## CHEMISTRY ATAR 1+2 SEMESTER ONE, 2015

# CHEMISTRY ATAR 1+2 EXAMINATION

**READING TIME: 10 Minutes**

 **WORKING TIME: 3 Hours**

**This examination is in three parts:**

 **SECTION ONE:**  25 Multiple Choice - 25 Marks

 **SECTION TWO:**  10 Short Answer - 35 Marks

 **SECTION THREE:**  3 Extended Answer - 40 Marks

 100 Marks

**INSTRUCTIONS:**

1. Attempt ALL questions (keep questions in each section separate in the correct answer booklet provided). Put your **NAME on the first page of each new section.**

2. Marks will be awarded for method despite an incorrect final result provided working is WELL SET OUT, NEAT and LEGIBLE. You will lose significant marks even if the answer is correct if you have shown insufficient working.

3. A **scientific calculator** is allowed and a periodic table and data chart is supplied.

**STRUCTURE OF THE PAPER**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Section** | **No. of Questions Set** | **No. of Questions to be Attempted** | **Marks Allocated** | **Recommended Time (approx) in Minutes** |
| Section1:Multiple-choice | 25 | 25 | 25 (25%) | 50 |
| Section 2:Short answers | 9 | 9 | 35 (35%) | 60 |
| Section 3:Extended answer | 3 | 3 | 40 (40%) | 70 |

 **Total Marks for Paper = 100 (100%)**

**INSTRUCTIONS TO CANDIDATES**

**Reading Time**: The examiners recommend that candidates spend the reading time mainly reading the Instructions to Candidates and Sections B, C and D.

***Section One - Multiple Choice***

Answer on the separate Multiple Choice Answer Sheet.

If you consider that two or more of the alternative responses are correct, choose the one that you think is best. If you think you know an answer, mark it even if you are not certain you are correct. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

FEEL FREE TO WRITE OR DO WORKING OUT ON THE QUESTION PAPER. Many students who score high marks in the Multiple Choice Section do this.

***Sections Two and Three***

Use a ballpoint or ink pen. You may not answer in pencil. Write your answers on the answer booklet provided. Make sure that your **NAME** is on the first page of each new section.

**CHEMICAL EQUATIONS**

For full marks, chemical equations should refer only to those species consumed in the reaction and the new species produced. These species may be **ions** [for example Ag+(aq)], **molecules** [for example NH3(g), NH3(aq), CH3COOH(aq)] or **solids** [for example BaSO4(s), Cu(s), Na2CO3(s)]. Phases MUST be shown in the equations for the first question of the short answer section.

**Section One: Multiple-choice 25% (25 Marks)**

This section has **25** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question place a cross in the box to indicate your answer. Use only a blue or black pen to cross the boxes. If you make a mistake, circle the incorrect answer and place a cross in a new box.

Suggested working time: 50 minutes.

1. The electron arrangement of sodium is 2.8.1. How many occupied main electron energy levels are there in an atom of sodium?

A. 1

B. 2

C. 3

D. 10

E. 11

2. Propane, C3H8, is the fuel used in the barbeques you might find in any Perth backyard. When propane burns the unbalanced reaction can be written as:

C3H8(g) + O2(g)  CO2(g) + H2O(g)

When this reaction is correctly balanced, the number of O2 molecules in the equation is:

A. 2

B. 3

C. 4

D. 5

E. 7

The next **TWO** questions are based on the following table, which summarizes the properties of five different substances numbered I, II, III, IV and V.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Substance*** | ***Melting Point*** ***(oC)*** | ***Electrical Conductivity in Solids*** | ***Electrical Conductivity in Molten State*** | ***Hardness and Malleability*** |
| I | 3550 | Non-Conductor | Non-Conductor | Hard and brittle |
| II | 1083 | Good Conductor | Good Conductor | Hard and Malleable |
| III | 801 | Non-Conductor | Conducts electricity | Hard and brittle |
| IV | -7 | Non-Conductor | Non-Conductor | Soft |
| V | 98 | Conductor | Conductor | Soft and Malleable |

3. Which substance would be an ionic compound?

A. I

B. II

C. III

D. IV

E. V

4. Which substance would be classified as a covalent molecular solid?

A. I

B. II

C. III

D. IV

E. V

5. Which of the following is **NOT** an example of a homogeneous substance?

 A. Carbon dioxide gas

 B. A mixture of oil and water

 C. Air

 D. Molten lead

 E. A solution of copper(II)sulphate

6. Which statement is **true** for most ionic compounds?

A. They contain elements of similar electronegativity.

B. They conduct electricity in the solid state.

C. They are coloured.

D. They are malleable and ductile.

E. They have high melting and boiling points.

7. Which statement is correct about two elements whose atoms form a covalent

 bond with each?

