

CHEMISTRY

Unit 1 – Written examination 1



2012 Trial Examination

SOLUTIONS

SECTION A – Multiple choice (1 mark each)

Question 1

Answer: C

Explanation

Electrons were discovered by Thomson around 1880. Roentgen discovered radioactivity in 1896. Soddy used the term isotope in the early 1900s and nanotechnology is really a 21st century science.

Question 2

Answer: D

Explanation

Neon and argon do not form ions. Chlorine would need to form a Cl^- ion to be the correct answer. That leaves calcium as the correct answer. Calcium atoms have 20 electrons but calcium ions will have 18.

Question 3

Answer: A

Explanation

The electronegativity of the elements increases gradually as you move across the Periodic Table. Melting points fluctuate but would end at a low value as chlorine is a gas. The metallic nature will be decreasing as well as electrical conductivity.

Question 4

Answer:D

Explanation

All aspects of the evidence given point towards an ionic compound. They have high melting points and they conduct in solution but not as solids.

Question 5

Answer:C

Explanation

The charge on ClO_3 must be -1 if it reacts 1:1 with lithium. The charge on Z must be +3 if it reacts with the -2 charge of sulfate as shown. This means the formula for Z chlorate will be $\text{Z}(\text{ClO}_3)_3$

Question 6

Answer:D

Explanation

Fluorine has a negative charge. Sodium is +1 and magnesium +2, so that leaves aluminium. Its position on the Periodic Table confirms it should be +3.

Question 7

Answer:A

Explanation

Note that the question reads 'most atoms' not most molecules. Each CuSO_4 contains 6 atoms, so 0.1×6 will give a higher total than all the other responses.

Question 8

Answer: B

Explanation

The covalent bonds in methane molecules are strong. It is the weak bonds between molecules that leads to the low melting point.

Question 9

Answer: D

Explanation

This question requires an empirical formula calculation. $\frac{7.2}{12} : \frac{1.6}{1} = 0.6 : 1.6 = 1 : 2.66 = 3 : 8$

Question 10

Answer: B

Explanation

If the empirical formula is C_3H_8 then the molecular formula is the same or some multiple of this. Since propane is a possible answer and it is C_3H_8 then B is the correct answer

Question 11

Answer: B

Explanation

Water is not linear, it is V-shaped. Ammonia does not have the right number of atoms and SiO_2 is a covalent giant array. Carbon dioxide is the correct answer as it is linear because it has two double covalent bonds.

Question 12

Answer: A

Explanation

The first and the third molecule are the same thing, just rotated around. This makes the first and second molecules both isomers of butane.

Question 13

Answer: B

Explanation

The molar masses of these compounds need to be worked out. Carbon dioxide and propane both weigh 44 g, while propene is 42. Therefore the number of propene particles will be greater if the mass of each is the same. The propane and carbon dioxide are the same.

Question 14

Answer: C

Explanation

Each of the molecules in C matches the general formula for an alkene of C_nH_{2n}

Question 15

Answer: C

Explanation

Each alkene has two less hydrogen atoms than the corresponding alkane, therefore the percentage carbon is higher in the alkene

D is incorrect as the percentage carbon in alkenes is always the same as the formula is always C_nH_{2n}

Question 16

Answer: A

Explanation

Surface tension allows objects that are slightly denser than water to float on water. The forces between the molecules are not balanced on the surface, so the paper clip can find it difficult to push through the water.

Question 17

Answer: B

Explanation

This is sodium chloride where there is a network of positive Na^+ ions and negative Cl^- ions.

Question 18

Answer: B

Explanation

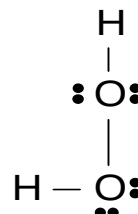
1.8×10^{24} is 3 mole when you divide by 6×10^{23} . Answer C is wrong because it refers to oxygen atoms. There are twice as many oxygen atoms.

Question 19

Answer: D

Explanation

Easiest way to explain this is with an electron dot diagram



Question 20

Answer: A

Explanation

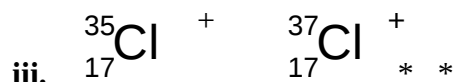
They all have the same electron configuration as Neon once they form ions. They have 10 electrons.

SECTION B: Short-answer questions

* = 1 mark

Question 1**a.**

- i. Chlorine has two peaks because there are two isotopes of chlorine. Isotopes are atoms of the same element that have different numbers of neutrons*
- ii. All ions passing through a mass spectrometer are positively charged. The most common charge is +1 *



iv. $\text{RAM} = \frac{35 \times 75.8 + 37 \times 24.2}{100}^* = 35.5^*$

1 + 1 + 2 + 2 = 6 marks

b.

- i. 22 *
- ii. electron configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$

There are electrons in the first 4 shells *

- iii. There are 7 subshells *

- iv. 12, the 3d electrons will occupy separate orbitals *

1 + 1 + 1 + 1 = 4 marks

- c. The material found was potassium metal*. This opened the way for the discovery of the other Group 1 metals and some of the Group 17 non-metals. *

2 marks

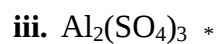
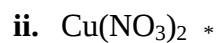
- d. Cavendish had isolated argon gas.* This was later named and identified along with the other Group 18 inert gases.* Until this time the inert gases were not known

2 marks

Total 14 marks

Question 2

a.



1 + 1 + 1 = 3 marks

b.

