Chapter 10: Periodicity

Homework marking scheme

1 a $C(g) \rightarrow C^+(g) + e^-$
equation [1]
state symbols [1]

b The electrons being added are in the same main energy level [1]
therefore, the electrons experience equal shielding from inner electrons. [1]
The nuclear charge is increasing [1]
therefore, each added electron feels a greater attraction from the nucleus and is therefore harder to lose. [1]

c i Either:
The electron being removed in element 5 is in a p orbital, which is less tightly bound [1]
than the electron being removed from element 4, which is in an s orbital. [1]
Or
The electron being removed from element 4 is a filled stable subshell, [1]
which is harder to remove than the p-electron from element 5. [1]

ii The electrons being added are in the same subshell [1]
the nuclear charge is increasing, therefore increasing the attraction for the electrons [1]
therefore, the electrons are harder to remove. [1]

iii The electron being removed from element 8 is in an already occupied orbital [1]
it therefore experiences repulsion and is easier to remove. [1]

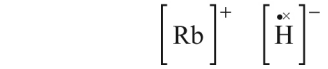
d When plotted against atomic/proton number [1]
it shows a repeating pattern. [1]

e When the Group 1 elements react they lose one electron from their outer shell [1]
the energy required for this is the 1st ionisation energy. [1]
As the group is descended the value of the 1st ionisation energy decreases [1]
therefore it becomes easier to lose the outer electron and the reactivity increases. [1]

f i The Group 1 elements structure consists of metal cations in a sea of delocalised electrons. [1]
The metallic bond [1]
is the mutual attraction of the metal cations for these delocalised electrons. [1]

ii The lithium ion is smaller than the caesium ion and therefore has a higher charge density, [1]
therefore, it attracts the delocalised electrons more strongly (and has stronger metallic bonds). [1]

g i $2Rb + H_2 \rightarrow 2RbH$ [1]

ii

charges correct [1]
two electrons in outer shell of H^- [1]
no electrons in outer shell of Rb^+. [1]

h **i** $RbH + H_2O \rightarrow RbOH + H_2$ [1]

ii $n(Ru) = \frac{0.346}{86.5}$ mol = 0.004 mol [1]

$n(H_2) = n(Ru) = 0.004$ mol [1]

volume of hydrogen = $n \times 24$ dm^3 = 0.096 dm^3 [1]

iii $RbOH + HCl \rightarrow RbCl + H_2O$

Therefore, $n(HCl) = n(RbOH) = n(Rb) = 0.004$ mol [1]

volume of HCl required = $\frac{0.004}{0.1}$ = 0.04 dm^3 (= 40 cm^3) [1]

2 **a** Element 4 [1]

because it has the smallest atomic radius.

The noble gases have the smallest atomic radius in each period because they have the greatest effective nuclear charge. [1]

b The electrons are added to the same energy level [1]

therefore, they experience the same shielding from inner electrons. [1]

The positive nuclear charge is increasing [1]

Therefore, increasing the attractive force on the electrons pulling them inwards. [1]

c **i** When the magnesium ion is formed the outer two electrons are lost. [1]

This removes one energy level of electrons thus decreasing the radius. [1]

ii When the phosphide ion is formed, three electrons are added. [1]

Therefore, the attractive force from the nucleus is spread over more electrons and each electron feels less attraction. [1]

iii Mg_3P_2 [1]

d $Mg_3P_2 + 6HCl \rightarrow 3MgCl_2 + 2PH_3$

correct symbols for reactants and products [1]

correct balancing. [1]

e The oxidation number of the phosphorus has increased from −3 to +5 [1]

therefore, it is oxidised. [1]

The oxidation number of the oxygen has decreased from 0 to −2 [1]

Therefore, it is reduced; the reaction is a redox reaction. [1]

f **i** AsH_3 [1]

ii As_4O_{10} [1]