A. The elements are metals.

B. The elements are non-metals.

C. The elements have very low electronegativity values.

D. The elements have very different electronegativity values.

E. The elements have a delocalized sea of electrons.

**The next question refers to the following information.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 18 |
|  | 2 |  |  |  |  |  |  |  |  |  |  | 13 | 14 | 15 | 16 | 17 |  |
| *A* |  |  |  |  |  |  |  |  |  |  |  |  | *Q* |  |  |  |  |
|  |  | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | *R* |  |  | *L* | *P* |  |
| *Z* |  |  |  |  |  | *F* |  |  |  |  |  |  |  |  |  |  | *Y* |
|  | *B* |  |  |  |  | *H* |  |  |  |  |  |  |  |  |  |  | *C* |
|  | *M* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

A representation of the periodic table is shown below. Certain elements are indicated by letters which are not their usual symbols.

8. Which one of the elements below most probably has the following properties?

 I melting point: 113°C

 II electrical conductivity: poor

 III forms a stable compound with hydrogen in which 2 mol of hydrogen atoms are combined with 1 mol of atoms of the element.

 A. Z

 B. B

 C. P

 D. L

 E. Y

9. Which one of the following statements is **FALSE**?

 A. M is more reactive than B.

 B. A has a larger atomic radii than Q.

 C. When Z and L react together they have the formula ZL2.

 D. The atom P can covalently bond to another atom of P to form a single bond to give it greater stability.

 E. The first ionization energy of Y is greater than Z.

10. Scientists are interested in nanoparticles because they:

A. Are chemically very reactive.

B. Have a high surface area to volume ratio.

C. Have high tensile strength.

D. They have high diffusion capability.

E. All the above.

11. Which contains the same number of ions as the value of Avogadro’s constant?

1. 0.5 mol NaCl

B. 0.5 mol MgCl2

C. 0.5 mol AlCl3

D. 1.0 mol MgO

E. 1.0 mol Na2O

12. Lithium hydroxide reacts with carbon dioxide as follows.

2LiOH + CO2 → Li2CO3 + H2O

What mass (in grams) of lithium hydroxide is needed to react with 11g of carbon dioxide?

 A. 6

 B. 8

 C. 12

 D. 24

 E. 48

13. Air bags in cars inflate when sodium azide decomposes to form sodium and nitrogen:

 2NaN3(s) → 2Na(s) + 3N2(g)

 Calculate the amount, in moles, of nitrogen gas produced by the decomposition of 2.52 mol of NaN3(s)

1. 1.68

1. 2.52
2. 3.78
3. 6.30

 E. 7.56

14. A neutral atom of the chlorine-35 isotope contains

1. 35 protons, 18 neutrons, 17 electrons.

 B. 17 protons, 18 neutrons, 17 electrons.

 C. 17 protons, 35 neutrons, 17 electrons.

 D. 18 protons, 17 neutrons, 18 electrons.

 E. 18 protons, 18 neutrons, 18 electrons

15. In which one of the following lists are all the formulas correct?

A. NaCO3,Mg(OH)2, K2SO4, LiNO3

 B. KCl, H2PO4, H2C2O4, CaBr2

1. CaF2, KHCO3, AgCl2, Na2S

D. K2CO3, KOH, Cs(NO3)2, MgF

E. NaNO3, CuO, KHSO4, BaCO3

16. Which one of the following substances is likely to be the poorest conductor of electricity?

 A. C(graphite)

 B. Hg(l)

 C. H2(g)

 D. NaOH(aq)

 E. KCl(l)

17. What is the correct symbol for a species that contains 15 protons, 16 neutrons and 18 electrons?

 A. 3116S

 B. 3116S3-

 C. 3115P

 D. 3115P-

 E. 3115P3-

18. The first ionization energy of an atom is described as the energy needed to

remove the most loosely held electron in an atom. Which equation below summarises this process for fluorine?

 A. F(g) + e- → F-(g)

 B. F+(g) + e- → F(g)

 C. F+(g) → F(g) + e-

 D. F(g) → F+(g) + e-

 E. F- (g) → F(g) + e-

19. Element X has the electron configuration: 2, 8, 6

 Element Y has the electron configuration: 2, 7

 The structure and formula of the compound formed between X and Y is most likely to be:

 A. ionic, XY2

1. ionic, X2Y

 C. covalent molecular, 2XY

 D. covalent molecular, X2Y

 E. covalent molecular, XY2

20. Which one of the following has the smallest number of oxygen atoms?

 A. 0.3 moles of H2SO4

 B. 0.5 moles of ozone, O3

 C. 0.7 moles of acetic acid, CH3COOH

 D. 0.8 moles of water.

 E. 0.4 moles of HNO3

21. Sodium reacts with water to give hydrogen gas and sodium hydroxide solution.

 What volume of hydrogen gas would be produced from the reaction of 22.99g of sodium at S.T.P.?