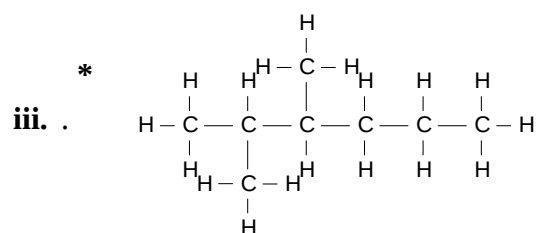
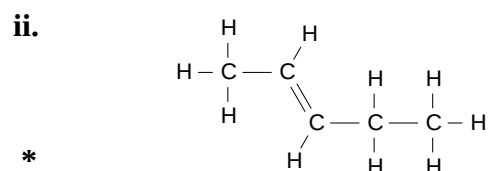
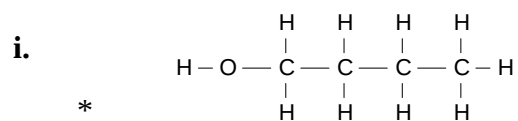
i. magnesium hydroxide *

ii. copper sulfide *

iii. aluminium nitrate *

1 + 1 + 1 = 3 marks

c.



1 + 1 + 1 = 3 marks

Total 9 marks

Question 3

Watchglass A: 0.50 mole of sulphur		Watchglass B: 0.50 mole of CuSO ₄	
number of mole of substance	equals	number of mole of substance	☒ / ☐ F
number of mole of atoms	equals	number of mole of atoms	T / ☒ F
number of atoms	equals	number of atoms	T / ☒ F
number of mole of sulfur atoms	equals	number of mole of sulfur atoms	☒ / ☐ F
number of mole of sulfur atoms	equals	number of mole of oxygen atoms	T / ☒ F
number of mole of sulfur atoms	equals	number of mole of sulfate ions	☒ / ☐ F

a. Circle T (true) or F (false) for each of the statements in the table

6 marks

b.

i. $\% S = \frac{\text{mass sulfur} \times 100}{\text{mass copper sulfate}} = \frac{32 \times 100}{159.5} = 20.1 \% \quad **$

ii. Yes *, the percentage does not change just because twice as much of everything is present*

2 + 1 = 3 marks

c. A 1.50 kg bag of garden fertilizer contains 1.2 % copper sulfate by mass.

i. $1,500 \times 1.2/100 = 18.0 \text{ g } ** \text{ of CuSO}_4$

ii. Since the % S is 20.1 %, the mass of sulfur will be

$$18 \times 20.1/100 \quad *$$

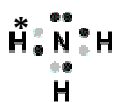
$$= 3.62 \text{ g } *$$

2 + 2 = 4 marks

Total 13 marks

Question 4

a.



1 mark

b. trigonal pyramid *

1 mark

c. Nitrogen more electronegative than hydrogen, so the nitrogen will be slightly negative and the hydrogen atoms slightly positive*

1 mark

d. Yes, the dipoles do not cancel out, hence the molecule is polar *

2 marks

Total 5 marks

Question 5

a.

i. compound CuSO_4 *

justification CuSO_4 will have a high melting point as an ionic compound and it will conduct as a solution*

ii. compound HCl *

justification HCl is a non-conductive liquid. It ionises in water hence will conduct*

iii. compound diamond *

justification diamond does not conduct. As a giant array it has a very high melting point.

It is very hard *

2 + 2 + 2 = 6 marks

b. Give the accepted chemical name for the following compounds

i. 2-butene *

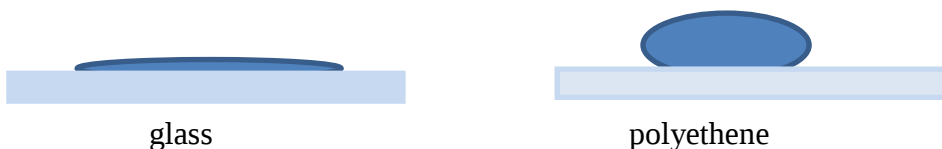
ii. 2-methylbutane *

1 + 1 = 2 marks

c. $688 \times 10^{-9} \text{ m} = 6.88 \times 10^{-7} \text{ m}$ *

1 mark

d.

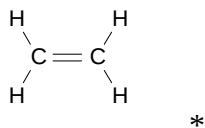


i. The glass is described as a hydrophilic* surface while the polyethene is hydrophobic*

ii. The molecules of water are attracted to the charges in the glass, so the water spreads out on the glass.* The molecules of water are not attracted to the non polar polyethene, so the water stays as a ball, attracted to itself. *

2 + 2 = 4 marks

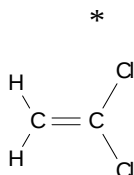
Total 13 marks

Question 6**a.****i.**

ii. It is not a polymer. Polymer molecules consist of over a thousand monomers, not just 5*

iii. HDPE molecules have very few branches. The molecules can line up well so a crystalline structure occurs with a higher density than the branched version*. LDPE molecules have branches, so the molecules do not pack together well so the density is low*

1 + 1 + 2 = 4 marks

b.

1 mark

c. The handles of a saucepan are usually made from thermoset polymers.

- i.** Thermoset polymers have crosslinks between the chains. The molecule has a high melting point and in fact decomposes rather than melts*
- ii.** The heat will eventually break the covalent bonds and the polymer decomposes*. It cannot be recycled as it does not melt*

1 + 2 = 3 marks

Total 8 marks