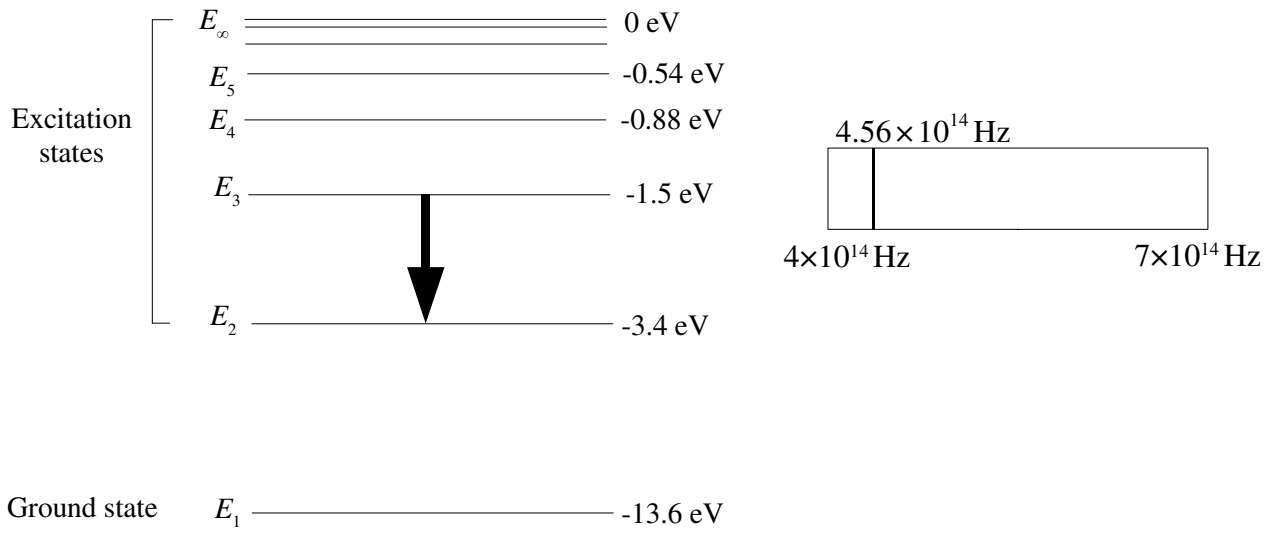
8. An atom can have different levels of energy depending on how far away the electrons are from the nucleus. When the atom drops from a high level to a lower level, the electrons move in closer and therefore lose potential energy. This energy is emitted from the atom as a photon.

9. $E_m = 1.60\times10^{-19}\times1.51 = 2.416\times10^{-19}$ J (3 s.f.) $\quad E_n = 1.60\times10^{-19}\times3.40 = 5.44\times10^{-19}$ J (3 s.f.)

   $E_n - E_m = hf \quad \therefore f = \frac{E_n - E_m}{h} = \frac{5.44\times10^{-19} - 2.416\times10^{-19}}{6.63\times10^{-34}} = 4.56\times10^{14}$ Hz (3 s.f.)

   The light emitted has a frequency of 4.56×10^{14} Hz (3 s.f.)

10.



11. The energy needed to free an electron from the gas of an element. The ionisation energy of the atom above is 13.6 eV.