A. 11.36 L

B. 11.49 L

C. 12.40 L

D. 22.71 L

E. 24.79 L

22. When 2.02g of KNO3 is dissolved in sufficient water, how many Potassium ions

 are there in the solution?

 A. 0.02 mol

 B. 0.04 mol

 C. 0.10 mol

 D. 0.20 mol

 E. 0.40 mol

23. Which of the following statements about chemical bonding is **false**?

 A. Covalent bonds are formed when electrons are shared.

B. Ionic bonds are formed when electrons from a non-metal atom are transferred to a metal atom.

 C. Covalent bonds within molecules are much stronger than the inter-molecular attractions between molecules.

 D. A triple covalent bond requires six bonding electrons.

 E. Ionic bonds generally lead to a lattice structure.

24. Which one of the following statements is **true** about elements in the same group of the periodic table?

1. They will all have exactly the same reactivities.

 B. They will all have the same number of valence electrons.

 C. They will all have the same number of electron shells.

D. They will all have identical physical properties.

 E. They will have the same electronegativity.

25. What is the most accurate description of the structure of a metal?

1. Metallic molecules.
2. Discrete atoms with a nucleus and electrons orbiting in energy levels.
3. Different metals in an alloy to form homogeneous metallic bonding.
4. A macromolecule with localised electrons.
5. A lattice of cations with delocalised electrons.

### END OF SECTION ONE

**Section Two: Short answer 35% (35 Marks)**

This section has **10** questions. Answer **all** questions. Write your answers on the paper

provided.

Suggested working time: 60 minutes.

1.Write the formula for each of the following compounds

|  |  |  |
| --- | --- | --- |
| (a) | Phosphoric acid |  |
| (b) | Aluminum hydroxide |  |
| (c) | Sulfur hexafluoride  |  |
| (d) | Sodium carbonate |  |
| (e) | Barium ethanoate |  |
| (f) | Ammonium nitrate |  |

 (6 marks)

2. Write down the missing entries that complete the following table for the chemical species shown:

 **29**

**X 2+**

 **65**

|  |  |
| --- | --- |
| Atomic number | (a) |
| Mass number | (b) |
| Number of protons | (c) |
| Number of neutrons | (d) |
| Number of electrons | (e) |
| Name of the element ‘X’ | (f) |

(3 marks)

3. Write balanced chemical equations for each of the following reactions:

1. Sodium carbonate reacts with hydrochloric acid to produce

 sodium nitrate, water and carbon dioxide.

1. Silver nitrate is added to sodium bromide to produce silver bromide

 and sodium nitrate.

1. Sodium metal reacts violently with sulfuric acid to produce

 sodium sulfate and hydrogen gas.

 (6 marks)

4. **Write** (numerical notation)the electron configuration of the following

 chemical species:

 (a) Potassium metal

 (b) Argon gas

 (c) Sulfide ion

 (d) Nitride ion

 (2 marks)

5.Draw the electron-dot diagram for the following chemical species

 (a) Lithium fluoride.

 (b) Ammonia

 (c) Hydrogen peroxide

 (d) Aluminum oxide

(4 marks)

6.A mass spectrometer sample of uranium exists as a mixture of three isotopes with the relative abundance:

 mass number 234, relative abundance 0.0055%
mass number 235, relative abundance 0.7200%
mass number 238, relative abundance 99.2745%

 Calculate the relative atomic mass of the sample of uranium to **four** decimal places.

 (2 marks)

7.Describe the **process or processes** by which you could separate the following mixtures. You must also **STATE the difference in property** that allows this separation technique to work:

(a) Ethanol and water.

(b) Sand and a solution of copper sulfate to recover **both** the sand and the

 copper sulfate.

(3 marks)

8. Magnesium burns in air with a blinding white flame according to the

 following equation:

 **Mg**(s) + **O2**(g)  → **2 MgO**(s)

1. If 2.730g of magnesium undergoes complete combustion convert this

 mass to moles.

1. How many moles of magnesium oxide will be produced?
2. Calculate the mass of magnesium oxide produced.

(4 marks)

9. Nitric acid may be manufactured from nitric oxide (NO) in a two-step industrial process as shown in the equations below. If 1.500 litres of nitric oxide gas, measured at S.T.P, is fully consumed in reaction answer the following questions.

