Chapter 2 – Answers to questions (for in-chapter questions)

1 The high voltage supply, the negative electrode or the gas inside the tube.

2 When electrons, which make up the cathode rays, hit the fluorescent screen, they lose energy to particles in the screen causing it to glow.

3 The deflection of the rays by charged plates.

4 a 1.0g,  
   b \( \frac{1}{6 \times 10^{25}} \) = \( 0.167 \times 10^{-23} = 1.67 \times 10^{-24} \) g  
   c \( \frac{1.67 \times 10^{-24}}{1840} \) g = \( 0.91 \times 10^{-27} \) g

5 Most of the atoms in the gold foil are empty space.

6 Because they are heading straight towards a positive nucleus which repels them.

7 The relative size of the nucleus to the whole of an atom in the foil.  
The size of the positive charges in the nucleus of an atom in the foil.  
The thickness of the metal foil.

8 a i A, ii B, iii C  
   b Because electrons are much lighter than protons.  
   c It would be deflected up towards the negative plate like A, but would be deflected much less than A.

9 a \( ^{37}_{17} \text{Cl} \), b \( ^{23}_{11} \text{Na} \), c \( ^{27}_{13} \text{Al}^{3+} \), d \( ^{16}_{8} \text{O}^{2-} \)

10 a 5p, 6n, 5e, b 35p, 46n, 35e, c 83p, 126n, 81e d 15p, 16n, 18e.

11 Copper contains isotopes of relative isotopic mass 63 and 65 in the ratio 7 : 3  
i.e. \( \frac{7}{10} \) and \( \frac{3}{10} \).  
\[ \therefore \text{Relative atomic mass of Cu} = \frac{7}{10} \times 63 + \frac{3}{10} \times 65 \]  
\[ = 44.1 + 19.5 = 63.6 \]

12 a blue, b red, c lilac

13 a 4.57, 1.60, 0.74, 0.40, 0.24, 0.16 all multiplied by \( 10^{14} \) s\(^{-1} \)  
   b Label the axes, show the units and plot points accurately.  
   c An accurate value for the frequency when \( \Delta f \) becomes zero is \( 32.7 \times 10^{14} \) Hz
14  a 2,  b 8,  c 1,  d 2.8.1

15  a 5,  b Group V

16

17  a 2, 5  b 2, 8  c 2, 8  d 2, 8, 5  e 2, 8, 8  f 2, 8, 11, 2

18  a 1s²,2s²2p³  b 1s²,2s²2p⁶  c 1s²,2s²2p⁶  d 1s²,2s²2p⁶,3s²3p³  
   e 1s²,2s²2p⁶,3s²3p⁶  f 1s²,2s²2p⁶,3s²3p⁶3d³,4s²

19  a 1s²,2s²2p⁶,3s²3p¹  
   b The outermost electrons in Mg are in a filled s sub-shell. Being in a filled sub-shell, 
   they have greater stability than the outermost electron in Al. Therefore, it is more 
   difficult to remove an electron from a magnesium atom than an aluminium atom.
   c P  
   d The electron structure of P is 1s²,2s²2p⁶,3s²3p³. This electron structure, having a 
   half-filled 3p sub-shell with one electron in each of the three 3p orbitals and therefore 
   evenly distributed charge, is more stable than the electron structure of S with four 
   electrons in the 3p sub-shell. So, it is more difficult to remove one electron from a P 
   atom than a S atom.

20  With increase in proton number down a group in the periodic table;
   • the distance factor will cause the first I.E. to decrease,
   • the nuclear charge factor will cause the first I.E. to increase,
   • the screening factor will cause the first I.E. to decrease.

21  Arrows pointing in opposite directions mean that the paired electrons in the box 
   (orbital) are spinning in opposite directions. This allows the magnetic attraction which 
   results from their opposite spins to counterbalance the electrical repulsion from their 
   identical negative charges. In this way, two electrons in the same orbital can be stable.
22

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23  a 3,  b 9  c 18