**2021 chemistry Unit 3 exam solutions**

**Section A: Multiple choice**

**Question 1**

B. This was Thomson’s model – that the electrons were dispersed in a positive medium.

**Question 2**

D. 3d6 makes this element the sixth on the first transition series which is iron.

**Question 3**

A. The melting points often peak in the middle of the period then drop again.

**Question 4**

C. When a metal is struck the layers can slide past each other.

**Question 5**

B. Calcium has two electrons in its outer shell and these will be donated to two separate chlorine atoms.

**Question 6**

C. This element is in group 2 if it is more reactive than magnesium and has an electrovalence of +2. If it has no d shell electrons it must be calcium.

**Question 7**

D. 1.204 x 1024 particles is 2 mole of particles. 1 mole of NaCl will have 2 mole of particles.

**Question 8**

D. Al is the only option that will form a +3 ion.

**Question 9**

C. As the mass is close to 24, the abundance of 24Mg is higher than the other isotopes.

**Question 10**

B. Ethanol has covalent bonds and will not conduct.

**Question 11**

D. 87.5/14 = 6.25 12.5/1 = 12.5 ratio of 1:2 = NH2

**Question 12**

C. 1.9 x 3 = 5.7 mole which is higher than the other options.

**Question 13**

C. Matches an N2 molecule.

**Question 14**

A.

**Question 15**

C. CO2 has dipoles but they are pulling in opposite directions so they cancel each other.

**Question 16**

C. The low mass of hydrogen leads to this having the highest oxygen percentage.

**Question 17**

A. Ethanoic acid’s hydrogen bonds will give it the highest boiling point.

**Question 18**

B. This has 6 carbon atoms like hexane.

**Question 19**

B. Molecular formula is C6H12.

**Question 20**

C. This has a double bond that will be lost during polymerisation.

**Section B: Short answer questions**

**Question 1** (9 marks)

**a. i**. Mass number and atomic number 2 marks

**ii**. isotopes 1 mark

**iii**. Uranium 238 have three more neutrons than 235U. 1 mark

**b**. **i**. mass spectrum 1 mark

**ii**. the element is ionised to give it a positive charge. The ions are placed in a magnetic field and accelerated to

high speeds.\* The magnetic field is curved so the degree of deflection gives an accurate reading for the mass of

the element relative to carbon. \* 2 marks

**iii**. RAM = (235 x 0.5) + (238 x 9.5)/100 = 237.9 (accept some range here as the graph values are not easy to read)

**c**. Argon actually weighs\* more than potassium despite it having a lower number of protons. It has more neutrons

than potassium.\* 2 marks

**Question 2** (7 marks)

**a**. **i**. The atoms get smaller as you move across the period. 1 mark

**ii**. As you move across the period, more positive protons are added to the nucleus. This increases the

acttraction of the electrons to the nucleus. The core charge is increasing. 1 mark

**iii**. The atoms get larger as you move down the group. 1 mark

**iv**. With each element an extra shell of electrons has been added so the atom is larger. 1 mark

**b**. **i**. This diagram lists the orbitals in order of energy\*. It can be used to write the electron configurations of

elements\*. 2 marks

**ii**. 1s22s22p63s23p64s2 1 mark

**Question 3** (9 marks)

**a**. Metals are large lattices of positive ions in a sea of electrons.\* In the case of aluminium, it has 3 outer shell electrons on each atom and these electrons are delocalised. \* Metal bonds are strong.\* 3 marks

**b**. The delocalised electrons will move to the positive electrode\*. This is why metals conduct electricity\*. 2 marks

**c**. **i**. gold zinc calcium lithium potassium 2 marks

**ii**. Transition metals are less reactive than group 2 which is less reactive than group 1. Reactivity increases as

you move down the group. 2 marks

**Question 4** (11 marks)

a. Sodium and oxygen can react to form an ionic solid\*. The sodium atoms donate their outer shell electron to oxygen\*. Two sodium atoms react for each oxygen atom and the formula is Na2O \* 3 marks

**b**. High melting point, hard, conduct electricity as a liquid.. 2 marks

**c**. **i**. Mg(OH)2 magnesium hydroxide **ii**. Li2CO3 lithium carbonate 4 marks

**iii**. NH4NO3 ammonium nitrate **iv**. Ag2O silver oxide

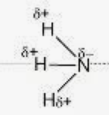
**d**. **i**. iron(II) carbonate FeCO3 **ii**. aluminium carbonate Al2(CO3)3

**Question 5** (11 marks)

**a**. V-shaped water Tetrahedral methane

Linear beryllium dichloride Linear hydrofluoric acid

Trigonal pyramid ammonia Trigonal planar borane



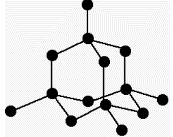
**b**. ammonia 2 marks

or water

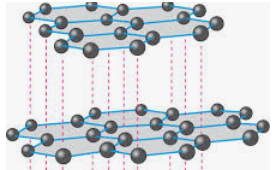
**c**. methane 1 mark

**d**. methane ethane 2 marks

**Question 6**  (8 marks)

**a. i.** allotropes 1 mark

**ii**. giant covalent lattice – each carbon is bonded in a tetrahedron to four other carbon atoms

 2 marks

**iii**. giant layer lattice, each carbon bonded to 3 other carbons.

Delocalised electrons 2 marks

**iv**. diamond is hard, graphite not. Graphite conducts, diamond does not. 2 marks

**b**. fullerenes, bucky balls, nanotubes 1 mark

**Question 7**  (5 marks)

**a**. 80 g mol-1 1 mark

**b**. %N = 35% (28/80 x 100) 1 mark

**c**. **i**. ammonium nitrate =100/80 = 1.25 mol 3 marks

**ii**. ammonium ions 1.25 mol

**iii**. nitrogen atoms 2.5 mol

**Question 8**

**a.** 2,3-dimethylbutane butan-2-ol pent-2-ene 3 marks

**b.**  C3H6O2 1 mark



**c**. 1 mark d.

**End of exam**

Section A: 20 marks

Section B: 62 marks