 2NO(g) + O2(g) 🡢 2NO2(g)

 3NO2(g) + H2O(l) 🡢 2HNO3(aq) + NO(g)

1. How many moles of NO(g) is consumed in the first stage of reaction?
2. How many moles of HNO3(aq) is produced in the second stage of

 reaction?

1. What mass of nitric acid is produced in this two stage process?

(3 marks)

10. Use your knowledge of mass spectrometer to answer the following

 Questions:

1. Arrange the following basic features of the mass spectrometer in the

 correct order from the start to the finish of the process:

 DEFLECTION : ACCELERATION : IONISATION : DETECTION

1. Explain **what is deflected** and **what causes this deflection** in the mass

 spectrometer.

(2 marks)

**END OF SECTION TWO**

**Section Three: Extended answer 40% (40 Marks)**

This section contains **three (3)** questions. You must answer **all** questions. Write your answers on the paper provided.

***Any calculations*** are to be set out ***in detail*** on the paper provided. You may be penalized significantly for failure to show appropriate working, even if you obtain the correct numerical answer. Marks will be allocated for correct equations and clear setting out of a partial answer, even if you cannot complete the problem.

This part carries **40 marks**.

 Numerical answers **MUST** be corrected to **THREE (3) SIGNIFICANT FIGURES**.

Suggested working time: 70 minutes.

1. The following question relates to the chemistry of the elements Carbon and Oxygen.

1. **Draw** a Bohr diagram of the full electron configuration of Carbon.

(1 mark)

1. **Draw** the electron-dot structure of the element Carbon.

(1 mark)

1. **Write** the full electron structure of the element Carbon.

(1 mark)

1. Carbon is found elementally in two main allotropic forms in nature – diamond and graphite. Explain in a paragraph why diamond has an exceptionally high melting point.

(2 marks)

1. Give one advantageous property that graphite possesses that diamond does not and give a subsequent use for this allotrope that relates to the property that you have outlined.

(2 marks)

1. **Draw** the electron–dot structure of oxygen gas.

(1 mark)

1. When carbon burns completely in air it forms carbon dioxide gas. **Draw** the electron–dot structure of carbon dioxide.

(1 mark)

1. Nanotechnology is a relatively new research area, what range of particle size is a nanoparticle?

(1 mark)

1. New allotropes of carbon were discovered in 1985 and described as nanoparticles. What name was given to the family of this allotropic form of carbon and give an example of a future use of either of these nanoparticles?

 (2 marks)

2. A typical acid plus metal reaction produces salt plus hydrogen gas which can collected over water.



1.73 grams of magnesium ribbon was added to dilute hydrochloric acid to produce hydrogen gas, according to the following equation:

 **Mg**(s) + **2HCl**(aq) → **MgCl2**(aq) + **H2**(g)

1. How many moles of magnesium were added to the hydrochloric acid?

(1 mark)

1. Had all of the magnesium reacted with the hydrochloric acid then how many moles of hydrogen would have been produced and what volume would this amount of hydrogen have occupied at STP?

(2 marks)

1. The hydrochloric acid solution had, in fact, been produced by the addition of 4.000 grams of hydrogen chloride gas. The gas totally dissolved as it bubbled through water to make the hydrochloric acid. Determine which of the reactants (hydrogen chloride or magnesium) was actually the limiting reagent and show your reasoning.

(2 marks)

1. What mass (in grams) of the excess reactant remains when the reaction is complete?

 (2 marks)

3. The following question relates to the chemistry of the elements **Potassium** and **Fluorine**.

1. What name is given to the **group** of elements of which fluorine is a member?

(1 mark)

1. **Draw** the electron-dot structure of the elemental Fluorine.

(1 mark)

1. **Write** the full electron structure of the element Potassium.

(1 mark)

1. Elemental Fluorine is a gas at room temperature. Explain in terms of bonding why it has such a low boiling point.

(3 marks)

1. Potassium, like many metals is an excellent conductor of electricity. Explain this excellent conductivity in terms of the bonding in the metal.

(2 marks)

1. Potassium reacts violently with Fluorine to produce a white crystalline solid (KF) with vastly different properties to the elements from which it is made. Draw the electron dot structure of potassium fluoride.

(1 mark)

1. Describe fully the type of bonding that occurs between Fluorine and Potassium in terms of elemental characteristics, electron movement and stability, and electrostatics of Potassium fluoride.

(4 marks)

1. Potasssium fluoride is found to be a non-conductor of electricity in the solid state. However it can conduct electricity in two other phases, detail these and explain why?

(4 marks)

1. Fluorineis the most “**electronegative**” element. Define what electronegativity means.
2. mark)
3. **State the trend** in electronegativity going across a period of the periodic table and explain the trend in terms of electrostatics.

(3 marks)

### END OF SECTION THREE

**END OF PAPER**